



**HPOIL GAS PRIVATE LIMITED  
(HOGPL)**

**TENDER FOR**

**LAYING & CONSTRUCTION OF 8" & 6" DIA U/G STEEL  
PIPELINE NETWORK AND ASSOCIATED WORK  
FACILITIES IN DIMAPUR DISTRICT OF NAGALAND GA**

**OPEN DOMESTIC COMPETITIVE BIDDING**

**TENDER NO. - HOGPL/VCS/25-26/C&P-NL/WC/CS/048**

**VCS REF. NO. VCS/HOGPL/261162/WC/2026/004**

**VOLUME II OF II: TECHNICAL**



ENERGISING QUALITY

**PREPARED AND ISSUED BY  
VCS QUALITY SERVICES PVT. LTD.  
NOIDA, INDIA**



**CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT  
OF NAGALAND GA**

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SCOPE OF WORK  
(FOR PIPELINE LAYING)

Total Sheets

52

Document No.

C261162

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2001

**M/s HPOIL GAS PRIVATE LIMITED**

**LAYING & CONSTRUCTION OF 8" & 6" DIA U/G STEEL  
PIPELINE NETWORK AND ASSOCIATED WORK  
FACILITIES IN DIMAPUR DISTRICT  
OF NAGALAND GA**

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### 1. INTRODUCTION

M/s. HPOIL Gas Private Limited (HOGPL) is in the process of starting to setup City Gas Distribution (CGD) Network for the Geographical area of Nagaland state.

VCS Quality Services has been appointed as Engineering Project Management Consultant by M/s HPOIL to provide engineering consultancy services for setting up CITY GAS DISTRIBUTION FACILITIES.

### 2. PROJECT BRIEF

The project scope includes the laying and construction of 8" and 6" underground steel pipeline network, along with MDPE pipeline (wherever required) laid in the same trench, including all associated works for the Dimapur GA, Nagaland.

### 3. PURPOSE

This document is for the detailed scope of work for pipeline laying and shall be read in conjunction with job specifications, technical specifications, schedule of rates (SOR) & various parts of bidding documents meant for the execution of the proposed **STEEL** pipeline section of City Gas Distribution Project at **DIMAPUR GA** of Nagaland.

### 4. DEFINITION

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order

|              |                                                                                                                                                      |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| PROJECT      | LAYING & CONSTRUCTION OF 8" & 6" DIA U/G STEEL PIPELINE NETWORK AND ASSOCIATED WORK FACILITIES IN DIMAPUR DISTRICT OF NAGALAND GA                    |
| OWNER        | HOGPL (HPOIL GAS PRIVATE LIMITED)                                                                                                                    |
| CONSULTANT   | VCS Quality Services Private Limited (VCS) the party to act for and on behalf of OWNER for the Detailed Engineering Services and Project Management. |
| MANUFACTURER | The party, which manufactures and supplies equipment and services to the OWNER or to Contractor                                                      |
| SOW          | Scope of Work                                                                                                                                        |

### 5. WORK TENDERED

Work tendered as a part of this Bid document consists of supply of materials as required, laying/ installation of Steel Pipeline laying, testing, pre-commissioning of pipeline, drying, preservation and commissioning along with laying, testing, and commissioning of

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underground Polyethylene (PE) pipelines (wherever required) in same trench network of sizes 125/90 mm Dia. The work includes installation of pipeline (Steel & MDPE) and related piping works at sectionalizing valve stations, Isolation valve chamber, and all associated mechanical, civil, architectural, structural, cathodic protection, electrical, instrumentation, telecom works at Stations along the route etc.

The brief scope of work includes supply of materials (other than free issue), pipeline laying work including but not limited to Construction Management, HSE & Quality Management, Survey, ROU management, clearing of ROU, grading, stringing, bending, welding (Manual), trenching, joint coating, lowering, crossings, crossings by HDD (wherever specified), Tie-ins, NDT and destructive testing, backfilling, laying of pipeline along-with OFC & HDPE ducts, , TCP works, site restoration, hydro-testing, dewatering, swabbing, drying, nitrogen purging (as applicable), pre-commissioning, commissioning and Gas-in of pipeline including construction / installation of related facilities, all piping works at Sectionalizing valve stations, Tap-off station & Injection points, etc. including associated Mechanical, Cathodic protection, Electrical works, Telecom works, Instrumentation, Civil works and Structural works at all stations.

This document shall be read in conjunction with Schedule of Rates, SCC, Technical specifications, standards, drawings, and other documents forming a part of the Tender Document.

**Note: - Laying of steel and MDPE hydrocarbon pipelines must compliance with applicable PNGRB guidelines. While laying more than one new pipeline or main in the same trench, a minimum clear separation of 500 mm shall be maintained between adjacent pipelines. When laid parallel to any existing underground cable, drain, or other utility, the pipeline or main shall maintain a minimum clear distance of 300 mm from the existing utility, complete in all respects.**

**All safety parameters shall be strictly followed in accordance with Petroleum and Natural Gas Regulatory Board (PNGRB) guidelines and the attached specifications."**

The scope of work for Pipeline laying is as follows.

| PIPELINE SECTION                                                                                                                               | SCOPE OF WORK                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>(DIMAPUR GA of NAGALAND)</b><br>Size 8" X Length 11.800 km (approx.)<br>Size 6" X Length 18.900 km (approx.)<br>PE Pipe of Size 125mm/ 90mm | Laying of 8" Dia steel pipeline of length 11.800 km, 6" Dia steel pipeline of length 18.900 km. Laying of PE 125/90 mm |

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This document covers details of work tendered, scope of work, scope of supply and other requirements pertaining to pipeline and associated facilities. All works and clauses of this document shall be applicable to all sections/parts unless specifically mentioned otherwise.

Details of associated Civil, Architecture, Structural, Mechanical, Piping, Instrumentation, Cathodic Protection, Corrosion Monitoring Works, Telecom Works, Electrical Works, Fire protection etc. are covered elsewhere in the Bid document.

### 5.1 The details of proposed work are as under: (DIMAPUR GA of NAGALAND STATE)

**Pipeline works comprising 8" Dia steel pipeline of 11.800 km (approx.) length and 6" Dia steel pipeline of 18.900 km (approx.) length, laid along with MDPE pipeline in the same trench, including other connectivity, and associated works.**

**The scope includes supply, installation, testing, pre-commissioning, and commissioning of steel and PE pipelines, along with all associated mechanical, civil, structural, electrical, instrumentation, and telecom works, as detailed below:**

Pipeline works comprising 8" Dia steel pipeline of 11.800 km length & 6" Dia steel pipeline of 18.900 km length, laid along with MDPE, including other connectivity, and associated works. Installation of SV stations and Isolation valves, all valves, fittings, etc. (for both steel & PE pipelines) & associated piping works. All PE valves shall be stem extension type and to be provided at every 1 km.

Entire works including installation of IJ, tee, all valves, equipment's, fittings, other facilities (for both steel & PE pipelines) and all associated mechanical, civil (pavement & supports works at SVs), instrumentation, telecom, structural, and all other SV terminal works civil approach road, electrical works etc.

- Entire work of SV Stations with/ without future tap-off, only tap off as specified in the drawings including installation of underground valves and blow down vents etc.
- Entire work of Isolation Valves (for both steel & PE pipelines) as specified in the drawings including installation of underground valves & other associated facilities.
- Supply, Installation, testing of HDPE duct & OFC Cable along with Steel & PE Pipeline in common trench.
- Installation of all Sectionalizing valve stations (SV which are within scope boundary) including construction of valve chambers along with all Mechanical, civil, structural, electrical, instrumentation, telecom, etc.
- Installation of all tap off including construction of valve chambers along with all Mechanical, civil, structural, electrical, instrumentation, telecom, etc.
- Crossings of road, rail, utilities, forest, underground pipelines, and water crossings (minor water body, canal, nala / drain, waterways etc.) by Open cut, HDD and boring including crossing drawing and calculation for HDD.
- Carrying out all topographical and geo-technical surveys required for re-routing (If required any).

|                                                                                                           |                                      |                        |            |
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- Installation of Pipeline by Horizontal Directional Drilling (HDD) method, wherever required.
- Installation of pipeline by machine Moling, wherever required.
- All works related to hydro-testing, dewatering, swabbing, drying and tie-in with adjoining pipeline/ terminal piping sections/parts including tie-in with the HDD sections.
- Carrying out pneumatic testing for PE pipelines.
- Carrying out magnetic cleaning & EGP.
- Pre-commissioning of the pipeline section and associated facilities.
- Commissioning assistance (as applicable) and Commissioning: Overall Commissioning of the pipeline including supply of Nitrogen for purging. Contractor shall also provide all assistance to owner during commissioning
- Idle time preservation by filling Nitrogen at a positive pressure of 2 bar (g) as per specification including supply of Nitrogen (if required)
- All works related to HDPE duct laying and optical Fiber cable (OFC) blowing.
- Making all necessary arrangements to prevent rolling down of removed earth while grading and ROU clearance in hill side and steep slope areas. Stabilization of side hill faces to prevent landslides.
- Making necessary arrangements to prevent rolling down of pipes in steep slopes.
- Supply and installation of slope breaker as per specifications and drawings in steep slope areas, wherever required;
- Supply and Installation of trench breakers with 1:4 ratio of cement and sand in bags for slopes, stabilization of soil, stabilization of trench, wherever required and as directed by Owner / Owner's Representative.
- Excavation of National Highway /State Highway/others Road/canals etc. during laying of Pipeline and restoration of same to original condition on completion of the work to the satisfaction of Concern Authority.

### 5.2 CONSTRUCTION FRONTS

The Construction fronts shall be mobilized for as indicated below:

| PIPELINE SECTION                                                                                                                               | SCOPE OF WORK                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>(DIMAPUR GA of NAGALAND)</b><br>Size 8" X Length 11.800 km (approx.)<br>Size 6" X Length 19.800 km (approx.)<br>PE Pipe of Size 125mm/ 90mm | Laying of 8" Dia steel pipeline of length 11.800 km, 6" Dia steel pipeline of length 18.900 km. Laying of PE 125/90 mm |

Fully equipped, maintained and functional fronts (as mentioned above) are required to be mobilized by the Contractor to complete installation of facilities covered under each section/part as a minimum. All the construction fronts shall work simultaneously. In addition, contractor shall deploy separate crews for rail, road, water crossings, and restricted areas. Contractor shall also mobilize separate teams for mechanical works SV Stations.

|                                                                                                           |                                      |                        |            |
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- 5.3** Successful Bidder is required to submit detailed methodology for working in rainy season before start of the work.
- 5.4** Contractor shall adopt suitable method of construction/ execution of work for restricted ROU/ Common ROU and deploy adequate equipment & manpower etc. as required. CONTRACTOR shall provide complete details of manpower, equipment etc. to be deployed. Contractor shall mobilize and provide all equipment, manpower (skilled and unskilled), consumables and other resources and separate crew etc. for each front as required for the execution of the complete job defined herein.
- 5.5** For execution of the pipeline work in the narrow ROU space in forest areas, the CONTRACTOR shall consider the special requirements/ measures and shall deploy adequate amount of manpower and equipment for performing the work.
- 5.6** Mechanical, civil, architecture, structural, temporary cathodic protection, corrosion monitoring system, electrical, instrumentation, telecom works for the respective sections/parts shall be carried out as per relevant job specification provided elsewhere in the Bid document.

### 6. DETAILED SCOPE OF WORK

The Contractor's Scope of work for the pipeline shall consist of, but shall not be limited to, supply (as required), fabrication, installation, testing, swabbing, drying, EGP, pre-commissioning, and commissioning of the proposed pipeline system including terminal piping works and hook-up works at terminals along with all associated mechanical, civil, architectural, structural, corrosion monitoring system, electrical, instrumentation, telecom, etc. All such works that are not indicated here below but are otherwise required to complete the work in all respects shall form part of Contractor's Scope of Work.

The scope indicated below shall be read in conjunction with Schedule of Rates as applicable, drawings, SCC, standards, specifications, and other documents forming part of the Contract document.

The detailed scope of work pertaining to pipeline shall be in general but not limited to the following:

#### 6.1 Main Steel Pipeline

- 6.1.1** "Receiving and Taking-over" of COMPANY supplied externally corrosion- coated and bare line pipes of all thicknesses at Company's designated storage yard in presence of Company's representative. Transportation including loading, unloading, handling, stacking, hauling, and stringing of pipes from Company's storage yards to Contractor's worksite(s)/ workshop(s)/ pipeline Right-Of-Use (ROU), including arranging all pipe trailers, cranes, arranging all necessary intermediate storage area(s) required thereof till the complete pipeline system is permanently installed.
- COMPANY shall set up storage yards for coated and bare line pipes near pipeline ROU as defined subsequently in this document. The exact location of Company's storage yards shall be intimated to the CONTRACTOR at the time of award. In addition, COMPANY shall set up stores for all items other than line pipes as defined in scope of supply.
- 6.1.2** All construction works shall be carried out as per "Approved for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the Company and revision of drawings.
- 6.1.3** Carrying out inspection of COMPANY supplied line pipes and pipe corrosion coating at the

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time of receiving and taking-over for all defect etc. in the presence of Company's representative

- 6.1.4 Carrying out repairs (including supply of all materials required for repair) of line pipe and pipe coating not attributable to COMPANY which will include repair of all defects/damages occurring during transportation and/ or handling after receiving and taking over.
- 6.1.5 For pipes were cutting out involves more than 25mm from pipe ends, ultrasonic inspection shall be carried out at pipe ends for line pipe and including supply of all equipment's. Contractor shall take prior approval from Company for the agency engaged for carrying out ultrasonic inspection.
- 6.1.6 Loading, unloading, handling, stacking, storing and transportation to workshop/ work site of all materials (other than bare and corrosion coated line pipes) that may be used for the construction of pipeline system either supplied by COMPANY at their designated storage yard/ store and/ or by CONTRACTOR. All Company supplied materials (other than line pipe) shall be issued to Contractor from Company's designated store.
- 6.1.7 Preparation of bevel end and coating edge of line pipes for welding.
- 6.1.8 Contractor shall incorporate the crossing details in the as-built alignment sheet after completion of work.
- 6.1.9 Carrying out all additional topographic and/ or geotechnical survey as required for local detours, detours at crossing locations and elsewhere during execution including preparing plan and profile drawings as directed by Engineer-in-Charge.
- 6.1.10 Geo-technical investigation and hydrological survey of all major water body crossings are being carried out by the Company and the same shall be provided to the contractors during execution of the contract. However, contractor shall verify the authenticity of the data provided during execution and if required, additional geo-technical investigation & hydrological survey shall be carried out by the contractors for HDD crossings without any cost and time implication. Geo-technical & topographical survey for all plots shall be carried out by the respective contractor during execution of the contract.
- 6.1.11 Carrying out thorough internal cleaning of all pipes to remove debris, shots, grits etc. to the satisfaction of Engineer-in-charge.
- 6.1.12 Mobilizing and providing all equipment's, manpower (skilled and unskilled), consumables and other resources etc., as required for the execution of complete work and thereafter demobilizing the same upon completion of work.
- 6.1.13 Obtaining all necessary approvals and work permits from concerned authorities having jurisdiction, as applicable for performing the work including shifting/ relocation and restoration of telephone/ electrical poles and underground pipes and other utilities etc., as required by local authorities and as directed by COMPANY. Contractor shall also obtain all necessary approvals and work permits from concerned authorities having jurisdiction for crossing underground utilities/ pipelines wherever encountered along the pipeline route.
- 6.1.14 Cutting/ uprooting of trees within ROU, counting the number and type of trees to be cut (before cutting) during pipeline laying works in presence of DFO/ concerned authorities keeping record thereof and handing over the cut trees as directed by concerned authorities/ COMPANY.
- 6.1.15 The Pipeline corridor shall be kept as narrow as possible at all times. The pipeline shall be

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fully buried. Wherever possible vegetation along the center line of the pipe shall be uprooted carefully, with soil and roots intact, so that it can be used in the reinstatement. During the excavation of the pipeline, trench top soil and subsoil material shall be kept separate and backfilled in the same order where possible imported backfill material shall be avoided and a selective backfill method used. The Trench shall be opened and closed as quickly as possible. Safe exit routes/ramps from the trench shall be provided for wildlife if a trench is left open overnight. The Pipeline shall not alter the drainage characteristic of the land. Clay Stopper bungs will be used as required.

6.1.16 Staking, clearing, grading of Right of Use (ROU) as required, trenching to all depths in all types of soils including soft and hard rock, including blasting, controlled blasting, chiseling, or otherwise cutting etc. to a width to also accommodate the OFC/ cable conduit as per relevant standards, drawings, specifications etc., stringing, aligning, bending, welding, NDT by AUT/X-ray, field weld joint coating including supply of all materials, protective coating of long radius bends and buried fittings/ valves including supply of materials, providing sand/ soft soil padding, rock shield in the trench wherever required including supply of sand/ soft soil, laying and lowering of the pipeline including locating existing pipeline using pipe locator, wherever applicable and maintaining the specified minimum spacing from existing pipeline(s), back filling including supply of select backfill material where required, carrying out rail, road, river, canal, drain, utility and submerged minor and major water course crossings including installation of carrier pipe inside casing pipe at cased crossings wherever required, providing two component epoxy coating on inner surface of casing pipe wherever required by statutory authority, bank stabilization of water course crossings as required, arranging all additional temporary land/ area required for construction purposes. Supply and installation of anti-buoyancy measures viz. continuous concrete coating, geo-textile gravel filled bags, saddle weight, extra cover, select backfill etc. on pipeline, installation of supports wherever required, tie- in/ hook-up with pipeline/ piping installed by others including cutting of temporary test headers, if any, re-beveling, NDT, fit-up, welding, radiography etc.; clean-up, ROU restoration, pigging, flushing, gauging, hydrostatic testing with the quantity of corrosion inhibitor as required, dewatering with the addition of approved chemicals to neutralize the effect of inhibitor added during hydro test at required dosage, swabbing, drying, pre-commissioning and commissioning of pipeline including supply of all materials such as required type and quantity of pigs, manpower, equipment, consumables and carrying out all associated works as per relevant specifications, standards and approved drawings enclosed with the Contract document.

6.1.17 All welding and NDT shall be carried out as per welding specification and as per welding specification charts enclosed in the bid document.

6.1.18 Welding Techniques & NDT

| Sl. No. | Description                 | Welding Technique | NDT   |
|---------|-----------------------------|-------------------|-------|
| 1       | 8" x 6.4 mm, API 5L Gr. X52 | Manual            | X-Ray |
| 2       | 6" x 6.4 mm, API 5L Gr. X52 | Manual            | X-Ray |
| 3       | 4" x 6.4 mm, API 5L Gr. X52 | Manual            | X-Ray |

Notes:

a) Pipeline welding may be carried out as mentioned above.

|                                                                                                           |                                      |                        |            |
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- b) Contractor to note that NDT of first 100 joints performed by each machine (if applicable) for weld joints welded by automatic welding, shall also be re-verified/ rechecked by radiography. On successful acceptance of the same, shall be allowed to be performed on remaining joints. Methodology and frequency of re-calibration shall be finalized at the time of execution.
- 6.1.19 Welding of all tie-in joints including tie-in joints and bends on either side of major river/ canal/ road/ rail crossings/ other facilities as required including adjoining pipeline spreads, cutting of test header, re-beveling and tie-in with adjacent pipeline segments.
- 6.1.20 Carrying out welding including cutting, edge preparation (inclusive of grinding the edges of pipe, fittings, flanges, etc. to match with the matching edges of different thickness wherever required), fit-up, bending, pre heating wherever required, NDT including radiography and other non-destructive tests as specified. NDT requirements for process and other piping shall be in accordance with relevant specifications enclosed with the Bid document.
- 6.1.21 Transportation of bare pipes or Coated Pipe, removing of 3LPE coating, fabrication, supply, installation, and coating of LR Bend as per requirement of pipeline route.
- 6.1.22 Corrosion coating of long radius 3D bends by heat shrink sleeve as per specification. Contractor to fabricate and use cold field bend in smaller turning points of the route
- 6.1.23 Field weld joints coating and corrosion coating of Long Radius (LR) bends and pup pieces of sectionalizing valves by Heat Shrink Sleeve. 100% solid high build epoxy (minimum 500-micron thk.) shall be applied for underground piping & valves.
- 6.1.24 Installation of all in-line insulating joints, valves, appurtenances, online instruments etc.
- 6.1.25 Providing slope breakers in steep slope areas including supply of all materials, wherever required. Contractor shall carry out slope breaker survey and slope breaker shall be installed (before backfilling) as per standard after approval of Engineer-In-charge. Supply and installation of slope breaker as per specification and drawing in slightly undulating areas (having slope 6° to < 20°); slope stabilization as per specification and drawing in highly undulating areas (having slope ≥ 20°)
- 6.1.26 Sand/soft soil padding of minimum 150 mm thickness around pipe throughout its length in areas where trenching shall be done in rock or gravel or pebble or murram or hard soil including supply of sand/ soft soil. The pipeline trench shall not be filled with gravel and large stones or boulders. Supply and installation of rock-shield in addition to 150 mm of sand/soft soil padding around the pipe in rocky areas. The rock shield (polyethylene mat) shall be of minimum 6 mm thick or as approved by CLIENT/PMC and same shall be as per COMPANY specifications & In areas where trenching shall be carried out in normal soil, sand/soft soil padding of minimum 75 mm thickness all around the pipe throughout its length shall be provided. Contractor shall furnish all details of proposed rock shield to be used, for COMPANY's approval. Extra digging of trench shall be carried out to comply with above requirements & to provide minimum cover (as specified) over pipeline within Quoted rates and with no additional Cost to Company.
- 6.1.27 Providing engineered select backfill consisting of loosely compacted cohesion less soil like sand (for the areas prone to seismic activity) including supply of cohesion less soil like sand for a distance of 500 m on each side, as per job standards. The pipeline shall be surrounded by at least 0.6 m of select backfill. Extra digging of trench shall be carried out to comply with above requirement.

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- 6.1.28 The list of crossings indicating crossing methodology is enclosed. However, mentioned crossing methodology for respective crossing may vary depending upon site conditions during time of execution. In case of such situation, Client /PMC has reserve right to inform contractor about revised crossing methodology to be adopted. The payment will be regulated based on the actual crossing methodology executed as per relevant SOR item.
- 6.1.29 Carrying out National highway /State Highway, Expressway, railways, and major road crossings by conventional/ boring/ Jacking/ HDD method.
- 6.1.30 Supply & Installation of 168 mm (6") CS conduit for OFC cable, HDPE for all crossings with HDPE sub ducted in CS conduit (with proper end-sealing and arrangement of wire/etc for pulling OFC).
- 6.1.31 Supply and Installation of warning mat over entire pipeline, and covering widthwise complete Pipeline and OFC duct as per relevant specification & drawings. Warning mat shall be laid above the top of pipeline at a distance as specified in drawings.
- 6.1.32 Qualifying Procedure for cold field bending of pipes, Making and handling of cold field bends at site as per the specification, as required for laying of pipelines and crossings is in the scope of contractor.
- 6.1.33 Providing all necessary barricading material, safety signboards, warning lights etc. to safeguard the pipeline against accidents during construction of line in city area.
- 6.1.34 Localized purging/ inertisation including supply of nitrogen during hook up with existing Pipeline/ piping at existing terminal, if any.
- 6.1.35 Loading, unloading, handing over and transportation of all surplus COMPANY supplied free issue materials including line pipe to COMPANY designated stores and stacking of the same. Stacking of surplus pipe & other material shall be inclusive of supplying of sand bags etc.
- 6.1.36 Return of surplus material/ bends etc. to storage yard/ work site/ Company's store shall be in Contractor's scope.
- 6.1.37 Carrying out cleaning, flushing, swabbing (as applicable), dewatering, testing, and pre-commissioning of pipeline and associated facilities at Dispatch Station, Sectionalizing Valve Stations & Receiving terminal up to the respective battery limits. Locating all major and minor leaks during hydro-testing, if any.
- 6.1.38 Repair of leaks/ burst, not attributable to Contractor, occurring in Company supplied material, shall be carried out by the contractor and the Contractor shall be compensated as per provisions of the contract. However, Contractor shall carry out repair of defects attributable to Contractor at no extra cost to Company. Contractor shall submit a report for failure to Company.
- 6.1.39 Carrying out magnetic cleaning (pigging with the help of magnetic pig to remove steel debris), electronic geometric pigging (caliper pigging) for each pipeline section/part including supply of all types of pigs, pig locating and tracking device, spares, consumables, manpower etc. as per specification enclosed with bid/ contract document.
- 6.1.40 Carrying out repair of all defects found during electronic geometric pigging including locating, digging, cutting, welding, NDT etc.
- 6.1.41 Commissioning of pipeline & associated facilities providing all equipment's, manpower, machinery, consumables including required number of pigs and assistance as required during commissioning of pipeline system and associated facilities viz. Dispatch

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Terminal, Sectionalizing Valve Stations and Receiving Terminal up to the respective battery limits.

- 6.1.42 Final clean-up and restoration of ROU and other conveniences like temporary approach roads/ temporary works, barren land, road, rail, canals, water crossings, cultivable land etc. to original condition as per specification and drawings to the entire satisfaction of COMPANY and/ or authorities having jurisdiction over the same, including disposal of surplus construction materials to Company's designated stock yard(s) or as directed by Engineer-in-charge. CONTRACTOR shall restore stones laid to mark the boundaries of adjoining fields to original conditions. Contractor shall arrange necessary clearance from all concerned authorities/ land owners to the effect that ROU has been restored back to the original condition.
- 6.1.43 Disposal of surplus excavated soil from trench outside ROU.
- 6.1.44 Idle time preservation by filling Nitrogen at a positive pressure of 2 bar (g) as per specification, if required including supply of Nitrogen.
- 6.1.45 Preparation of as-built drawings, pipe-books, documents, photographs and project records as per specification and instructions of the COMPANY including furnishing of all Test Certificates/ Inspection Reports for all materials used for permanent installation. Taking over Crossing details from HDD agency (in case of separate agency) and compilation of all as-built drawings, project records, pipe book etc. shall be in laying contractor's scope of work.
- 6.1.46 Taking over surplus bare and coated pipe from coating contractor at storage yard after completion of work, loading, unloading, transportation and handing over of all surplus Company supplied free issue material including short length of pipes to Company's designated Storage yard as directed by Engineer-in-charge.
- 6.1.47 In case any activity though not specifically covered in schedule of rates description but same is covered under scope of work/ Specification / drawings, it is understood that the contractor shall do such performance & provisions so mentioned without any time & cost implication.**
- 6.1.48 Installation of casing pipes (by open cut/jacking/ boring/ any other trenchless technique) assembly, including supply of all materials, casing insulators and end seals, vents and drains etc. complete, at cased crossings.
- 6.1.49 Supply of HDPE duct for laying of OFC.
- 6.1.50 Providing loosely compacted cohesion less soil like sand, murrum, silty sand for specified distance in seismic prone areas.
- 6.1.51 Crossings of streams/canals/Nala by Open Cut or as specified in Crossing Methodology
- 6.1.52 Pre-construction surveys, preparation of detailed construction method statement and calculations for Company's approval.
- 6.1.53 Geo-technical investigations, if required.
- 6.1.54 Site preparation, arranging required land for setting up of string fabrication yard and obtaining necessary permissions from concerned authorities.
- 6.1.55 Preparation of pipeline Launch way, continuous concrete coating of pipes, repair of damages to corrosion and concrete coating, string preparation, field welding, NDT including radiography, pretest of completed strings, corrosion and concrete coating of field joints, trenching, laying at approved depth, backfilling including supply of select backfill material

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(where required), stabilization of banks, post installation hydro test, capping, providing and installing of markers, etc.

- 6.1.56 Installation of HDPE conduit, laying of OFC inside the conduit. Contractor shall install pipeline and HDPE conduit together in river crossings and HDPE conduit shall be strapped using corrosion resistance straps to the main pipeline in the top quadrant. Stability of the combined installation shall be ensured.
- 6.1.57 HDD works shall be carried out in accordance with specification enclosed with bid package. For directionally drilled crossing, following shall be performed:
- Carrying out all surveys and collection of data, as may be required for the design and construction of the crossings.
  - Carrying out all engineering, design calculations and preparing all construction drawings for laying of pipeline and optical Fiber cable inside steel pipe as per requirements for installation of river crossings by HDD method. Contractor shall prepare crossing drawing & calculation and submit all for approval work will start only after Approval from PMC/ Client
  - All construction activities required for installation of the crossings viz. site preparation, preparation of pipe string, repair of damages to corrosion coating, field welding, NDT including radiography, pretest of completed string, corrosion coating of field joints, holiday testing of complete pipe string, drilling in all types of soil including gravel, boulders and disintegrated and hard rock, installation of pipeline, post installation hydro-testing of the crossing section, capping, providing and installing markers at crossings.
  - Elastic Bend Radius: Total maximum longitudinal stress in the pipeline due to tension and bending at any location shall not exceed 90% of the SMYS of the pipe material.
  - Field joint coating shall be carried out by using approved sleeves.
  - Supply of duct of flexible HDPE/plastic corrugated tubing for laying of OFC cable, preparation of steel conduit string and corrosion coating of weld joints.
  - Installation of pipeline and 6" NB steel conduit for OFC (together in a single drilled hole or separately in two independent drilled holes as Approved by EIC).
  - Tie-in with main pipeline after successful installation of pipeline at river crossing.
  - All associated pipeline work w.r.t. temporary Cathodic protection.
  - Testing and jointing of OFC at either ends with OFC in main pipeline trench.
  - Contractor shall dispose bentonite slurry safely as per technical specification and environmental requirements as applicable.
- 6.1.58 Clean-up and restoration of ROU and other conveniences like road, rail, canals, cultivable land, water facilities, irrigation facilities, boundary wall/fence etc. to original condition as per specification and drawings to the entire satisfaction of Company and/or Authorities having jurisdiction over the same, including disposal of surplus excavated soil and other construction materials to a location identified by Contractor approved by local authority without causing any disturbance to environment and to the entire satisfaction of Company.
- 6.1.59 Contractor shall arrange necessary clearance from the concerned authorities/ land owners to the effect that ROU/ ROW has been restored back to original condition. Contractor shall carry out joint survey with representative of Competent Authority (CA) and will obtain clearance in writing from CA that ROU has been restored to original condition. Necessary clearance from statutory authority / NOC for restoring the ROU to original condition shall be

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in Contractor's scope. Necessary proof of restoration i.e. through photographs and video recordings will have to be submitted by the contractor where ever NOC is not available.

- 6.1.60 Supply and installation of all types of pipeline markers including their painting suitable for and Normal/Highly/Costal/marine corrosive environment (as specified in Design Basis) and all associated civil works. Location of markers shall be as per specification/ standards and as directed by Engineer-in-Charge. If Corrosive environment is not defined then stringent requirement of above-mentioned corrosive environment shall be followed.
- 6.1.61 Installation of all inline/ online instruments/ valves/ insulation joints/ appurtenances etc. as per requirements of approved drawings
- 6.1.62 Tie-in with the pipeline at rail, road, river, and other crossings including cutting of test headers as required and tie-in with terminal piping & with existing facilities as applicable.
- 6.1.63 At all pipeline tie-in locations, the trench shall be excavated further wherever possible and permanently lubricated HDPE duct shall be laid away from the pipeline to avoid damage to the HDPE conduit and to the pipeline.
- 6.1.64 Preparation of video films with audio commentary covering all aspects of pipeline construction annotated as required, conversion of the same to video CD/DVD ROM format and USB, submitting three (3) sets of the same.
- 6.1.65 All incidental and associated works and any other works not specifically listed herein but are required to be carried out to complete entire work related to pipelines and the associated facilities and making the entire pipeline system ready for operation.
- 6.1.66 Repair of any leaks/burst occurring during testing of main pipeline.
- 6.1.67 Installation of carrier pipe in canal/ road (NH/ Express highway)/ railway crossings by boring/ HDD/ Trench less method, as directed by Company. Whenever HDD/Trench less method is to be adopted for pipeline installation, the same shall be carried out as per specification. Contractor to note that the minimum elastic bend radius to be adopted, shall be as per pipeline engineering design basis enclosed with the tender.
- 6.1.68 Any other works not specifically listed herein but are required to be carried out to complete entire work related to pipelines and the associated facilities.**

### 6.2 ASSOCIATED WORKS FOR PIPELINE CONSTRUCTION

- 6.2.1 Installation of CS casing pipes (by open cut/ jacking/ boring) assembly, including transportation & supply of all materials, viz. CS casing Pipe, casing insulators and end seals, vents and drains etc. complete, at cased crossings. In case, coated casing pipe is supplied as free issue material, then the contractor shall remove coating before installation.
- 6.2.2 Cased crossings shall be installed at locations as per instructions of Engineer in- charge. The number of crossings indicated in alignment sheets is subject to change based on engineering, construction and statutory requirements or the requirements of the authority having jurisdiction over a utility crossing.
- 6.2.3 Supply and installation of all types of pipeline markers including their painting suitable for Normal/Highly/Costal/marine corrosive environment (as specified in Design Basis) as per specification and all associated civil works. If corrosive environment is not defined then stringent requirement of above-mentioned corrosive environment shall be followed.
- 6.2.4 Tie-in/ hook-up of pipeline at Dispatch / Receipt Terminal / SV Stations/ and existing

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facilities, if any, is in the scope of Contractor.

- 6.2.5 Laying Contractor shall engage underground Scanning agency for finding out the location and depth of underground utilities particularly residential and other areas in consultation with Engineer In charge/ Client and Concerned Authorities.
- 6.2.6 Contractor shall also inform all local authorities in advance and obtain all necessary approvals for crossing underground utilities/ pipelines wherever encountered along the pipeline route. Contractor shall be required to carry out all the works as mentioned in the work permit.
- 6.2.7 Owner Reserve the right to award part of the work to Contractor. Or Contractor Performance is not found satisfactory owner reserve the right to award part of Contractor work to others.
- 6.2.8 Bidders shall also be responsible for Collaborate, Cooperate, co-ordination and communication for smooth execution completing the site work from respective statutory authorities i.e., PWD, NHA, SH, Railway, Nagar Nigam, Local authorities, Forest/ central forest etc.
- 6.2.9 Wherever advised by owner, Collaborate, Cooperate, co-ordination and communication for smooth execution completing the site work for clearance from Statutory Authorities including regular follow ups and obtaining the clearance shall be done by Contractor. Client will issue introductory letter for applying and for submission of demand note raised by statutory authorities. Contractor shall do the follow up with the concerned authorities to get the clearance to execute the job in time.
- 6.2.10 Contractor shall provide schedules, progress reporting, organization chart at construction site, quality assurance plan and developing quality control procedures, as per requirements of the bid package.
- 6.2.11 Contractor shall be responsible for payment of claims if any arising out of damage/ obstruction to public utilities like OFC lines of DOT, water pipelines etc. where the claims will cover the restoration costs as well as loss of revenue due to down time. Owner may deduct cost of such claims from contractor's bill to settle such claims.
- 6.2.12 Providing all equipment's, manpower, machinery, consumables, apparatus, tools and tackles for fabrication, installation, inspection, testing, pre-commissioning, and commissioning complete as required including facilities for inspection and interpretation of testing results by Company/Company's Representative personnel; providing all types of safety tools, tackles, devices and apparatus, equipment etc.
- 6.2.13 Co-ordination and supervising the work of Approved sub-Contractors.
- 6.2.14 Transportation of appropriate materials to worksite, intermediate storage points, maintaining and operating an adequate material control procedure at worksite.
- 6.2.15 Fabrication of all piping, structural components as per approved drawings.
- 6.2.16 All associated civil, structural, electrical, instrumentation; HDPE duct laying and telecom works shall be performed in accordance with relevant specifications and requirements enclosed elsewhere in the bid package.
- 6.2.17 Contractor shall depute independent third-party inspector for carrying out radiographic inspection and interpretation of radiograph of welds. Third party inspector shall be approved by Company.
- 6.2.18 Provide, maintain, and operate all temporary facilities required for the construction related

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works and remove after completion of work.

6.2.19 Hook up/tie-in of pipeline and piping system with terminal facilities.

### 6.3 Piping Works at Tap- off Points and Sectionalizing Valve Stations.

Facilities to be installed at various sectionalizing Valve (SV) Stations, as a part of overall pipeline system are shown in respective diagrams enclosed.

#### Tap- off Points/ SV Stations/Isolation Valves

- Preliminary typical drawings for the SV/tap-off stations are enclosed with this Bid. These drawings are indicative only and are enclosed to enable the Contractor to understand the nature of work involved. Issued for Construction (IFC) Drawings shall be progressively furnished to the Contractor, at an appropriate time at project execution stage.
- Contractor shall carry out all works strictly in accordance with the Issued for Construction (IFC) drawings and reference specifications/ standards, documents, data sheets etc. enclosed with this Bid document and instructions of Company/ Engineer- in-Charge and other provisions of Bid document.
- The Contractor's Scope of Work for the work tendered shall consist of, but not be limited to, supply (as indicated in Scope of Supply), installation, testing, pre- commissioning and commissioning of terminal piping complete, with all associated mechanical, civil, architectural, structural, corrosion monitoring system, electrical, instrumentation, telecom, etc. as applicable including all such works which though specifically not indicated here but will otherwise be required to complete the work in all respects.
- The scope indicated below shall be read in conjunction with Schedule of Rates as applicable, drawings, standards, specifications, and other documents forming part of the Contract document.

6.3.1 "Receiving and Taking over" as defined in specifications of all Company supplied materials including equipment from the Company's designated place(s) of issue defined elsewhere, transportation including loading, unloading, handling from Company's designated place(s) of issue to Contractor's own stock yard(s)/ work site(s)/ workshop(s), including arranging all necessary intermediate storage area(s) thereof till the materials are installed in permanent installation.

6.3.2 Procurement and supply of all materials, equipment's that are included in the scope of supply of Contractor, transportation of all materials from manufacturer's works including loading, unloading, handling, storing and transportation to work site(s)/work shop(s) including arranging all necessary intermediate storage area (s) thereof, as required.

6.3.3 Fabrication, erection, testing of all above-ground/ buried piping system including installation pipes, valves (manual and remote actuated), flanges, fittings, flow tees, , insulating joint etc.; carrying out all applicable works associated with buried pipeline within the SV station ,carrying out welding, NDT including radiography; weld repairs/ retesting, cleaning/ flushing hydro testing, dewatering, functional testing, cutting of mainline and beveling (if required), excavation in all types of soil for installation of piping and pipe supports, pre-commissioning, providing commissioning assistance(whenever required) and commissioning including supply of all materials and manpower that are required during pre-commissioning and commissioning and all associated works.

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- 6.3.4 Installation of Sectionalizing Valve stations in all terrains/ soils including all above ground/ underground piping at all elevations and depths including all civil works, viz. filling and compaction of valve station areas, excavation of pits, gravel filling, construction of supports, foundations, construction of access road to installation from nearest metaled road, installation of all valves and valve actuators and all fittings/ piping works.
- 6.3.5 Preparation of isometrics and/or fabrication drawings required for the purpose of fabrication during execution of work.
- 6.3.6 Obtaining all necessary approvals and work permits from concerned local authorities having jurisdiction including hot work permit as applicable for performing the work in existing terminal facilities. Arranging of adequate fire-fighting equipment viz. fire brigade, fire extinguisher, shielding from existing facilities, oxygen mask etc. for carrying out the work safely to the satisfaction of COMPANY.
- 6.3.7 Carrying out welding including cutting, edge preparation (inclusive of grinding the edges of pipe, fittings, flanges, etc. to match with the matching edges of different thickness wherever required), fit-up, bending, pre heating wherever required, NDT including radiography and other non-destructive tests specified. NDT requirements for process and other piping shall be in accordance with relevant specifications enclosed with the Contract document.
- 6.3.8 Installation of all types of valves (manual/ actuated), all types of inline/ online instruments such as PSVs (other than those covered separately), safety valves, tapping for thermowells, sample connections, pressure gauges, corrosion monitoring system etc. for all sizes and ratings including fixing of gaskets, bolts, studs and nuts of all sizes, ratings, and materials.
- 6.3.9 Installation of all in-line and on-line instruments including Skin Temperature measurement assemblies.
- 6.3.10 All works for corrosion monitoring system (CMS) system as described in relevant document enclosed elsewhere with Bid document.
- 6.3.11 All associated civil works, viz. levelling, filling and compaction of station areas as required, necessary stone pitching at the sides of earth fill (if required), excavation of pits, gravel filling, paving as required, access road to installation from nearest metaled road, etc.
- 6.3.12 All associated structural and mechanical works including supply of all materials required, unless covered separately elsewhere in the Bid document, including construction of foundations (PCC/ RCC works) for equipment's and pipe supports and sleepers, fabrication and erection of supporting structural elements for piping such as shoes, clamps, anchors, guides, insert plates, brackets, structural column, valve operating platforms, pipe crossovers etc. Contractor shall provide grating as per details currently included in the tender document or as per details furnished subsequently.
- 6.3.13 Supply of bolts, nuts, gaskets, washers, U bolts, clamps, clips, gaskets for supports for all piping works.
- 6.3.14 Supply, fabrication and erection of supporting structural elements for piping such as shoes, clamps, anchors, guides, insert plates, brackets, structural column etc.
- 6.3.15 All associated structural, instrumentation, telecom, mechanical and civil works including supply of all material required, covered separately elsewhere in the Bid document.
- 6.3.16 Hook-up of piping with equipment's and vessels and hook-up of all piping at the battery limit with the pipeline/ piping including cutting of temporary test header, re- beveling, NDT, fit-

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up, welding, radiography etc. including interface/ coordination as required with other Contractor(s)/Agencies.

- 6.3.17 Painting of above ground piping (including supply of materials), structural steel elements, for pipe supports, all equipment's and all related miscellaneous items as required and as directed by Engineer-in-charge. Paint shall be suitable for highly corrosive environment in accordance with specification. Wherever touch up/ repair of primer is required, high build epoxy zinc phosphate primer shall be used
- 6.3.18 Protective coating of 100% solid high build epoxy minimum 1000-micron thk. (power Crete R95) for all underground piping, valves, fittings, etc.
- 6.3.19 Corrosion protection coating of all field weld joints for buried piping of all sizes including supply of all materials.
- 6.3.20 Cleaning (card board blasting), Hydro testing, dewatering, and drying of piping system of all sizes as per specifications enclosed.
- 6.3.21 Final clean up and restoration of site, facilities etc. as per the requirement of COMPANY/ Engineer-in-Charge including filling (wherever required) and grading of areas around stations for avoiding any local flooding of area.
- 6.3.22 Transportation and stacking of all surplus COMPANY supplied free issue material to Company's designated store after completion of works or as directed by Engineer-in-Charge.
- 6.3.23 Preparation of as-built drawings, documents, and project records as per instructions of Engineer-in-Charge.
- 6.3.24 Preparation of detailed procedures for fabrication, installation, testing, pre- commissioning, and commissioning. Such procedures shall be submitted to COMPANY/ Engineer-in-Charge for review and approval.
- 6.3.25 Obtaining all statutory clearances, approvals, permissions, and hot work permit for the works as required.
- 6.3.26 Fabrication and erection of piping supports and change of existing support/additional supports installed by others as directed by Engineer-in charge.
- 6.3.27 Idle time preservation of mainline and terminal piping by nitrogen gas with positive pressure 2 bar (g) for specified period.
- 6.3.28 Any other works not specifically listed herein but required for completion of the works in all respects.
- 6.3.29 All construction works shall be carried out as per "Issued for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the COMPANY and revision of drawings.

### 6.4 Main PE Pipeline

- 6.4.1 Transportation of Free Issue material from OWNER stores to contractor stores and proper storing, stacking, providing security, insurance cover during transportation and storage, laying, commissioning, and handing over pipelines to owner.
- 6.4.2 Uncoiling/stringing the PE pipes of required sizes (i.e. Dia 125/ 90) pipes into trenches (in same trench of steel pipe) as per approved procedure.

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Supply and Installation of PE pipe Rest material and fittings like Elbow, Tees, Reducers, Couplers, tapping saddles, Transition fittings, End cap, and Sleeves etc. including construction of supports, Valves pits (at every 1 km), Inspection chambers etc. as per specification, drawing & satisfaction of the Engineer in charge (EIC). All PE valves shall be stem extension type and shall be provided at every 1 km.

- 6.4.3 Joining the pipe ends with fittings of valves by approved automated electro-fusion techniques only as per tender specification.
- 6.4.4 EF welding machine should be one having GPS coordinate future nowadays available in market like GF++ MSA 340.
- 6.4.5 EF operator to be deployed for EF welding must be certified from approved vendors of EF fittings manufacturer like GF/ Kimplas/ Section IX of ASME BPV.
- 6.4.6 Laying pipelines by any methodology including trench less technology methods with or without casing pipes (HDPE pipes) as per specifications and as directed by EIC.
- 6.4.7 HDD profile & Utility coordination report to be submitted before HDD approval to EIC. Any HDD performed beyond the intended /approved length will be paid as per SOR.
- 6.4.8 Carrying out pneumatic testing and purging as per specifications and approved procedures, providing all tools & tackles, instruments, manpower and other related accessories for carrying out the testing of pipes.
- 6.4.9 Purging should be done to point till Oxygen percentage is less than 2%. Contractor must arrange Purity certificate of N2 used for purging. It is compulsory to use Nitrogen cylinder trolley while using Nitrogen for purging/ testing. It must be necessary to qualify welder/ manpower for Procedure Qualification Record for performing testing by pressure testing the PE pipe coil.
- 6.4.10 Restoration of existing ground features such as grass/ turfing, paving, roads, drains, concrete, floral beds, fencing, tiles, marbles, flooring masonry etc. to original condition and to match with adjoining conditions, functionally and aesthetically up to the entire satisfaction of Owner / Owner's representative /any other third-party agency designated by owner and local authorities, failing which, it will be done at the risk and cost of the contractor. Obtaining No Objection Certificates for the restoration work done from the concerned authorities.

### 6.5 Temporary Cathodic Protection Works

Temporary Cathodic Protection works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

### 6.6 Civil, Architecture & Structural Works

Civil, Architecture & Structural works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

### 6.7 Instrumentation Works

Instrumentation works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

### 6.8 Telecommunication Works

Telecommunication works shall be carried out as per the scope detailed in particular job

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specification enclosed elsewhere with the tender.

### 6.9 Electrical Works

Electrical works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

## 7 SCOPE OF SUPPLY

### 7.1 Materials to be supplied by COMPANY as Free Issue

Company shall supply the following Pipeline/ Terminal piping materials required for permanent installation to the Contractor at an appropriate time during the execution stage as free issue materials:

#### a) 3LPE externally Coated, API 5L Gr. X-52 Steel Line Pipe.

- Entire required quantity of coated line pipes of all thickness shall be supplied by Company. Line pipes (coated) shall be made available to the Contractor at designated storage yards. Transportation of the line pipe from designated storage yards in to work site shall be in the scope of the CONTRACTOR. Further the CONTRACTOR must ensure safe storage.
- Bare Line Pipes API 5L Gr. X-52 shall be used for above ground piping section by the respective part Contractor. Contractor can use the Coated Pipe after removal of coating & painting the same with approved painting Scheme.
- The quantities of coated and bare line pipes indicated in the bid document are approximate and may vary. The exact quantity shall be intimated to the Contractor after award of work.
- Contractor to note that it is the responsibility of installation contractor to return surplus pipes to the COMPANY designated storage yard as per instructions of Engineer In-Charge after completion of installation works.
- Receiving and taking over of coated line pipes at Storage yard including its inspection. All trucks / trailers for transportation of line pipes from storage yards to site/ ROU/ Contractor's storage Yard shall be supplied by contractor.
- Contractor shall note the exact location of Pipe Storage Yards shall be intimated to the Contractor at the time of award. Contractor shall be responsible for performing all works as per scope of work at the finally selected storage yard location by the COMPANY at no extra time / cost to the COMPANY.
- Contractor shall note that location for SVs is approximate and may vary based on the availability of land and NH/ SH/ Rail approach. The exact location of SV stations shall be intimated to the Contractor at the time of award or during execution of work. Contractor shall be responsible for performing all works as per scope of work at the finally selected SV locations by the COMPANY at no extra time/ cost to the COMPANY.
- Transportation of pipes and other free issue material from place of issue is in Contractor's scope. Contractor shall note that the prices indicated in the Schedule of Rates shall be inclusive of taking the delivery and transportation of line pipes and other material from the above storage yard/ stockyard to work place(s).

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- Bevel Protectors of the line pipes shall be the property of the pipeline installation Contractor. He must collect and dispose of the bevel protectors. Contractor shall quote accordingly.

### b) **Metallic Valves (ball, plug, globe etc.) of size 4" and above**

- Wherever required, actuators shall be supplied along with valves

The Company shall make above free issue materials available at the Client store.

Contractor shall arrange all trucks/ trailers, cranes etc. for transportation of above materials including loading at Company store, unloading at contractor's storage yard/ work site, arrangement of cranes, handling etc.

Contractor shall return all surplus material to company designated storage yard as decided by Engineer- In- charge.

### c) **MDPE Pipe**

#### **Conditions for COMPANY Supplied Material**

- i. The Contractor shall be responsible for taking over of the material and subsequent handling, hauling, transportation to the actual work site(s)/fabrication yard(s) and storage & safe keeping of the materials. Contractor shall arrange all equipment/ cranes etc. for loading of these materials on their truck/trailers for transportation except line pipe.
- ii. The Contractor shall inspect all COMPANY supplied free issue materials at the time of taking over from the COMPANY and defects noticed, if any, shall be brought to the notice of COMPANY/ COMPANY representative and jointly recorded. Once the material has been taken over by the Contractor, all the responsibility for safe keeping of the materials shall rest with the Contractor.
- iii. Every month the Contractor shall submit to the COMPANY an account for the material issued to the Contractor in the Performa prescribed by Engineer-in- Charge.
- iv. On completion of the works, Contractor shall submit a "Material Appropriation Statement" for all materials supplied by the COMPANY as free issue materials.
- v. The scrap allowances shall be permissible as per the provision of Bid document. The percentage allowance shall be accounted on the basis of actual consumption as incorporated in the work.
- vi. All unused and scraps material shall be the property of the COMPANY and shall be returned by Contractor to COMPANY at COMPANY's designated storage point(s) including transportation of the same from Contractor's stock yard(s)/worksite(s)/work shop(s) to the COMPANY's designated storage point(s). Contractor shall be responsible for the proper measurements of the unused/ scrap materials to be returned to the COMPANY.

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- vii. Rebuffing of dents in bevels less than 1 mm in depth shall be carried out by Contractor ahead of welding in the field at no extra cost to Company.
- viii. For the purpose of accounting of pipes all cut pieces in length of 2m and above when returned to the Company's storage point shall be considered as serviceable material. All pipes measuring less than 2 m shall be treated as scrap/wastage.
- ix. All unused pipes and serviceable/ scrap material shall be the property of the Company and shall be returned by Contractor to Company at Company's designated storage point(s).

### 7.2 Materials to be supplied by CONTRACTOR

The procurement and supply, in sequence and at appropriate time and place, including inspection and expediting, of all materials and consumables required for completion of the work as defined in this bid document except the materials specifically listed under para 6.1 above as COMPANY free issue material, shall be entirely the CONTRACTOR's responsibility and the item rates quoted for the execution of the WORK shall be inclusive of supply of all these materials. All materials supplied by the CONTRACTOR shall be strictly in accordance with the requirements of relevant COMPANY material specifications enclosed with the Contract document. All equipment's, materials, components etc. shall be new and specifically purchased for this job from Company approved vendors, duly inspected by third party inspection agency (shall be 3.2 certified-) along with manufacturing certificate for relevant pressure containing equipment/ materials/ parts/ components etc. For other contractor supplied equipment/ materials/ parts/ components, contractor has to submit test certificate as per technical specification/ applicable codes/ approved QAP (as applicable) before supply. As a minimum, the materials to be supplied by CONTRACTOR may include but shall not be limited to the following

- i. Insulating Joints
- ii. 3D Bends (90°, 45°, 22.5° & 12.5°) of sizes as per tender requirement.
- iii. Supply of MDPE valves and fittings.
- iv. All materials like Assorted pipes, all type of valves (up to 2"), all type of Flanges (WNRF, BLRF etc.) elbows, tees, reducers, weldolets, sockets, nipples, spectacle blinds, end caps, Gasket, and stud & bolt etc. as per tender requirement; spacer & blinds required for permanent installation in the system. Each item shall be inclusive of commissioning spares. List of such spares shall be made part of the offer and the quoted unit/total price shall be inclusive of the spares.
- v. Supply of HDPE Telecom Duct, OFC cable & CS Conduit
- vi. All equipment's & consumables such as welding electrodes, oxygen, acetylene, inert gases, all types of welding electrodes, filler wires, solder wires, brazing rods, flux etc. for welding/ cutting and soldering purposes.
- vii. All equipment's, materials, components etc. shall be new and specifically purchased for this job. All material to be supplied by the Contractor shall be purchased from the approved

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vendors of the Company, duly inspected by Third party inspection agencies as per vendor list attached in tender documents. The list of approved vendors is enclosed along with bid document.

- viii. The procurement and supply, in sequence and at appropriate time, of all materials and consumables required for completion of the Work as defined in this bid document except the Company free issue material, shall be entirely the Contractor's responsibility and price quoted for the execution of the Work shall be inclusive of supply of all these materials.
- ix. All materials for all types of pipeline markers including cement, sand, reinforcements, structural steel etc. and paint conforming to normal corrosive environment as per specification enclosed with the bid documents.
- x. Casing insulators and end seals and materials for casing vents and drains as per drawings.
- xi. All materials required for continuous concrete coating/ gravel filled geo- textile bags/ saddle weight for providing negative buoyancy to the pipeline wherever required. Contractor shall take prior approval of COMPANY and furnish all details including design calculations in case of use of purpose-built geo-textile bags. For river crossings, only continuous concrete coating shall be provided for negative buoyancy.
- xii. Supply of warning mats as per the technical specification/ EN:12613 standard (latest edition).
- The material of warning mat shall be of virgin quality polyethylene (PE) / polypropylene (PP) as per EN:12613 (latest edition).
  - It shall have UV-resistant, non- biodegradable, non-hazardous and non-toxic properties. If warning mat is made from PE material, then, the same shall have anti-rodent properties in addition to above properties.
  - Warning mat shall have golden yellow color and printed text shall be in red color and of non-delectable type with high abrasion resistance.
  - All test shall be conducted and accepted as per requirement of EN:12613 (latest edition) unless otherwise mentioned in approved QAP.
  - Handling including loading and unloading, packaging, transportation, laying shall be carried out as per manufacturer's / supplier's guidelines so that material at all stages upto laying shall be in safe and sound condition.
  - Printer matter and their layout shall be approved by PMC/owner before supply.
  - Print matter shall be printed in English and Local language alternatively at every 1 m distance. Manufacturer's name, year of manufacturing and batch/lot number shall appear at every running meter of warning mat strip
  - In case warning mat is supplied in more than 500 mm width, a sample of width 500 mm from the same lot/batch of material shall be tested as per requirement of EN:12613. The

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sample drawn should have same production parameters (except width) as of higher width section.

- Contractor must submit the QAP of warning mat for approval before commencement of production. Inspection of material will be done at vendor's works by owner/PMC representatives. Any test failed during inspection for the referred lot/batch, the total lot/batch will be rejected.
  - Print matter text/ font size will be of letter height 15 mm and thickness of letter line 2 mm. However, vendor to ensure that print matter text size shall be legible when viewed from the range of minimum 5 m distance without magnification.
  - If center width of the mat is not sufficient to accommodate the requirement mentioned above, in that case the vendor may put separate PE Centre band/strip to accommodate the below mentioned requirements.
  - PE center band/strip shall be golden yellow color and made from virgin quality, high density polyethylene, center band/strip thickness shall be of minimum 0.1 mm thick and shall have UV-resistant, non- biodegradable, non-hazardous, non-toxic, and anti-rodent properties.
  - PE center band /strip width shall be 100 mm for warning mat width up to 550mm and 150 mm width of PE center bend shall be kept for warning mat width more than 550mm
  - PE center band/strip shall be pasted on center of the warning mat in such a manner, so that after paste inherent material properties of warning mat shall not be compromised. Further peel strength of the used adhesive material shall be sufficient so that PE center band/strip shall not peel off during handling, transportation, storage, laying in trench and in wet environment/condition either at above ground or underground condition. Manufacturer/Supplier shall give declaration/ compliance statement regarding the used adhesive for paste purpose of PE centers band/strip.
  - The warning mat shall be supplied in single part of 600 mm width for 12" Pipeline.
- xiii. Supply of all materials for installation of wind-shock and safety signboard at different stations.
- xiv. All materials and consumables required for external corrosion coating and concrete coating (where required) of field weld joints.
- xv. All materials required for field joint coating, corrosion coating of LR bends, pup pieces of sectionalizing valves and repair of damaged corrosion coating of line pipe. Contractor shall confirm that proposed field joint coating material is suitable for type of terrain encountered along pipeline route. Contractor shall take prior approval from COMPANY for field joint coating material to be used. The cut back length shall be 150 mm + 20 (-0) mm.
- xvi. All material, equipment & consumables for HDD works including approved sleeve.
- xvii. All materials required for sand/ soft soil padding around pipeline (150mm where**

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**trenching has been carried out in rock, gravel, pebble, murram, or hard soil & 75 mm thickness where trenching has been carried out in normal soil) and optical Fiber cable, select backfill of approved quality, slope breakers, bank stabilization of water crossings etc.**

- xviii. For rocky areas, rock shield shall be provided in addition to sand/ soft soil padding. Rock shield shall be of high density extruded polyethylene mat with following properties:

|                      |             |                |
|----------------------|-------------|----------------|
| Thickness            | ASTM D-1777 | 6 mm (minimum) |
| Compressive Strength | ASTM D-1621 | 250 PSI        |
| Impact Resistance    | ASTM G-14   | 100 in-lb      |

- xxviii. Contractor shall obtain prior approval from Engineer-in-charge for rock shield material & its application procedure.

- xxix. All materials including consumables, nitrogen etc. required for hook-up with existing facilities and equipment's.

- xxx. Mobilizing and providing all necessary barricading material, safety signboards, warning lights etc. to safeguard the pipeline against accidents during construction of line in city area.

- xxxi. All safety tools, tackles, devices, apparatus, equipment etc. including ladders and scaffolding complete as required.

- xxxii. All stud bolts, nuts, jack screws, all type of gaskets (metallic spiral wound gaskets) in required quantities to be used for permanent installation into the system for all sizes and ratings of flanges and flanged valves, equipment etc., including nuts, bolts, gaskets, washers, U bolts, clamps, clips etc. for pipe/ equipment supports. All materials for supports shall be in contractor's account.

- xxxiii. All types of coating and painting materials including primer and paints suitable for specified corrosive environment for painting above ground piping and 100% solid high build epoxy (minimum 1000-micron Thk.) for underground piping/ valves, fittings, flanges etc.

- xxxiv. All pipes, fittings, flanges, blind flanges, gaskets, nuts, bolts, clamps, strainers, equipment/ consumable, metallic blinds, temporary gaskets as required for filling, pressurizing, hydrostatic testing, and dewatering, swabbing etc. including test headers for pigging and hydro-testing.

- xxxv. All materials such as cohesion less soil/ sand required for installation of pipeline in seismic active zones.

- xxxvi. All materials, equipment's, consumables etc. required for magnetic cleaning and caliper pigging of pipeline.

- xxxvii. All materials required for civil, structural, and general civil works including structural steel, cement, reinforcement, concreting, grouting etc. in facilities like dispatch terminal, IP

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Station, SV stations, injection points and receiving terminal including all types of equipment and material required for excavation/ construction of pits for equipment and instrument installations and steel/ structural steel materials of all types.

- xxxviii. All materials required for repair/ restoration of pavements, roads, bunds, walls, other structures affected/ damaged by Contractor's construction activities. Materials shall be equivalent/ superior to those used for original construction of the facility.
- xxxix. All equipment and consumables required for hydrostatic testing like pumps, pressure and temperature gauges, test water, and corrosion inhibitors for test water for hydrostatic testing.
- xl. Supply of insulators, end seals etc. in case of cased crossings; supply of 6" NB CS conduit. CS conduit of 168 mm dia. for OFC shall also be used in open cut river crossing by strapping with concrete coated line pipe.
- xli. All materials, consumables and equipment required for welding and for all types of tests and NDT such as radiography, ultrasonic testing, magnetic particle, dye penetrate examination etc. including radiography film, X-ray/ gamma ray machines, developing equipment and consumables, Ultrasonic equipment etc.
- xlvi. All safety tools, tackles, devices, apparatus, equipment etc. including ladders and scaffolding complete as required.
- xlvi. All steel materials such as structural steels, reinforcement steels, and steel for all types of supports, foundations, ladders, platforms, etc.
- xlvii. All steel materials such as structural steel, reinforcement steel, shims, wedges, packing plates (machined wherever required), pipes, nuts & bolts, washers, U-bolts, anchor bolts, clamps, clips, pipe saddles/ shoes etc. as required for the fabrication of structural supports and supports basements/ foundations, platforms etc. Pipes supplied by COMPANY shall not be used for fabrication of supports and support saddles etc.
- xlv. All materials for corrosion protection of buried piping, pipe fittings, valves, casing pipes, etc.
- xlvi. All materials and equipment's related to blasting of rock/ controlled blasting for excavating trench, grading of ROU, pipeline & pipe laying/ installation, and other works.
- xlvi. All materials for surface type temperature element.
- xlvi. Mobilizing Pipe/ cable locator for locating existing pipelines/ cables.
- xlix. All types of corrosion measuring instruments e.g. corrosion coupons, corrosion probes etc. wherever required as per specification.
- l. Sand ridges (sand, polyethylene sheets etc.) and other materials for stacking of surplus pipes at Company's designated storage yard.

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- li. Corrosion inhibitor, oxygen scavengers and bactericides for water used for hydrostatic testing including water for testing.
- lii. Required quantities of nitrogen for idle time preservation and pre- commissioning of Pipeline and associated facilities, if required.
- liii. All pigs for cleaning, gauging, filling, dewatering, swabbing, drying, pre- commissioning, and commissioning of the pipeline.
- liv. All materials i.e. fittings, flanges, valves, blind flange etc. required for isolation and nitrogen purging for pipe section, manpower, equipment, pigs, consumables, nitrogen required for carrying out commissioning of pipeline along with necessary piping and instrumentation connection for monitoring flow rate, pressure, temperature etc. providing temporary facilities for venting/ flaring along with necessary piping, valves and instrumentation etc. shall be in contractor's scope.
- lv. All materials, manpower, spares, tools & tackles and consumables for carrying out pre-commissioning activities and during commissioning (including bi-directional and foam pigs, compressor, nitrogen required for achieving the specified criteria for pipeline intertization/ purging prior to declaring pipeline fit for commissioning) necessary piping and instrumentation connection for measuring flow rate, pressure, temperature etc., temporary facilities for blowdown/ venting/ flaring along with necessary piping, valves & instrumentation as well as consumables and manpower required during pre-commissioning and commissioning.
- lvi. All materials and consumables required for external corrosion coating and concrete coating (where required) of field weld joints shall be included in the cost of laying of pipeline network and shall be in scope of contractor.
- lvii. Direx or equivalent field joint coating material for HDD works.
- lviii. All materials required for sand/soft soil padding around pipeline and optical fiber cable, select backfill of approved quality, slope breakers, bank stabilization of water crossings wherever required.
- lix. All materials including consumables required for hook-up with adjoining pipeline section or wherever required.
- lx. Supply of cohesion less soil, if required, like sand, silty sand, etc. for complete backfilling of pipeline trench for a specified distance in areas prone to Seismic activity.
- lxi. All primer and paints for painting above ground piping. All painting shall be as per specification enclosed with the bid package. Paint shall be suitable for low temperature application as per company specification enclosed with the bid document wherever specified.
- lxii. Material for the maintenance of sand ridges and other materials for pipe stacking at Contractor's warehouse/storage yards'/work site/ROU.

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- Ixiii. All materials for skin measurement instrument.
- Ixiv. All temporary materials and consumables required for filling and pressurizing in connection with hydrostatic testing, dewatering, swabbing and pre-commissioning activities, etc. Including pipes, flanges, fittings, gaskets, bolts, nuts, etc. required for fabrication of temporary pig traps and /or test headers.
- Ixv. All materials required for repair/restoration of pavements, roads, canals, temporary water pipes, walls, other structures affected/damaged by Contractor's construction activities. Materials shall be equivalent/superior to those used for original construction of the facility.
- Ixvi. All pigs for cleaning, gauging, de-watering, swabbing, filling, pre-commissioning, and commissioning of the pipeline.
- Ixvii. Pumps and water to be used for hydrostatic testing/ flushing. All materials & consumables such as Corrosion inhibitor, oxygen scavengers and bactericides, required during hydro testing and idle time preservation, as required.
- Ixviii. All casing pipes, casing insulators and end seals including materials for vent and drain and strapping CS conduit with pipe and carbon steel pipes in required quantities.
- Ixix. All consumables and equipment's required for all types of tests and NDT such as radiography, ultrasonic testing, magnetic particle, dye penetrant examination etc. including radiography film etc.
- Ixx. All safety tools and tackles, devices, apparatus, equipment, personal safety gazettes to be used as personal protective equipment (such as helmets, safety belts, safety shoes, etc.) including ladders and scaffolding etc. complete as recommended by Engineer-in-Charge as per relevant safety standards
- Ixxi. All structural steel material for all types of supports.
- Ixxii. All materials and equipment for excavating trench or grading the Right-Of-Use pipeline and pipe laying/installation and other works.
- Ixxiii. All steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms etc. including Bolts, nuts, washers, U bolts, clamps, clips, gaskets, Shims, wedges and packing plates (Machined wherever required) and materials required for fabrication of low friction sliding bearing supports.
- Ixxiv. All fencing, gate and steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms, etc
- Ixxv. All other materials not specified above but required for successful completion of the entire work whether temporary or permanent in nature.
- Ixxvi. All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant Company material specifications enclosed with the tender document.

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- lxxvii. Corrosion resistant straps required for strapping CS/ HDPE conduit with mainline at crossings of water bodies and other crossings.
- lxxviii. All spares for pre-commissioning and commissioning as required for all items supplied by Contractor for the entire pipeline system.
- lxxix. All materials, equipment and personnel required for videography and all associated works.

The item rates quoted for the execution of the work shall be inclusive of supply of all materials mentioned above unless specifically covered otherwise under schedule of rates. The quantities indicated in schedule of rates under Contractor's scope of supply are approximate. Contractor shall carryout MTO of all materials required based on IFC general arrangement drawings, P&IDs and firm up the actual requirement of materials. All escalation/ extra materials procured by Contractor for contingencies shall be Contractor's property and no payments shall be made for such materials. Payment shall be made for actual materials installed by the Contractor as a part of permanent installation.

- lxxx. Supply of PE valves & fittings of sizes from 125 / 90 mm.
- lxxxi. All PPE materials required for safe execution of projects.

**In case, any item is covered in scope of work but is not present in Schedule of Rates (SOR), it will be assumed that bidder has included cost implication of those items in their total price.**

### 7.3 STORAGE OF MATERIALS

- 7.3.1 All materials shall be preserved against deterioration and corrosion due to poor or improper storage while under the custody of the Contractor.
- 7.3.2 All materials shall be duly protected by the CONTRACTOR at his own cost with the appropriate preservatives like primer, lacquer coating, grease etc. and shall be covered with suitable material to prevent them from direct exposure to sun, rain, wind and dust.
- 7.3.3 Whenever applicable, pipes shall be stacked according to the identification marks and stacks shall be arranged on sleepers/ sand pads at least 300 mm above ground.
- 7.3.4 The CONTRACTOR shall check that valves, fittings, specials etc. are not subjected to corrosion from hydrostatic test water remaining in the packing. Any such condition when detected should be brought to the notice of Engineer-in-Charge and remedial measures taken as directed.
- 7.3.5 All machined surfaces shall be properly greased and should be maintained and protected from damages.
- 7.3.6 Openings of equipment, machinery, valves etc. shall be kept blocked/ covered with blinds to prevent entry of foreign matter.
- 7.3.7 As far as possible materials shall be transported to the site of erection only just prior to the actual erection and shall not be left lying around indefinitely on ground but kept on packing/ sleepers etc. to maintain the minimum distance from the ground as specified and/ or as per directions of Engineer-in-Charge.
- 7.3.8 Client reserves right to unload line pipe directly in the store on contractor. Contractor shall maintain store yard accordingly and shall submit their price considering factor of the same. Client shall not pay any extra cost to Contractor for loading & unloading the contractor's store or elsewhere for handling of Line pipes

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### 8 SCOPE OF WORK AND SCOPE OF SUPPLY FOR OTHER DISCIPLINES

Detailed scope of work and scope of supply covered in this document given above is pertaining to pipeline laying and associated pipeline terminal/ station piping works only. Detailed scope of work related to civil, architectural, structural, Cathodic protection, corrosion monitoring system, electrical, instrumentation, telecom, firefighting, and water supply works are covered in separate documents in detail and the same are enclosed elsewhere with the Bid document. All these documents shall be read in conjunction with this document and shall form an integral part of the overall Scope of work of the Contractor(s).

### 9 OTHER CONDITIONS OF BID

#### 9.1 Basis of Work

**All piping/ pipeline works shall be carried out as per following:**

- a) Approved for construction Piping General Arrangement Drawings (GADs).
- b) Approved for construction Alignment sheets/ crossing drawings.
- c) Piping Material Specifications.
- d) Specifications
- e) Piping support standards/ drawings and support index.
- f) Any other drawings/ sketches prepared by Company and/ or by the Contractor and approved by the Company

#### 9.2 Topographic Survey

- The alignment sheets including plan and ground profile details, details of various crossings shall be provided at site for contractor's reference and information only.
- It shall be the Contractor's responsibility to verify the pipeline routes. Wherein Contractor's opinion the survey and investigation data is not found to be sufficient in detail, it shall be the responsibility of the Contractor to collect/ arrange and provide such topographic surveys.
- Further, successful contractor(s) after award of work shall immediately carry out topographic survey and geotechnical investigation of all crossings other than those provided by the company in the pipeline route and prepare crossing drawing for each crossing. The drawing shall be submitted for Company's approval. IFC alignment sheet shall be issued based on the input of above crossing drawings.
- The formats for crossing drawing to be used are enclosed with the bids. Contractor shall also incorporate the crossing details in the as built alignment sheet after completion of work.
- Contractor shall also perform any additional topographic surveys and geotechnical investigations that may be required for local detours or at crossings or at any other location during execution of the project without any extra cost to the COMPANY. Pipeline alignment shall be marked on village maps by CONTRACTOR wherever detouring is beyond existing

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ROU. CONTRACTOR shall be deemed to have considered such eventualities while formulating his bid.

- It shall be the responsibility of the Contractor to re-establish the route from the survey data made available by Company. Contractor shall maintain and preserve survey monuments (staked on ground) such as bench marks and intersection points, till construction is completed.

### 9.3 Alignment Sheets and Station Drawings

- Surveyor Alignment Sheets and crossing drawings shall be provided at site. The details of class location, crossings details are separately enclosed. These drawings/ details are indicative only and are furnished to enable to estimate the quantum of work and to quote a firm price for the work.
- Final drawings marked "Issued for Construction (IFC)" shall be furnished by COMPANY to CONTRACTOR at project execution stage after submission of crossing drawings by the Contractor as per mentioned elsewhere in the bid.
- Typical station drawings are also included in the Bid package. These drawings are marked as "Tender Purpose Only".
- The IFC (Issued for Construction) drawings issued during project execution stage may vary from the drawings included in the Bid Package. CONTRACTOR shall carry out all works in accordance with these IFC drawings at no extra cost to the COMPANY.

### 9.4 Description of pipeline Route

#### I. Route Description

- The number of crossings and features along the pipeline route described in survey report are approximate. CONTRACTOR shall not be entitled for any compensation in terms of time and cost in case of variation in the above. Contractor shall verify the above data and carry out pipeline installation works without any extra cost & time to COMPANY.
- Most of the areas the Pipeline network shall be laid along the road/ industrial area and residential area. The ROU shall be restricted in all along the pipeline network Route.

### 9.5 Soil Investigation and Soil Resistivity survey

COMPANY has carried out soil investigation (visual classification/ stratification) and resistivity survey along the entire pipeline route. Data collected from such, shall be provided at site. Such data is issued to CONTRACTOR for his reference purpose only. It shall be Contractor's responsibility to verify the data and satisfy himself regarding accuracy and utility of data. CONTRACTOR shall carry out any additional soil data/ investigation required for installation. CONTRACTOR shall not be entitled for any compensation in terms of time or cost in case of any variation in actual site conditions from the data furnished in the bid package. **It shall be Contractor's responsibility to familiarize himself with sub-soil conditions along the pipeline route and workout the lengths of pipeline to be laid**

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**in different subsoil conditions including the quantum of rock excavation that would be necessary. Unit rates quoted shall also be inclusive of all rock excavation. No extra compensation shall be payable to CONTRACTOR for any rock excavation whatsoever.**

### 9.6 Pipeline ROU

Contractor shall carry out construction work within the width of pipeline available ROU as made available to them with no time and cost implication to the Company. The Contractor shall arrange any additional ROU requirement for construction purposes. It shall be Contractor's responsibility to make arrangement for any additional land required for fabrication, construction, storage, and all other work areas. In certain restricted areas such as private holdings, congested and plantation areas etc. ROU is restricted. In forest areas only 10 m ROU will be made available to the contractor. Contractor shall propose suitable execution methodology and time schedule for construction/ execution of work at areas of restricted ROU and deploy adequate equipment& manpower etc. as required. Contractor shall also arrange additional land during installation of Pipeline by HDD. Damages, if any, to existing pipeline and facilities shall be Contractor's account. Wherever the detouring is carried out beyond ROU during pipeline installation, the detoured pipeline alignment shall be marked on village maps by the pipeline installation Contractor.

### 9.7 Pipeline Passing Through City Area and Along NH/ SH

In case the pipeline passes through city areas, it will be laid generally in the carriage way. Wherever it is not possible to lay the pipe line on the carriage way for any reason whatsoever, the pipeline will be laid on service road / footpath. It will be the responsibility of the Contractor to identify all the underground utilities after surveying the area along the gas pipeline route and lay the pipeline with clear distance (as specified in Specification) from other existing utilities like cable, water pipeline etc. In case of hydrocarbon pipeline the clear distance shall be as specified in Specification.

### 9.8 Restriction of ROU

- In congested urban/industrial areas where the exact location of the existing services (aboveground as well underground) is not known, the contractor shall contact the concerned authorities to get the permission to cross the existing utility including approval of the final alignment of the pipeline before commencement of work. Contractor shall obtain the Digging Permit from the respective authority. In addition to this acquisition of NOC from the respective utilities' companies will be also in the scope of the contractor.
- In most of the areas, the Pipeline shall be laid along the road and residential/ Industrial/ city area. The ROU shall be restricted in the entire pipeline Route. Contractor shall consider all these eventualities while bidding. It shall be Contractor's responsibility to make arrangement for any additional land required for fabrication, construction, storage and all other work areas. Contractor shall carry out construction work with in the width as available to him. Damage to any obstruction, temporary/permanent structure, boundary walls etc.

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shall be repaired and restored and shall be to Contractor's account.

- The Contractor must ensure that during laying of the pipeline minimum damage occurs to the land. The land has to be restored to original condition. All construction activities shall be in accordance with the local Government regulations.
- During pipeline construction, measures shall be adopted in order to minimize the impact of pipeline construction activities on the environment.
- In case contractor wishes to propose any detour from the acquired alignment due to constructability problems or otherwise, he may be permitted to do so only after explicit approval from the Company. All immediate measures for taking the land and compensations to land owner(s) shall be to Contractor's account. Company shall proceed with regular notifications etc. in due course. All statutory fees shall be paid/ reimbursed by Company. However, such activity shall not affect the construction schedule and overall completion period. In many areas due to pipeline being laid in ROW of NH/ SH areas and due to several underground obstacles encountered during construction, mechanical trenching may not be possible. In such cases Contractor shall perform the work by manual means without any Cost as well as time implications.
- The contractor shall finalize the alignment of pipeline by making the trial pits at regular intervals to ensure the location of existing underground utilities.
- In urban/ Industrial areas where there are numerous underground utilities, the cover of 1.2m /1.5 m may not be sufficient; Contractor will not raise any compensation for any such necessary deepening. Due to deepening of trench, it may be required that shoring of trench may be required to avoid collapse of the same along the road. The same shall be done by the contractor without any cost implications.
- Due to restriction by statutory authorities, the Contractor may not be allowed to work during monsoon season. Thus, for such areas the contractor shall plan his work accordingly and submit his schedule to relevant authorities without any time as well as Cost implication.
- In city areas where, due to restrictions by the statutory authorities, the movement of heavy machinery is not allowed, the laying /Construction activities shall have to be carried out manually. Only tire mounted equipment such as Hydra/ JCB etc. will be permitted with consent of the concerned authorities.
- Contractor may plan to work in the Night shift to avoid traffic and in residential/industrial/city areas to keep minimum disturbance during day time. But Contractor has to plan and take approval from Engineer In charge/ Client and Concerned Authorities before start of construction. Contractor to arrange all lighting and safety precaution for the same.
- The authorities may impose stringent conditions for laying the pipeline in certain areas like limited length of working section, night work shift only etc. Thus, the contractor must submit his working methodology to relevant authorities in order to obtain the necessary permission for laying the pipeline prior to commencement of work.
- Due to non-mobilization of the heavy machinery and due to underground utilities, the welding of long pipe string above ground and lowering may not be possible, therefore

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welding may need to be carried out in the trench by making bell holes for individual pipe or small sections of pipe.

- To comply with the agreed work schedule, the contractor may work in shift or extended hours.
- The Contractor shall be deemed to have taken into consideration all variations as mentioned above at the time of formulating his bid and no extra compensation either by way of time or cost shall be admissible.

### 9.9 Particular Instructions

- In Principle all statutory permissions from all concerned shall be obtained by Client. However, all activities related to liaison, co-ordination etc. with all authorities needed to achieve the work as per schedule will be under Contractor's scope including taking work permit/ Digging Permit before commencement of work. Contractor shall also inform and seek necessary permission from the local traffic police before commencement of trenching work.
- For access route to the working strip, the Contractor will be responsible to negotiate with the relevant owner, tenant, or authorities. Any deemed compensation will be borne by the Contractor.
- The contractor shall be responsible for overall entire quality control activities for the present project.
- Contractor proponent shall have to take prior approval of concerned Government agencies while carrying out blasting wherever required.
- Contractor proponent shall have to take preserve top soil dug and shall be restored to original condition on completion of the work.
- Owner shall obtain permission from the Forest department. However, required assistance to get the permission from the respective authorities, necessary liaison, co-ordination etc., with the authorities needed to achieve the work as per schedule including taking work is in the Contractor's scope.
- While carrying out the laying activities any damage to other utilities to be repaired by the contractor to the full satisfaction of the utility agency. Any claim arises out of damage of other utilities shall be borne by the contractor.
- Contractor proponent shall construct the pipeline and other infrastructure and adopt safety measures as per the standards & specification laid down by the concerned agencies from time to time.
- Contractor proponent is required to comply with the manufacturing, Storage and import of Hazardous Chemicals Rules -1989 framed under the Environment (protection) Act 1986.
- On completion of all temporary work structures, surplus materials and wastes shall be suitably disposed of.

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- Similarly, any additional conditions issued by statutory authorities will also have to be complied with by the contractor without any cost implications.

### 9.10 Preparation of Construction Site

The overall duration of the works at every point of the pipeline route, from the opening of the working area to lowering of pipeline and trench backfilling shall not exceed the permit condition of relevant authority.

### 9.11 Working Strip

No ROU exist for the city portion line along the authority land. Working strip may be available along the road side for the construction site. Contractor should deploy suitable equipment and adopt his working methodology accordingly.

### 9.12 Reducing The Working Strip

Contractor shall not be compensated for any reduction in the width of working strip.

### 9.13 Reverse of The Working Strip

No fencing of any kind along the pipe route is essential to be provided. However, it remains the responsibility of the Contractor to barricade the area of open trenches so that no untoward accident takes place.

### 9.14 Excavations (underground obstacles)

In congested area or if deemed necessary by Owner's Engineer or concerned authorities where numerous utilities may be encountered the contractor should carry out the excavation manually without entitlement of any compensation.

### 9.15 Reinforced Concrete Slabs as Mechanical Protection for the Pipe

Crossing of utilities will be done by invariably going below the utilities maintaining a clear gap of minimum 30 cm except hydrocarbon pipelines. From hydrocarbon pipelines, clear gap of minimum 50 cm shall be maintained. If due to site constraint it is not possible to lay the pipeline as per the above cover requirement, Contractor shall initiate the proposal for approval of Deviation and obtain written permission from EIC.

### 9.16 Markers

Pipeline Warning Markers shall be installed at each and every Kilometer. Apart from this, additional warning markers shall also be installed at each side of highways (NH/SH), major district roads (MDR), all metaled roads, railway crossings, water body crossings, any other

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major crossings and at entrance to stations.

For urban Agglomeration (UAs) / Towns having a population of 1 lakh or more, the warning marker shall be installed at least at every 50 meters and if required additional markers shall be installed where there is possibility of damage or interference.

Pipeline Warning Sign shall in general be installed at

- National and State Highway Crossings (2 Nos.)
- Other Road Crossings (1 No.)
- Railway Crossings (2 Nos.)
- Minor Water Crossings (less than 15m width) (1 No.)
- Minor Water Crossings (above 15m width) (2 Nos.)
- Major Water Crossings (2 Nos.)
- Valve Station (1 No.)
- And at any other location as shown in the approved drawings and as directed by the COMPANY.
- Pipeline Warning Sign shall identify the existence of the pipeline

**Aerial markers** shall in general be installed along the pipeline at every 5 kilometer's interval and at places specified by COMPANY. The aerial kilometer marker having the warning details can also be treated as warning marker.

**Kilometer markers** shall in general be installed at every one (1) kilometer interval along the pipeline route and in place of every fifth kilometer marker, aerial marker shall be provided. The Aerial/ Kilometer Markers having the warning details can also be treated as Warning Marker.

**Right-of-Way/ boundary markers** shall be installed along entire network at a maximum spacing of 100 meters in urban area & 200 meters within industrial parks for steel mains. These shall be installed on either side of the pipeline alignment to define the ROW boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROW limits. In urban agglomerates (UAs)/ towns having a population of 1 lakh or more, pipeline route marker shall be installed at least at every 25 meters.

Additional warning signs or markers shall be installed to indicate the presence of a pipeline at road, highway, railroad, stream, canal, nala crossing and other locations where there is a possibility of damage or interference.

### 9.17 Directional Markers

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Direction markers shall be installed to identify the significant turning points of the pipeline during aerial traverse. One direction marker shall be installed at each turning point. In addition, direction markers shall also be installed along the pipeline alignment at 150 m upstream and downstream of turning points.

### 9.18 Excavated Materials

- The excavated material shall be placed in such a way as to avoid any inconvenience to property owners, or interference to the circulation of pedestrians or vehicles as well as to the operation of near-by installations. The excavated material shall be piled up in such a way that they enable the watering of the trees. No excavated material shall be piled up in the road crossings. It may be insisted upon by the authority to remove all the excavated materials immediately after trenching.
- To prevent the excavated stone and earth from falling into the trench, a strip
- 20cm shall be left clear between the edge of the trench and the bottom of the pile of excavated earth. This width may be increased, according to the nature of the ground and the atmospheric conditions.
- Wherever necessary, the contractor is required to remove the excavated material from the site and to be kept at a dump yard until the trench is to be back filled and to be brought back to the site for backfilling.
- When the excavated material is judged by the Engineer to be unsuitable for re-use, the Contractor shall remove it from the site as the digging of the trench proceeds and shall supply in its place suitable material approved by the Engineer-In-Charge.
- Contractor is required to arrange the steel plates (preferably 1.5 meters wide x 20mm Thk.) to place on the excavated trench for smooth movement of traffic.

### 9.19 Signaling, Fencing & Lighting

- Each site shall be provided with an identification board mentioning the reason for the work and the names of the Company, the Contractor, and the Consulting Engineer, as stipulated in the special specifications.
- At both ends of the trench, the Contractor shall install 2 traffic and warning signs, and Display board one immediately close to the trench and the other ahead, as required by the Engineer-In-Charge.
- The Contractor shall install lights and warning lights around all working areas, in accordance with the special specifications. The voltage shall conform to the safety regulations in force.
- The Contractor shall install barricading and lighting of all trial-holes, trench sections and other excavations.
- The Contractor shall provide watchmen wherever deemed necessary for the safety of the public and of the workers, in particular as regards working sites, on site material stockage, temporary dumping yards, etc.

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### 9.20 Barricading

- The contractor shall provide the barricades of size 2m wide X 1.5m high of wooden/plastic/steel with necessary supports along the open trenches to protect/caution the public about the digging work without any cost to owner. The barricades shall be painted as per the requirement of authority with the owner's/Consultants/Contractor's details, job being carried out, cautions, inconvenience captions, etc. also needs to be provided.
- Contractor shall Excavated trench & pits in residential area, area near heavy traffic and other areas for kept for movement of animals, shall not be left open without barricading. Contractor shall consider all these eventualities while bidding.

### 9.21 Site Visit

- Bidders are advised to make site visits for complete pipeline network route to establish the route, missing survey stones and familiarize with the working conditions familiarize themselves with all the salient features of subsoil, terrain and available infrastructure along the pipeline route so as to plan for deployment of man and machinery. Contractor shall be deemed to have considered all constraints and eventualities on account of site conditions along pipeline route while formulating his bid. Contractor shall not be eligible for any compensation in terms of cost and/ or time, on account of site conditions along pipeline route varying to any extent from whatever described in the Bid Package and the survey/drawings/data furnished along with the Package.

### 9.22 Line Pipes & Coatings

#### Taking Over of Pipes

COMPANY shall supply bare, externally corrosion coated with 3-layer polyethylene coating and internally epoxy coated line pipes. Contractor shall receive and take over the pipes progressively as per construction requirements at designated place of issue in presence of Company's representative. At the time of taking-over, Contractor shall perform inspection of pipes and pipe coating for all defects in the presence of Company's Representative. COMPANY shall be liable for repair defects and damage to pipe coating noticed at the time of taking over. However, installation Contractor shall repair all defects to pipe and pipe coating occurring after taking over including those during transportation and handling. Rebuffing for dents (in bevels) less than 1 mm in depth shall be carried out by Contractor ahead of welding in the field at no extra cost to COMPANY. Contractor shall take-over the entire quantity of bare and coated line pipe from storage yard after completion of installation works.

Return of surplus line pipe material to Company's designated storage yard is in installation Contractor's scope including loading, transportation, unloading, handling, stacking of pipes at storage yard and getting the pipes inspected to Company's representative at storage yard.

#### Repair of Coatings

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CONTRACTOR using suitable material compatible with parent coating system shall carry out any repairs to 3-layer polyethylene coating. The coating repair material and procedure for application shall be submitted to COMPANY for approval prior to start of construction.

Repair of PE coated pipes in field shall be carried out as follows in accordance with bid specification.

- i. Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2.0 mm and an area not exceeding 20 cm<sup>2</sup> shall be rebuild by heat shrink patch only and without exposing to bare metal.
- ii. Defects of size exceeding above mentioned area or holidays of width less than 300 mm shall be repaired with heat shrink repair patch by exposing the bare metal surface.
- iii. Defects exceeding the above and in number not exceeding 2 per pipe and linear length not exceeding 500mm shall be repaired using heat shrinkable

### 9.23 Statutory Permissions

The COMPANY shall obtain a general permission from the various authorities having jurisdiction over the area as necessary for construction of the pipeline. However, for some of the permissions, if not available, Contractor shall do the follow up with the concerned authorities to get the permissions to execute the job in time. However, all statutory payments required for such permissions shall be reimbursed by Company at actuals. CONTRACTOR shall obtain the necessary permits like work permit/ excavation permit/ trench opening permit etc. for all works from the authorities/local bodies having jurisdiction before the actual execution of various phases of the works and all stipulations/ conditions/ recommendations of the said authorities shall be strictly complied with at no extra cost to COMPANY. CONTRACTOR shall also obtain all necessary permissions from the concerned authorities (& local bodies if any) for installation of pipeline at railways, roads, water crossings and at places where blasting is required. COMPANY may, however, assist CONTRACTOR in obtaining such permissions, wherever required, by issuing recommendation letters etc. In case of damage to other utilities/ infrastructure, Contractor shall be responsible and the required compensation as per the directions of concerned authorities/ COMPANY shall be paid by the Contractor. After completion of work, Contractor shall obtain a certificate from the concerned authorities that the job has been completed as per their requirement and the area/ land has been restored to their satisfaction.

### 9.24 Controlled Blasting's

In case blasting is required for making of trench for laying pipeline, it shall be responsibility of the contractor to ensure safety of pipeline while carrying out blasting operations. The controlled blasting procedure shall be subject to approval of Company.

### 9.25 Environmental Restrictions

- The following measures shall be adopted during pipeline construction in order to minimize

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the impact of pipeline construction activities on the environment.

- While working in plantation areas, Contractor shall take due care to minimize the damage of trees. The number of trees felled shall be restricted to minimum based on working requirement for pipeline installation. In the paddy field area, Contractor shall exercise maximum care not to damage the crop outside the ROU. The compensation of damage of crop outside ROU, if any, shall be to Contractor's account. Damage to any obstruction, temporary/ permanent structure, boundary walls etc. within ROU shall be repaired, restored and shall be to Contractor's account.
- During ROU clearance, the vegetation shall be cut off at ground level leaving the roots intact to the extent possible. Only stumps and roots directly over the trench shall be removed for pipeline installation.
- Intake and discharge of water required/ used for line flushing and testing should not cause unacceptable environmental disturbance. During dewatering process, proper drainage arrangement shall be made to discharge the hydro-test water to avoid flooding of the nearby area.
- As far as possible, the contractor shall ensure that river and stream crossings are done during dry season to avoid disturbance of breeding grounds and soil erosion. The riverbed, embankments and dykes shall be restored adequately after installation of crossings
- The contractor shall exercise adequate care while working, in order to avoid damage to forests and wildlife.

### 9.26 Pipeline through Seismic Areas

The requirements specific to safety of pipeline against seismic activity:

- Backfill for pipeline trench at locations where the pipeline crosses the faults should be provided with loosely compacted (unit weight  $< 1.8 \text{ t/m}^3$ ) cohesion less soil for a distance of 1 km on both side of such crossings. The angle of friction of cohesion less soil to be used for backfilling should not be more than  $25^\circ$ . In case the dugout soil of the trench is clayey in nature (undrained shear strength greater than  $0.5 \text{ T/m}^2$ ), the local soil shall be replaced by engineered (cohesion less) backfill as mentioned in previous paragraph. Otherwise, the same dugout soil can be used as backfill. The recommended backfill shall be at least 600 mm thick all around the pipeline. Extra digging of trench shall be carried out to provide 600 mm cohesion less soil all around the pipeline.
- If the fault crossing zone, the pipeline is in rocky terrain, the following recommendation is made. When the pipeline is to be laid on a rocky terrain, the stones/ boulder/ rock dugout from the trench should be crushed such that maximum size of stone/ boulders is limited to 20 mm. The crushed stone should be mixed with locally available soil, before using as backfill. Alternatively, 150 mm sand padding shall be provided all around the pipeline before crushed boulders/ stones are placed over the sand padding. In this case the size of boulders can be increased up to 100 mm.
- A minimum gap of 100 m shall be maintained between two successive bends of the underground pipeline where the deflection angle is more than  $45^\circ$ . Rerouting shall be carried

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out in consultation with Company incase minimum gap could not be maintained.

### 9.27 Pipeline Burial

The pipeline shall be buried normally at a depth of 1.0 meter except river/ rail/ road/ canal/ water crossings/ paddy fields/PWD roads where cover shall be as given in design basis, Alignment sheet or as per the requirements of statutory/ local authorities whichever is more stringent. Increased wall thickness (as indicated in alignment sheets) and cover shall be provided at critical locations and at crossings.

The pipeline, in general shall be laid underground with minimum cover as provided in design Basis.

### 9.28 Crossings

For all rails, road, canal, river & other water crossings, Contractor shall liaison with relevant authorities and intimate them well in advance about the schedule and methodology of crossing. It shall be obligatory on the part of the laying Contractor to ensure that Authorized Representative of the authority under whose jurisdiction the crossing falls should be made available at site by the Contractor at the time of making crossing. After completion of works and complete restoration of ROW, Contractor shall provide NOC from the relevant official pertaining to complete restoration to their satisfaction and certification in respect of no other damage caused to their property outside the earmarked ROW.

### 9.29 Railway Crossings

**In case of permission by Boring:** Pipeline at railway crossings shall be provided with a casing pipe. The casing pipe shall be three nominal pipe sizes larger than carrier (unless advised otherwise by concerned authorities) and shall be installed by boring/ jacking/ HDD/ ramming. Internal of Casing pipe shall be coated with two- component epoxy coating wherever required by statutory authorities. It should be noted that the extent of casing pipe generally specified by Railways is 14.0 m beyond centerline of the outermost tracks on either side or 0.6 meter beyond the ROU/ROW limits of Railways on either side, whichever is more. Carrier pipe shall be electrically insulated from the casing pipe and casing ends shall be sealed using durable, electrically non-conducting materials. The crossing drawing shall be subject to approval of concerned Railway Authorities prior to implementation. The railway crossing shall comply with the requirements of API 1102 and Indian Railways regulations. The crossing angle shall be as close to 90° as possible. Cover of casing pipe for railway crossings shall be minimum 1.7 m wherever railway track is on embankment. Care shall be taken to isolate the pipeline crossing installation from aerial electrical wires and shall be suitably insulated from underground conduits carrying electrical wires. The casing pipe shall be provided with minimum 50 mm diameter vent pipe. Casing vent pipe shall be at least 1.2 m away vertically from aerial electrical wires and shall be suitably insulated from underground conduits carrying electrical wires on railway land. Casing pipe should be so placed and oriented so as to prevent any leakage inside railway boundary except through the vent pipes. The casing pipes shall be installed with even bearing throughout the length

**In case of permission by HDD:** If railway authority grants permission for crossing of railway by HDD method, pipeline shall be laid at least 7 m below the ground level throughout

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the railway land width embankment and also at least 7m below formation level in cutting throughout land width.

Further, as per railway Guideline on Pipeline Crossing under Railway track, in case of pipelines carrying gas, Railway operations should be considered equivalent to Location Class 4 for design of carrier pipe thickness. Design factor of 0.4 shall be used for calculating wall thickness of carrier pipes within railway land and up to a distance of risk radius outside the railway boundary (ROU/ROW) on either side.

### 9.30 Road Crossings

- The method of crossing of roads such as open cut/ trench-less shall be firmed up by CONTRACTOR in consultation with concerned authorities and COMPANY. The CONTRACTOR shall also take due care to identify and take due precautions so as not to disturb or damage the utilities like cables, water lines, and other structures.
- After laying the pipeline in a road crossing by open cut method, the CONTRACTOR shall completely restore the road to its original condition.
- While laying the pipeline in road crossings by open cut method the CONTRACTOR should ensure that the traffic is not stopped during the execution of work. This may be done by cutting half of the road at a time so as to enable the traffic to pass on the remaining half of the road. Alternatively, the CONTRACTOR can provide diversion roads to maintain the flow of traffic. For NH crossings, traffic of both sides shall not be disturbed.
- The CONTRACTOR shall provide proper caution boards during daytime and danger lights during night time when the cutting operation of the road is going on.
- For cased crossings, the pipeline should be taken through the casing pipe, the top of which should be at least 1.2 meters below the road top as specified or as per the requirements of the local authorities, whichever is higher. Casing pipe shall extend min. 600 mm beyond Road ROU/ROW on either side. The casing pipe shall be installed by trenchless method like boring/ jacking/ HDD. The casing pipe shall be three nominal pipe sizes larger than carrier pipe. The crossing angle shall be as close to 90° as possible. Casing insulators and end seals shall be provided to ensure electrical isolation of carrier pipe and casing pipe.
- For National Highways/ state highways, crossing shall not be too near the existing structure on the NH maintaining a minimum distance of 15 meters or as specified by Highway Authority.
- The National Highway crust shall be built to the same strength as the existing crust on either side of the trench or to thickness and specification stipulated by Highway Authority. Care shall be taken to avoid the formation of a dip at the trench.

### 9.31 Canal/Drain/Minor Water Crossings

- Canal and other water crossings shall be carried out by open cut/ trench-less technology method. CONTRACTOR shall firm the method of crossing in consultation with concerned

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authorities and COMPANY.

- HDD method shall be adopted for river/water/ canal crossings that are specifically mentioned in this document or decided at site by Engineer-in- charge. These crossings shall be installed and paid separately as per schedule of rates.
- No damage should be caused to any irrigation sources, while laying the pipeline through canal crossings.
- The flood banks of the River/ Canal should be brought to the original condition, if they are damaged by the laying of the pipeline. Stabilization of banks shall be carried out as per requirements of concerned authorities.
- The detailed construction methodology/ plan and time etc. shall have to be finalized by CONTRACTOR in consultation with concerned authorities having jurisdiction over canals/ rivers. COMPANY shall provide assistance by providing introductory letters.

### 9.32 Existing Pipeline Crossings

The specific requirements of Owner / operator of existing pipeline shall generally be followed. The minimum clearance between the lines shall be 500 mm below existing pipeline unless specified otherwise.

### 9.33 Pipeline in Forest Area

- Contractor shall restrict the pipeline laying activities within the ROU acquired. No additional land in forest area shall be used. Contractor shall clear only the minimum width required for laying of pipeline. Number of trees/ plants felled shall be kept a minimum based on construction requirements. ROU width in forest area is 10 m. or less.
- Full care shall be taken to ensure that no damage is caused to the adjoining forest area while carrying out the work. However, in case of any damage, Contractor shall be liable to pay suitable compensation as per requirements of Forest Department.

### 9.34 Installation of Conduits for Optical Fibre Cable at Crossings

- At all crossing locations (viz., rail, road, canal and minor water course crossings) the optical Fiber cable shall be installed inside a HDPE Telecom Duct to be installed by the CONTRACTOR.
- At all such crossings where the carrier pipe is installed by open-cut of the facility crossed, HDPE conduit shall be installed along with the pipeline for installation of the Optical Fibre Cable. At river crossings where anti buoyancy measures are provided for the carrier pipe, HDPE conduit shall be placed inside a CS casing pipe and shall be strapped to the mainline at 5m interval using high strength PE straps. Net specific gravity of pipe in empty condition should not be less than 1.2. In any case, OFC conduit shall not be installed in casing of carrier pipe.

### 9.35 Cathodic Protection Works

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- Temporary Cathodic Protection (TCP) of respective pipeline sections/parts shall be in the scope of the CONTRACTOR. However Permanent Cathodic protection works (PCP) will be carried out by different agency under different contract while the pipeline laying works are going on. For details of Temporary Cathodic Protection works, refer the enclosed Temporary Cathodic Protection Works attached elsewhere in tender documents.

### 9.36 Hydrostatic Testing

#### Pipelines

Hydrostatic testing of mainline shall exclude valves at terminals, SVs and facilities that are to be installed as a part of the scrapper stations. Temporary test headers shall be provided and the mainline shall be hydrostatically tested between the temporary test headers only. The highest point of the test section shall be subjected to the minimum test pressure as specified below. The minimum hydrostatic test pressure in the pipeline during testing shall be as follows:

#### 1.5 times Design Pressure

- The maximum hydrostatic pressure shall not however exceed the pressure required to produce hoop stress equal to 95% of SMYS of pipe material based on the minimum wall thickness in the test section. The test duration shall be 24 hrs. Hydro test shall be done with corrosion inhibitor, wherever required. Mainline valves shall be installed after successful completion of hydrostatic pressure testing. Station piping to be tested hydrostatically for minimum 6 hours at pressure of 1.5 times Design Pressure.
- The pipeline string of HDD crossing shall be pre-tested for min. 6 hours and post- installation testing for min. 24 hours at 1.5 times the design pressure.
- The pipeline string of 500 m. and above shall be hydro-tested (post- installation) as per mainline hydrotesting procedure.
- Control and instrumentation piping, actuators to be tested by Dry air or nitrogen at pressure of 1.1 x MOP (design pressure), test time- soaping time.
- In case any class location is upgraded due to requirements, the hydrotest pressure shall be governed by the actual class/ population density.
- Subsequent to separate hydro testing of pipeline and associated facilities, the Contractor shall carry out tie-in/ hook up. Pipes/ prefabricated assembly used for such tie-in shall be pre-tested to a test pressure specified for the pipeline. The Contractor at no extra cost shall provide all materials required for the fabrication of the test headers to Company. After successful completion of hydrostatic testing, the Contractor shall de water the pipeline as per the directions of Engineer-in-charge.
- For HDD, Pre-hydrotest, post-hydrotest and pipeline final hydrotest, contractor has to arrange soft water in view of alkalinity/ Salinity in the river water.

#### Dewatering & Swabbing

- It is envisaged that dewatering and swabbing operations shall be carried out as a part of

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pre-commissioning activities. Contractor shall take up dewatering of pipeline after hydrostatic testing only when Contractor is ready for swabbing operations. Till such time Contractor is ready to start pre-commissioning activities, the pipeline/ section of pipeline after hydrostatic testing shall be left filled with inhibited water. In case, if contractor proposes to dewater any test section for any reason depending upon site conditions (e.g., using test water for adjoining section due to nonavailability of water), the Contractor shall swab such sections as per applicable requirements of Contract and fill the section with nitrogen at a pressure of 2 bar (g) with residual content of oxygen less than 1% v/v at no extra cost to the company. In no case shall the pipeline be kept empty i.e., without nitrogen filling.

- Transfer of test water from one test section to another section may be considered, however dosing additional quantity of corrosion inhibitor shall be done.
- Disposal of water (hydro testing) shall be done by Contractor after seeking necessary permission from concerned authority/ land owner so that no liability on this account comes on COMPANY.

### Corrosion Inhibitor (Wherever applicable)

- The products to be used for corrosion inhibition of the water used for hydro testing and their dosage shall be as specified in Hydro test specification.
- Contractor (not the inhibitor manufacturer) shall get the inhibitor tested for corrosion inhibition and microbiological control efficiency from competent Govt/ PSU Laboratory. The test report shall be submitted to COMPANY for approval prior to undertaking hydro testing works. The dosage as recommended by COMPANY shall only be adopted. Necessary records for dosing of inhibitor should be maintained by the laying Contractor and such records should be handed over to COMPANY.

### Terminal Facilities

- Piping facilities between the insulating joint and hook up point/ battery limit, sectionalizing valve stations and all above ground facilities installed by Contractor shall be hydrostatically tested to a test pressure equivalent to **1.5 times design pressure** as per "Flushing and Testing of Piping System" enclosed with the Contract document. All valves in the piping network being hydro tested shall be kept in the crack open position. Holding time shall be minimum **six hours**.

### Preservation

- **The positive pressure shall be maintained at 2 bar (g)** in the pipeline during preservation. The necessary arrangements like valves, fittings, manpower etc. shall be kept for maintenance of pressure in the pipeline during idle time.

## 9.37 Direction of Construction

- The direction of construction shall be in the direction of flow, unless specified otherwise. In case the contractor proposes to carry out construction in direction opposite to direction of flow, the contractor may do so at no extra time and cost to Company and subject to Company Approval.

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### 9.38 Leak Detection

- CONTRACTOR shall submit a detailed procedure for leak detection during hydro test. Such method of detection shall consume minimum possible time to complete the hydro test activity within contractual completion schedules. This procedure needs approval of the Engineer-in-charge.
- All works for locating and repair of major leak/ burst attributable to COMPANY (occurred during hydrostatic testing) including necessary repairing/ replacing/ cutting and removing out defective pipe length as defined in the specification and shall be payable as per relevant items of schedule of rates.
- All works for locating and repair of minor leak attributable to COMPANY (occurred during hydrostatic testing) which require sectionalizing of pipeline shall be payable as per relevant items of schedule of rates.
- Contractor shall carry out repairing/ replacing of defective pipe length including cutting and removing of defective pipes, pre testing of replacement pipe for 24 hours and welding into main line, NDT of the welds, coating of the weld joints, clean up, re-testing of pipeline including providing all equipment's, manpower & consumables.

### 9.39 Magnetic Cleaning, Caliper Pigging

- The individual contractor shall carry out magnetic cleaning and caliper pigging of the pipeline system being installed by him. Contractor shall engage a specialized agency that have previously carried out such operations (magnetic cleaning and caliper pigging) and shall develop procedures, supervise and monitor the entire operations, coordinate with other Contractor(s) as required. Rectification of defects observed during caliper pig run, shall be carried out by individual section/part contractor including digging, cutting, replacement, repair, welding, NDT etc.

### 9.40 Pre-Commissioning and Commissioning assistance of Pipeline

- Pipeline Contractor shall be responsible for pre-commissioning and commissioning assistance of the pipeline system being installed by him. The above shall include P&ID checks (with respect to requirement of design/ operation/ safety and interlocks of latest revision of P&IDs), flushing, tightness test, de-watering, as required and supply of consumables required during pre-commissioning and commissioning assistance. Contractor shall supply manpower, materials, equipment including consumables along with necessary piping and instrumentation connections for monitoring flow rate, pressure, temperature etc. temporary venting along with necessary piping, valves, and instrumentation as well as consumables.

### 9.41 Commissioning

- Contractors shall mobilize all equipment, consumables, and manpower for carrying out pigging, drying, inertization and commissioning activities.
- Whenever required, contractors shall provide commissioning assistance to other section/part contractor.

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- Contractors shall engage a specialized team/ agency who have previously carried out such operations and shall develop procedures, supervise and monitor the entire operations, coordinate with other Contractor(s) as required till the time commissioning operations are completed. Contractor shall mobilize all equipment, materials, consumables including pigs, nitrogen, and manpower etc. for commissioning activities. All necessary piping connection as required shall be carried out.
- Commissioning activities shall be carried out as per applicable specifications enclosed with Contract.

### 9.42 Priorities

- COMPANY may, at its sole option, assign priority of construction to any part of the total pipeline or terminal works. Contractor shall comply with such priority of execution without any time and cost implication to the COMPANY.

### 9.43 Terminal Piping Works

- The construction work shall be carried out based on Issued for Construction (IFC) drawings issued to Contractor at the time of construction. The final IFC drawings issued during execution stage may vary to some extent from the drawings included in the Bid Package. CONTRACTOR shall carry out all works in accordance with the IFC drawings and reference specifications/ documents with the Contract at no extra cost to the COMPANY.
- The piping fabrication, erection, welding, flushing and hydro testing and painting works shall be carried out as per standard piping specifications enclosed with Contract. The hydro test duration shall be minimum 6 hours.

### 9.44 Working in Areas of Existing Facilities

- For pipeline installation work within existing terminal facilities which are under operation, Contractor shall obtain all necessary permissions for working in/ around the facility including hot work permit as applicable and shall be fully responsible for the safety of the existing facilities/ areas during all phases of work and shall fully abide by and comply with the restrictions and conditions of COMPANY/ concerned authorities imposed on Contractor from time to time. Providing all safety appliances, gas detectors required during execution of the work, arranging of adequate firefighting equipment viz. fire brigade, fire extinguisher, shielding from existing facilities, oxygen mask etc. for carrying out the work safely to the satisfaction of COMPANY shall be done by the Contractor.
- Contractor may be permitted to work for limited hours in such places. For working on Sundays/ Holidays, the required permission may be obtained well in advance. During any emergency, work shall be suspended till further permission is obtained by Contractor. Idle period in case of interruption shall not be compensated to Contractor.
- The structure/ electric poles/ telegraph poles existing in the vicinity of proposed pipeline shall be properly taken care so that the stability of structure is not affected during construction.

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### 9.45 Contractor Responsibilities

- Appraisal and taking cognizance of site-conditions, pipeline route, Central Government/state Govt. rules and regulations/ bye-laws, applicable Indian Standards and Codes, authorities having jurisdiction over the work site(s), environmental and pollution rules and regulations including conditions/ stipulations laid down by the concerned authorities etc. The CONTRACTOR is deemed to have recognized any restrictive features and constraints of the site(s), pipeline route and/ or specific requirements of the work and made due allowance for it in the work to be performed by him. Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction fronts, fully equipped and fully manned with other required support facilities etc.
- An onsite – offsite emergency plan shall be prepared and submitted to Disaster Management Authorities under intimation to respective state authorities.
- Company shall provide the available information and survey data along pipeline route and crossings. Company gives no guarantee or warranty as to the accuracy or completeness of the information provided. It is the Contractor's sole responsibility to obtain sufficient information / data along pipeline route and crossings to allow safe and sound design and installation of the proposed pipeline.
- Interpretation and verification of data/information furnished by Company in respect of pipeline route surveys, crossing details, contained in the bid package. Any additional information/data/surveys etc. required by Contractor for detailed engineering and execution of the works shall be obtained by him. Company may assist him in obtaining such information/ data by issuing recommendatory letters.
- Entire design and detailed engineering including drawings and installation procedures, engineering for procurement & fabrication, engineering for installation including drawings, QA/QC procedures, etc. performed by the Contractor for complete pipeline system shall be reviewed and approved by Company. Contractor shall submit six sets of design/detailed engineering documents, drawings, procedures Company's review and approval. All works shall be executed based on approved documents only.
- Provide office and office support services/facilities for Company's Personnel at Contractor's design office for design review and approval of documents as per the requirement of the bid package.
- Review and approval of Contractor's entire work(s) by Company shall in no way relieve the Contractor of his sole responsibility for safe and efficient design, engineering, installation, and subsequent operation of pipeline system.
- Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction spreads, fully equipped and fully manned with other required support facilities etc. commensurate for spreads needed for successful execution of the works.
- Contractor shall depute independent third-party inspector for carrying out radiographic inspection/ UT and interpretation of radiograph/ UT of welds. Third party inspector shall be approved by Company.

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- Pre-commissioning/ commissioning of entire pipeline/piping system.
- Preparing and furnishing calculation books, pipe books, material/ purchase requisitions, final purchase orders including specifications, Vendor's data books (including Guarantees), fabrication and construction drawings, all survey reports, inspection and testing reports, as-built records for all phases of work.
- The Contractor is cautioned to exercise extreme care and take necessary precautions to prevent damage to the existing pipeline(s), facilities, electrical and other cables during execution of the entire works. Restoration/reconstruction of all structures/ facilities affected during pipeline construction shall be carried out by Contractor.
- Wherever Contractor comes across water lines/open channels/drains in the fields used for cultivation, suitable arrangements similar to or higher specs. than the existing type shall be made by the Contractor for ensuring water supplies across the fields and maintain the same till construction is completed in that stretch. Any claims arising out of non-compliance to the above requirements, as granted by competent authorities shall be to Contractor's account.
- Contractor shall carry out all testing and inspection of materials, equipment etc. in independent testing institutions, laboratories, if so desired by Company.
- Disposal and treatment of treated hydro-testing water, excavated materials and surplus materials etc. as per local authority's requirements.
- Any other work not specifically listed but required for successful completion of entire pipeline system

### 9.46 Technical Requirements

The technical requirements for the pipeline laying as well as terminal works as defined herein shall be read in conjunction with Schedule of Rates, specifications, standards, drawings and other applicable documents enclosed with the Bid document. All piping/pipeline works shall be carried out as per following:

- Approved for construction Piping General Arrangement Drawing (GADs).
- Approved for construction Alignment sheets/crossing drawings.
- Piping Material Specifications.
- Specifications.
- Piping support standards/drawings and support index.

## 10 AS BUILT DOCUMENTS

On successful completion of hydrostatic testing, the Contractor shall prepare As Built drawings/ reports for entire pipeline/piping system as specified in scope of work. All "As Built" drawings / reports shall be submitted as below.

### Main Pipeline

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- As laid alignment sheets and crossing drawings/details.
- As built HDD crossing details, as applicable.
- Details/ Drawings of Sectionalizing Valve (SV) stations.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints packed kilometer wise in separate card board boxes in one set.
- Pipe and calculation books/records.
- All inspection & testing documents.
- All purchase specification & procurement documents
- All piping GA drawings and supports at terminals.
- Installation and testing reports.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints.

Above list is minimum requirement.

Contractor shall prepare all documents as per the requirements indicated in Specification for Documentation for Pipeline Construction enclosed with the Contract document. In addition to the hard copy, three copies of final documents shall also be submitted in electronic media i.e., CD ROM/ DVD ROM diskettes and USB drive. Software used for the presentation of these documents shall be as follows: Type of document Software

- Reports MS Office (Word / Excel)
- Drawings AutoCAD

For the purpose of preparation of as-built drawings, Contractor shall update the "Issued for Construction" drawings provided by the Company. For drawings where electronic copies are available for IFC drawings, Contractor shall provide as built drawings in electronic form as well as in hard copies. Where only hard copies are available for IFC drawings, Contractor shall prepare and submit as built drawings in hard copies.

### 11 DOCUMENTS TO BE SUBMITTED AT TIME OF BIDDING

No technical documents are required to be submitted at the time of bidding. Bidder is advised to comply with all requirements of Bid document without any deviation. Company reserves the right to reject any bid with deviation without making any reference to the Bidder.

### 12 DOCUMENTS, SPECIFICATION, STANDARDS AND DRAWINGS

- Owner shall furnish piping and instrumentation diagrams (p & i d), preliminary plot plan along with the tender. Owner shall also supply design & engineering drawings and construction drawings including general arrangement drawings for piping, mechanical & instrumentation systems and other related/ required systems, at appropriate times and as requisitioned by contractor in his time schedule.

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- Contractor shall prepare isometric drawings & bill of materials and submit the same for owner/ consultant's approval/ record. Contractor shall prepare drawing for utilities line as required as per SOR and submit the same for owner/ consultant's approval/ record.
- No construction small or big shall be carried out without proper construction drawings duly approved by owner's engineers or site office or owner's representative duly authorized to do so. For mainline, route survey alignment sheets and crossing survey details shall be furnished along with bid by owner. However, detail-crossing drawings with crossing methodology shall be submitted by contractor for prior approval. Any additional survey and data required to complete above should be done by contractor without any extra cost.
- After completion of construction & commissioning of terminal, contractor shall incorporate all the correction in drawings, prepare and issue the drawings "as-built drawings" as listed below to owner as final submission of drawings. For mainline pipeline alignment sheet, all x-ing details, all cp drawings, pipe book etc. And for terminals P&ID, layout DRG., piping gad, isometric, all electrical & instrumentation DRG, all civil drawings. For final submission only 4 sets of documents plus the original transparencies shall be handed over by contractor. Any construction done by contractor without duly approved drawings shall be wholly at his risk and cost. Contractor shall also submit soft copy of pipe book in excel along with hard copy. Soft copy of all as-built drawings shall be also submitted in AutoCAD. Videography/ photograph of all major activities/ milestone achieved shall also be arranged and submitted by the contractor. For details of documentation to be submitted for mainline and terminal refer enclosed specification for documentation for standard specification for pipeline construction enclosed elsewhere with the tender.

### Specifications

The work shall be carried out by contractor strictly in accordance with the specifications enclosed in tender.

### Additional Clauses

- Contractor to note that the minimum requirements of inspection and testing of the bought-out items shall be governed by attached QAP with the tender document. However, contractor shall submit their QAP in line with the requirement specified in attached QAP for owner's/ pmc's approval.
- Contractor to note that all the documents/drawings submitted by them as a part of bid shall be considered only to assess bidder's technical capability and shall in no way absolve them from complying with all the requirements of the tender. All works to be performed by the bidder shall be strictly in accordance with tender conditions.
- Contractor shall submit duly signed & stamped hard copies of all required documents/ drawings/ data sheets etc. to VCS for their review & approval as per terms & condition of tender documents. The date of receipt of these documents/ drawings/ data sheets etc at vcs shall be deemed as the date of submission. If any documents/ drawings/ data sheets etc require re-submission due to any error/ deficiency noticed during review/ approval stage, in that event the additional time required by the contractor to get the revised document/ drawing reviewed/approved by VCS shall be solely to contractor's account and in no case,

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contractor shall be entitled for any time or cost benefit.

- The drawings/documents/ data sheets etc. shall be reviewed, checked, approved, and duly signed/stamped by successful contractor before submission. Revision number shall be changed and revisions shall be highlighted by clouds during submission of revised documents/drawings/data sheets by the successful contractor. Whenever the successful contractor requires any sub-supplier drawings to be reviewed/approved by VCS, the same shall be submitted by the contractor after review/ approval and stamped by the contractor. Direct submission of the sub-supplier's drawings/documents/data sheets etc. without contractor's approval shall not be entertained.
- Review/approval of the contractor's submitted drawings/ documents/ data sheets etc by VCS would be only to review the compatibility with basic design and concepts including mainline work procedure and in no way absolve the successful contractor of his responsibility/contractual obligation to comply with tender requirements, applicable codes, specifications, and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the contractor without any extra cost or time, whether or not comments on the same were received from VCS during the drawing review stage.
- Contractor shall make & maintain their own suitable sized storage yard/ area (covered as well as open space) to store free issue materials in proper manner. Contractor shall also maintain the free issue materials in good condition during entire storage period by using all type of servicing/overhauling such as cleaning, greasing, protecting from rusting/ pitting etc.
- Storage yard/ area shall have proper motorable approach, adequate indoor & outdoor area lighting, potable & service water, proper rack & wooden sleeper etc. For staking/ storing the material, availability of material handling equipment of adequate capacity etc.
- Owner/pmc's site in-charge shall visit & inspect the contractor's storage yard/ area and upon his concurrence only, the free issue materials shall be stored by the contractor at the particular storage yard/ area. Delay in issuance of fim due to non-acceptance of contractor's storage yard (i.e. mainly because of non-compliance of the minimum condition as mentioned above for storage yard/ area) shall not be attributable to owner/pmc.
- During construction, owner/ pmc, on their discretion, have reserve right to take samples for any bought-out item received at site and test the same in a lab approved or equivalent laboratory even if the lot has already been inspected and cleared by pmc / owner for use in construction. The cost for such testing shall be borne by the contractor. In case of failure of the samples, the lot shall be rejected and the same shall be replaced by the contractor without any additional cost to owner.

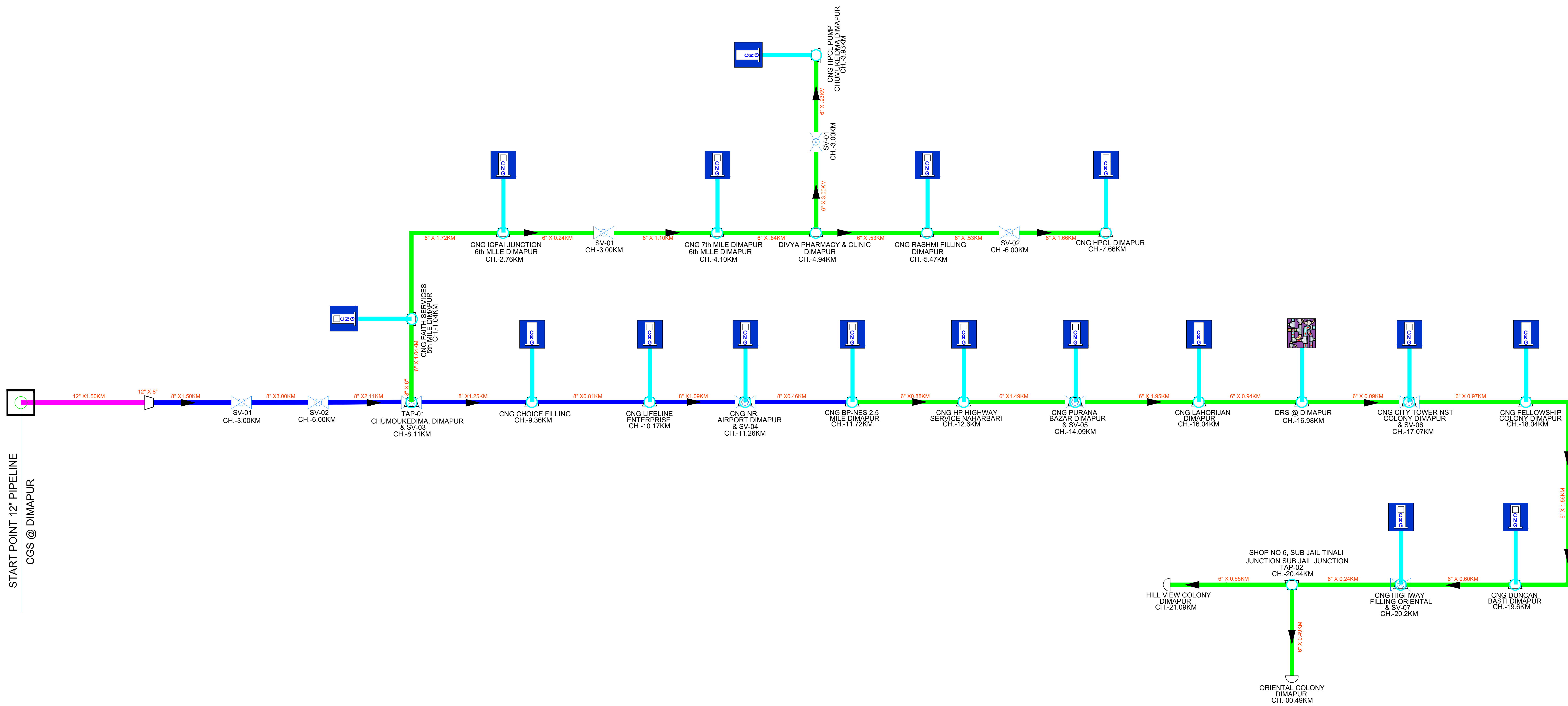
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# SCHEMATIC DIAGRAM

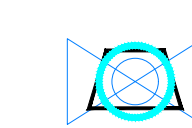
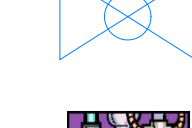
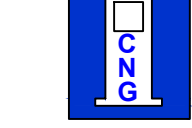


# PIPELINE SCHEMATIC DRAWING

## FOR :- DIMAPUR

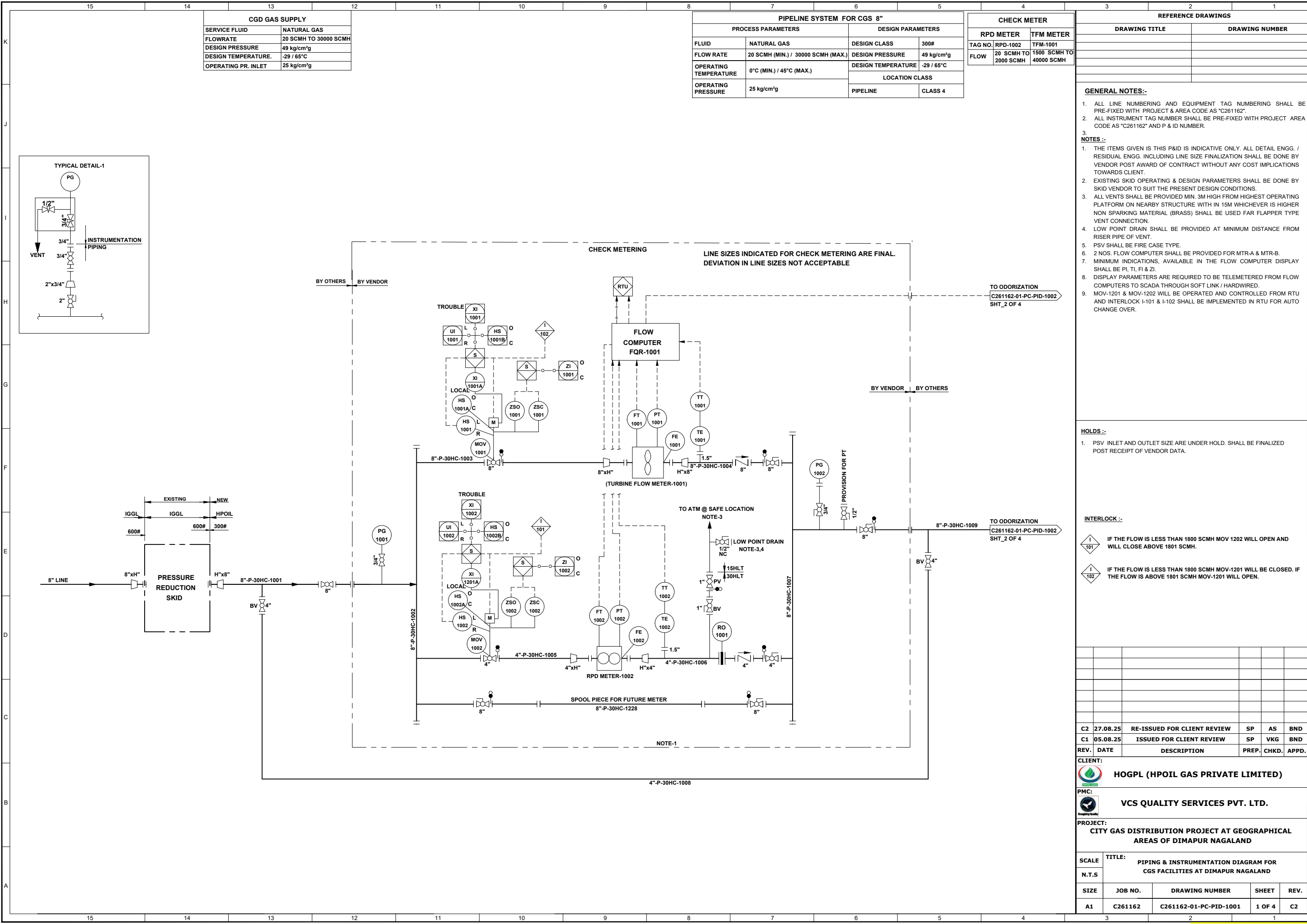


### LEGEND:

- **TAP OFF POINT WITH SECTIONALIZING VALVE**
- **TAP OFF POINT**
- **SECTIONALIZING VALVE**
- **DISTRICT REGULATING STATION**
- **RO STATION**
- **6" PIPELINE**
- **8" PIPELINE**
- **12" PIPELINE**

| 0       | 05.08.25 | ISSUED FOR CONSTRUCTION                                                                                         | PUN                    | AS    | BND   |
|---------|----------|-----------------------------------------------------------------------------------------------------------------|------------------------|-------|-------|
| REV.    | DATE     | DESCRIPTION                                                                                                     | PREP.                  | CHKD. | APPD. |
| CLIENT: |          | HOGPL (HPOIL GAS PRIVATE LIMITED)                                                                               |                        |       |       |
| PMC:    |          | M/s. VCS QUALITY SERVICES PVT. LTD.<br>PLOT #22, UNIT NO. 1109-1116, TOWER-4, ABC<br>SECTOR-135, NOIDA - 201304 |                        |       |       |
| TITLE   |          | SCHEMATIC ARRANGEMENT OF<br>PIPELINE FACILITIES FOR<br>DIMAPUR GA                                               |                        |       |       |
| SCALE   | NTS      | DWG. NO.                                                                                                        | C261162-01-PL-SCMH-001 | REV-0 |       |





| CGD GAS SUPPLY      |                         |
|---------------------|-------------------------|
| SERVICE FLUID       | NATURAL GAS             |
| FLOWRATE            | 20 SCMH TO 30000 SCMH   |
| DESIGN PRESSURE     | 49 kg/cm <sup>2</sup> g |
| DESIGN TEMPERATURE  | -29 / 65°C              |
| OPERATING PR. INLET | 25 kg/cm <sup>2</sup> g |

| PIPELINE SYSTEM FOR CGS 8" |                                    |                    |                         |
|----------------------------|------------------------------------|--------------------|-------------------------|
| PROCESS PARAMETERS         |                                    | DESIGN PARAMETERS  |                         |
| FLUID                      | NATURAL GAS                        | DESIGN CLASS       | 300#                    |
| FLOW RATE                  | 20 SCMH (MIN.) / 30000 SCMH (MAX.) | DESIGN PRESSURE    | 49 kg/cm <sup>2</sup> g |
| OPERATING TEMPERATURE      | 0°C (MIN.) / 45°C (MAX.)           | DESIGN TEMPERATURE | -29 / 65°C              |
| OPERATING PRESSURE         | 25 kg/cm <sup>2</sup> g            | LOCATION CLASS     |                         |
|                            |                                    | PIPELINE           | CLASS 4                 |

| CHECK METER               |                         |
|---------------------------|-------------------------|
| RPD METER                 | TFM METER               |
| TAG NO. RPD-1002          | TFM-1001                |
| FLOW 20 SCMH TO 2000 SCMH | 1500 SCMH TO 40000 SCMH |

| REFERENCE DRAWINGS |                |
|--------------------|----------------|
| DRAWING TITLE      | DRAWING NUMBER |
|                    |                |
|                    |                |
|                    |                |
|                    |                |
|                    |                |

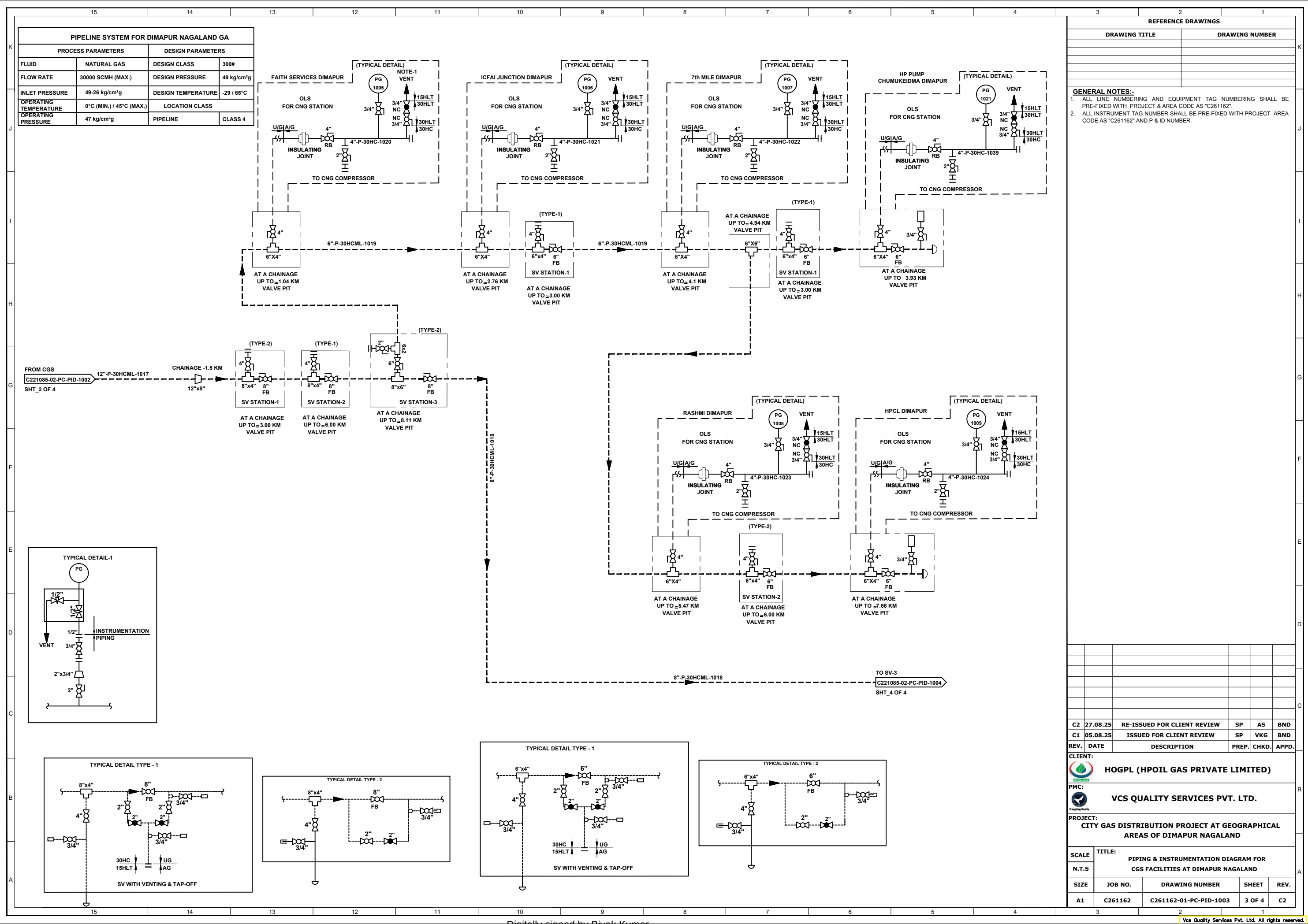
- GENERAL NOTES:-**
- ALL LINE NUMBERING AND EQUIPMENT TAG NUMBERING SHALL BE PRE-FIXED WITH PROJECT & AREA CODE AS "C261162".
  - ALL INSTRUMENT TAG NUMBER SHALL BE PRE-FIXED WITH PROJECT AREA CODE AS "C261162" AND P & ID NUMBER.
- NOTES :-**
- THE ITEMS GIVEN IN THIS P&ID IS INDICATIVE ONLY. ALL DETAIL ENGG. / RESIDUAL ENGG. INCLUDING LINE SIZE FINALIZATION SHALL BE DONE BY VENDOR POST AWARD OF CONTRACT WITHOUT ANY COST IMPLICATIONS TOWARDS CLIENT.
  - EXISTING SKID OPERATING & DESIGN PARAMETERS SHALL BE DONE BY SKID VENDOR TO SUIT THE PRESENT DESIGN CONDITIONS.
  - ALL VENTS SHALL BE PROVIDED MIN. 3M HIGH FROM HIGHEST OPERATING PLATFORM ON NEARBY STRUCTURE WITH IN 15M WHICHEVER IS HIGHER NON SPARKING MATERIAL (BRASS) SHALL BE USED FAR FLAPPER TYPE VENT CONNECTION.
  - LOW POINT DRAIN SHALL BE PROVIDED AT MINIMUM DISTANCE FROM RISER PIPE OF VENT.
  - PSV SHALL BE FIRE CASE TYPE.
  - 2 NOS. FLOW COMPUTER SHALL BE PROVIDED FOR MTR-A & MTR-B.
  - MINIMUM INDICATIONS, AVAILABLE IN THE FLOW COMPUTER DISPLAY SHALL BE PI, TI, FI & ZI.
  - DISPLAY PARAMETERS ARE REQUIRED TO BE TELEMETERED FROM FLOW COMPUTERS TO SCADA THROUGH SOFT LINK / HARDWIRED.
  - MOV-1201 & MOV-1202 WILL BE OPERATED AND CONTROLLED FROM RTU AND INTERLOCK I-101 & I-102 SHALL BE IMPLEMENTED IN RTU FOR AUTO CHANGE OVER.

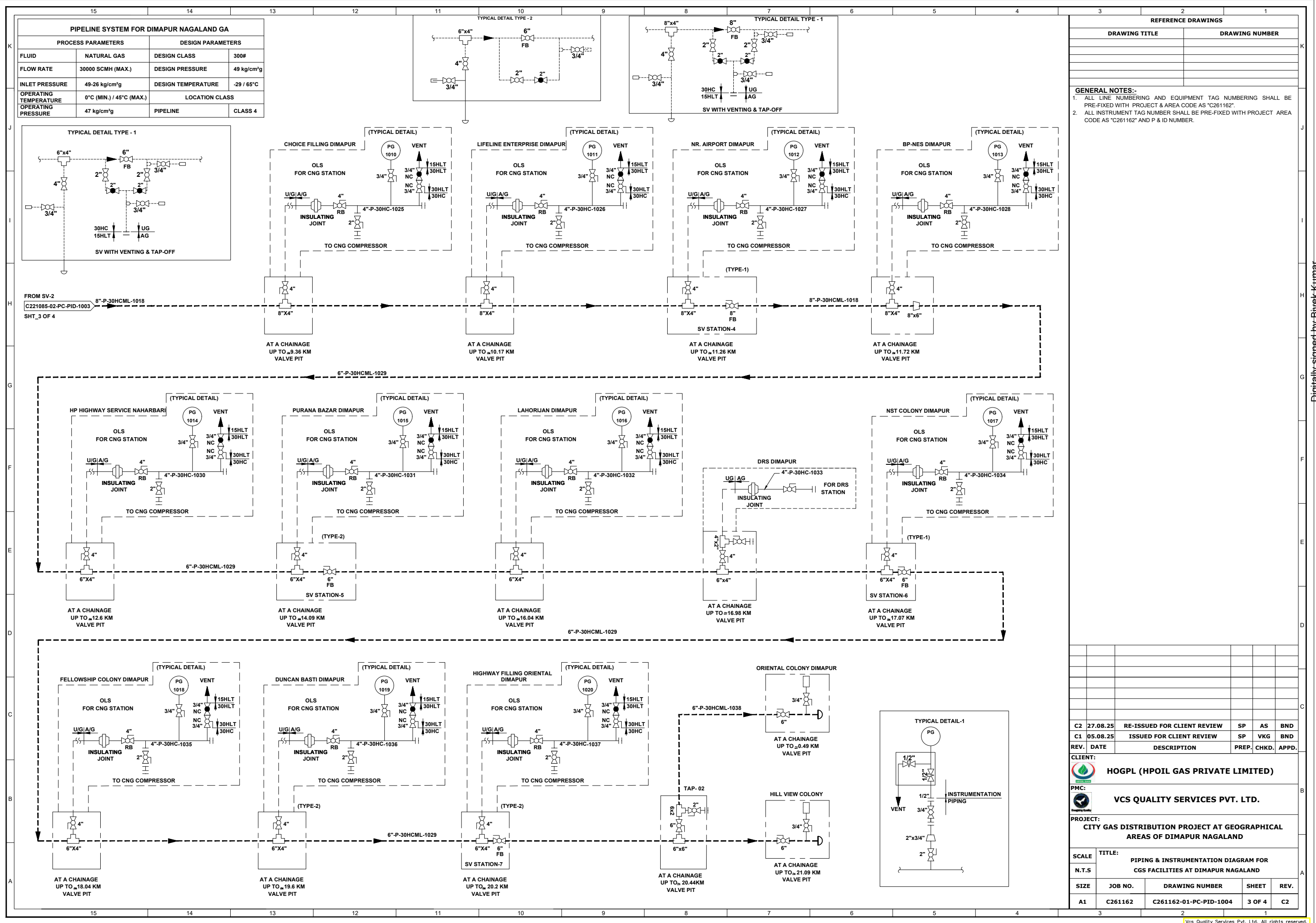
- HOLDS :-**
- PSV INLET AND OUTLET SIZE ARE UNDER HOLD. SHALL BE FINALIZED POST RECEIPT OF VENDOR DATA.
- INTERLOCK :-**
- I 101** IF THE FLOW IS LESS THAN 1800 SCMH MOV 1202 WILL OPEN AND WILL CLOSE ABOVE 1801 SCMH.
  - I 102** IF THE FLOW IS LESS THAN 1800 SCMH MOV-1201 WILL BE CLOSED. IF THE FLOW IS ABOVE 1801 SCMH MOV-1201 WILL OPEN.

|                                                                                |                                                                                |                             |        |       |       |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------|--------|-------|-------|
| C2                                                                             | 27.08.25                                                                       | RE-ISSUED FOR CLIENT REVIEW | SP     | AS    | BND   |
| C1                                                                             | 05.08.25                                                                       | ISSUED FOR CLIENT REVIEW    | SP     | VKG   | BND   |
| REV.                                                                           | DATE                                                                           | DESCRIPTION                 | PREP.  | CHKD. | APPD. |
| CLIENT:                                                                        |                                                                                |                             |        |       |       |
| <b>HOGPL (HPOIL GAS PRIVATE LIMITED)</b>                                       |                                                                                |                             |        |       |       |
| PMC:                                                                           |                                                                                |                             |        |       |       |
| <b>VCS QUALITY SERVICES PVT. LTD.</b>                                          |                                                                                |                             |        |       |       |
| PROJECT:                                                                       |                                                                                |                             |        |       |       |
| <b>CITY GAS DISTRIBUTION PROJECT AT GEOGRAPHICAL AREAS OF DIMAPUR NAGALAND</b> |                                                                                |                             |        |       |       |
| SCALE                                                                          | TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR CGS FACILITIES AT DIMAPUR NAGALAND |                             |        |       |       |
| N.T.S                                                                          |                                                                                |                             |        |       |       |
| SIZE                                                                           | JOB NO.                                                                        | DRAWING NUMBER              | SHEET  | REV.  |       |
| A1                                                                             | C261162                                                                        | C261162-01-PC-PID-1001      | 1 OF 4 | C2    |       |

Digitally signed by Bivek Kumar Singh  
Date: 2026.04.01 11:29:21 IST







**PMS**



Energising Quality

PROJECT NUMBER: C261162



PIPING MATERIAL SPECIFICATION

Total Sheets

51

Document No

C261162

00

PP

PMS

2001

HPOIL GAS PVT. LTD.(HOGPL)

|     |            |                          |      |      |      |
|-----|------------|--------------------------|------|------|------|
|     |            |                          |      |      |      |
|     |            |                          |      |      |      |
| C1  | 27.01.2026 | ISSUED FOR CLIENT REVIEW | AS   | PA   | DK   |
| REV | DATE       | DESCRIPTION              | PREP | CHKD | APPR |





## CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA

### ABBREVIATION

|       |                                            |
|-------|--------------------------------------------|
| ANSI  | American National Standards Institute      |
| ASME  | American Society of Mechanical Engineers   |
| ASTM  | American Society for Testing and Materials |
| AARH  | Arithmetic Average Roughness Height        |
| BS    | British Standards                          |
| CS    | Carbon Steel                               |
| MS    | Mild Steel                                 |
| IS    | Indian Standard Code                       |
| NFPA  | National Fire Protection Association       |
| OISD  | Oil Industry Safety Directorate            |
| PNRGB | Petroleum & Natural Gas Board              |
| ERW   | Electric Resistance Welding                |
| BE    | Bevel End                                  |
| BW    | Butt Welded                                |
| FF    | Flat Face                                  |
| PBE   | Plain Both End                             |
| PE    | Plain End                                  |
| RF    | Raised Face                                |
| SCRF  | Screwed End - Female                       |
| SCRM  | Screwed End - Male                         |
| CA    | Corrosion Allowance                        |
| M     | To Match Pipe                              |

|                                                                                     |                                      |                        |            |
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# CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA

## 1.0 INTRODUCTION

This specification covers minimum requirements for the material specification for pipe, fittings, flanges, line blinds, bolts, gaskets, and valves that shall be used for natural gas pipeline and associated facilities in accordance with ASME B31.8, OISD-226 and PNGRB guideline.

This specification also defines, by piping class for each listed service, and defines the pressure/temperature limitations within which they may be used.

This specification shall be read in conjunction with various codes and standards as applicable.

## 2.0 CODES AND STANDARDS

Pipeline and pipeline terminal facilities envisaged as part of this project shall be designed and engineered primarily in accordance with the provisions of the latest edition of the following codes:

|              |   |                                                                      |
|--------------|---|----------------------------------------------------------------------|
| ASME 31.3    | : | Process Piping                                                       |
| ASME 31.8    | : | Gas Transmission and Distribution Piping Systems                     |
| OISD STD-226 | : | Natural Gas Transmission Pipeline and City Gas Distribution Networks |
| PNGRB        | : | Petroleum and Natural Gas Regulatory Board                           |

All codes, standards and specifications referred herein shall be the latest edition of such documents.

For sake of brevity the initials of the society to which the codes are referred may be omitted in the specifications, for example, B16.5 is a code referring to ASME A106 is a code referring to ASTM.

In addition to this PMS, various piping and pipeline materials shall also be applicable.

## 3.0 MATERIAL SPECIFICATIONS

Individual piping class has been generally designed to cover a set of service operating within pressure-temperature consideration as per ASME B16.5/ B16.34 or part of it. Deviations of material from class specifications may occur due to specific design conditions and/or availability. These deviations are permissible if they equal or better the individual class requirements and shall be subjected to approval on case-to-case basis.

|                                                                                                           |                                      |                        |            |
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### 4.0 CLASS DESIGNATION CODE

The piping class designation shall generally consist of three digits made up of a letter, number & letter e.g. 15HC, 15HLT, 30HC, 30 HLT etc. as follows:

First two numerals letter indicates ASME class rating, e.g.

15 - 150 Class

30 - 300 Class

The first alphabet indicates differences in the Fluid Services within the same class rating and material, e. g. H stands for Hydrocarbon, W stands for Water, G stands for Galvanize etc.

The last one or two letter (as applicable) indicates type of material, e.g.

C - Carbon steel

LT - Low Temperature (Carbon Steel)

### 5.0 TECHNICAL REQUIREMENTS

#### 5.1 General Notes

1. All piping materials selected under this specification shall be in compliance with the project specification.
2. Material selections shall comply with the maximum pressure and temperature limitation as specified in the service summary.
3. Substitution of equivalent materials is subject to approval of the Client /PMC. All requests for substitution shall be accompanied with sufficient data, drawings, and descriptive details to permit evaluation by the Client /PMC.
4. Cast iron, ductile or malleable iron, aluminum, plastic, or copper-bearing alloys shall not be used in hydrocarbon service.
5. Piping design pressure is based on flange maximum-allowable working pressure, unless otherwise noted in Job Specification.
6. When required, impact testing shall comply with applicable standards and material specifications.
7. All gaskets shall be asbestos free.
8. Aluminum jumper shall be provided across the flanged joint and length of the bolt shall be taken such that at least two threads remain exposed after the nut for fixing the continuity jumper.

|                                                                                                           |                                      |                        |            |
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### 5.2 Units

1. All units are expressed in SI system with the exception of nominal pipe sizes (NPS) and bolting diameters, which are in inches.
2. Pressures are gauge pressures (in Kg/cm<sup>2</sup>g) and temperatures are in deg. Celsius (°C).
3. Pressures and Temperatures ratings are based ASME 16.5.

### 6.0 PIPELINE

- Line pipe material grade and wall thickness details are indicated in PMS.

### 7.0 PIPES

- Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as per piping material specification for the applicable class.
- Pipe dimensions shall be in accordance with ASME B 36.10 for carbon steel ASTM standard pipes & API 5L for carbon steel API 5L grade pipes.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- For butt weld end, bevel shall be in accordance with API specification 5L or ASME B16.25 as applicable.
- Where difference in thickness of matching pipe ends exist, bevels for such matching pairs shall be prepared in accordance with ASME B 31.8.
- Pipes shall be supplied with beveled end. Beveling shall be in accordance with ASME B16.25. Where plain end pipes are specified, as for small bore pipes for socket welded piping, the pipes shall be supplied with square cut ends.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- Dimensions of socket weld ends shall confirm to ASME B 16.11. Bore shall match pipe OD and pipe ID.
- Pipe to pipe joints shall be made as follows:

For sizes up to & including DN40

Socket weld/ As per Piping Class

For size DN50 and above

Butt Welded

|                                                                                                           |                                      |                        |            |
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### 8.0 FITTINGS

- Fully killed carbon steel shall be used in the manufacture of fittings. The fitting shall have carbon equivalent not exceeding 0.45, based on check analysis.
- Threaded joints, if used, shall conform to American Standard taper as per ASME B1.20.1 NPT.
- Dimensions of socket welded/screwed fittings shall conform to ASME B 16.11. Swage shall be as per BS 3799.
- Dimensions of steel butt welded fittings shall be as per ASME B 16.9.
- Bore of socket welded fittings shall suit outside diameter (OD) of pipe and its thickness.
- Butt welding ends shall conform to API specification 5L or ASME B 16.25 as applicable. In case of difference in thickness of matching ends, requirements of ASME B 31.4 shall apply.
- Integrally reinforced forged branch fittings such as Sockolet, Weldolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B16.9 and MSS-SP-97 shall conform to manufacturer's standard.
- Fittings thickness tolerances shall match pipe thickness tolerance.

### 9.0 BENDS

- Unless otherwise specified for process piping, elbow of radius  $R = 1.5 D$  shall only be used.
- In order to accommodate changes in vertical and horizontal alignment in piggable section of pipeline, Elastic bends/ Cold field bends/ Hot formed long radius bends shall be used. Radius of bend shall be as per Design Basis.

$D$  = Specified Outside Diameter

- Miters shall not be used.

### 10.0 FLANGES

- Pressure Temperature rating of flanges shall conform to B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Dimensions of flanges shall be in accordance with B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Neck of weld neck (WN) flanges shall suit pipe bore and thickness.
- Bore of socket welded (SW) flanges shall suit pipe O.D. and its thickness.
- Threads for screwed flanges, if used, shall conform to American Standard taper as per ASME B 1.20.1 NPT.

|                                                                                                           |                                      |                        |            |
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- Sizes for blind flanges shall be indicated by nominal pipe size.
- Unless specified otherwise in Piping Material Specification the flange face finish shall be as per ASME B16.5.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B 16.48/ manufacturer's standard.
- Flange face finish for raised face flanges shall be as per ASME B16.5/ ASME B 16.47 as applicable. For RTJ flanges groove finish shall be 32-63 micro inches AARH as per MSS-SP-6. Hardness of groove surface shall be minimum 140 BHN.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B16.48 / manufacturer's standard.
- Two jackscrews, 180° apart shall be provided for all RTJ flange assemblies and Spacer blind/ Figure 8 assemblies. Holes for jackscrews shall be drilled and tapped at site. Jackscrews shall be as per ASTM A193 Gr. B7. Heads of jackscrews shall be heavy hexagonal type and jackscrew end shall be rounded. Dimensions shall be as per ASME B18.2.1.
- Flanges shall be packed and shipped in such a way as to prevent damage of machined parts.
- All machined or threaded parts shall be protected in accordance with ASTM A700. Suitable protection shield, or cover shall be provided on the gasket contact surface.
- Carbon steel forgings shall be supplied with a maximum carbon content of 0.25% and CE of 0.45 by product analysis.
- The finish of contact faces of pipe flanges & connecting end flanges of valves & fittings shall be governed by ASME B16.5 & following:  
Roughness requirements (Finish: AARH standards per ASME B46.1):
  - a) Raised Face (RF): Serrated finish 125 to 250 µin Ra.
  - b) Flat Face (FF): Serrated finish 125 to 250 µin Ra.
  - c) Ring Type Joint (RTJ): Extra-smooth finish 63 µin Ra max.
- Flat face flanges, unless specified on the Piping Specifications, shall not be used without specific Client/PMC approval. Full-face gaskets shall be used with flat-face flanges as per ASME B16.20.
- All flanged joints shall be installed with a single gasket between contact faces.

|                                                                                                           |                                      |                        |            |
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- Spectacle blank (figure 8 blank), blank (blind) & spacer shall confirm to the requirement of ASME B16.48 up to sizes 24". For 150#, 300# and 600# spectacle blank shall be used up to 8", blank (blind) & spacer for sizes 10" & above

### 11.0 GASKETS

- Spiral wound metallic gasket with Graphite filled winding with SS304 inner ring and CS outer ring/ Soft iron octagonal ring type joint gasket, and shall conform to ASME B 16.20/ API 601
- Spiral wound gaskets shall be self-aligning type.

### 12.0 BOLTING & THREADS

- Nuts for stud bolts shall be American Standard Hexagon Heavy Series and double chamfered.
- Dimension and tolerances for stud bolts and nuts shall be as per ASME B18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ASME B16.5/ASME B16.47 with full threading.
- Threads for nuts shall be as per ASME B 1.1 as follows:

|                                    |   |        |
|------------------------------------|---|--------|
| Nuts for stud bolts Dia ¼" to 1"   | : | UNC-2B |
| Nuts for stud bolts Dia 1½" to 3¼" | : | 8UN-2B |
- Threads for stud bolts shall be as per ASME B 1.1, as follows:

|                           |   |        |
|---------------------------|---|--------|
| Stud bolts Dia ¼" to 1"   | : | UNC-2A |
| Stud bolts Dia 1½" to 3¼" | : | 8UN-2A |
- Threads for threaded pipe, fitting, flanges and valve shall be in accordance with B1.20.1 taper threads, unless specified otherwise.
- Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded. Stud bolts shall be fully threaded with two hexagonal nuts.

### 13.0 THREAD SEALANT

- Threaded joints shall be made with 1" wide PTFE jointing tape.

### 14.0 VALVES

- Valve ends shall be as per valve data sheets for various piping class.
- Sectionalizing valves, Block valves and other isolation valves installed on the main pipeline shall be ball valves with butt welding ends. All inline isolation valves on the mainline (pipeline) shall be full bore valves to allow smooth passage of cleaning as well as intelligent pigs.

|                                                                                                           |                                      |                        |            |
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## CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA

- All buried valves shall be provided with stem extension shall have Butt Welded ends as per relevant specification/ data sheet.
- All valves in the piggable section of pipeline and Main Process Flow Line shall be Full Opening valve as per API 6D. Other valves shall be Reduced Opening type unless specified otherwise in P&ID.
- Flange dimensions and face finish of flanged end valves shall conform to clause 10.0 of this specification.
- Butt welding ends of Butt-Welded valves shall conform to ASME B 16.25.
- Face to face and end to end dimensions shall conform to applicable standards.
- Valves shall conform to following standards unless specified otherwise in piping material specification for various piping class.

### **Flanged/Socket Welded end valves (1½" and below)** **Design STD. for Process lines**

|              |   |                 |
|--------------|---|-----------------|
| Gate Valves  | : | API 602         |
| Globe Valves | : | BS EN ISO 15761 |
| Check Valves | : | BS EN ISO 15761 |
| Ball Valve   | : | BS EN ISO 17292 |
| Plug Valve   | : | BS 5353         |

### **Flanged/Butt Welded end valves (2" and above)** **Design STD. for Process Lines**

|              |   |         |
|--------------|---|---------|
| Gate Valves  | : | API 6D  |
| Globe Valves | : | BS 1873 |
| Check Valves | : | API 6D  |
| Ball Valve   | : | API 6D  |
| Plug Valve   | : | API 6D  |

- All manual operated valves shall be provided with wrench / hand wheel or gear operator as specified here in below.
- **Gate Valves**

|                            |   |                                                                            |
|----------------------------|---|----------------------------------------------------------------------------|
| For ANSI class 150 and 300 | - | Hand wheel operated for size ≤ 12" NB.<br>Gear operated for size ≥ 14" NB. |
| For ANSI class 600         | - | Hand wheel operated for size ≤ 10" NB.<br>Gear operated for size ≥ 12" NB. |

|                                                                                                           |                                      |                        |            |
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- **Globe Valves**

For ANSI class 150, 300, 600 and 900 - Hand wheel operated for all Size.

- **Ball Valves & Plug Valves**

For all ANSI class - Wrench operated for size  $\leq 4$ " NB.  
Gear operated for size  $\geq 6$ " NB.

- **Actuated Valves**

Actuated valves shall be as per P&IDs. The actuator shall have provision for remote operation as per P & IDs. All Actuated valves shall have additional provision of hand wheel operation.

### 15.0 QUICK OPENING END CLOSURE

Quick opening end closure to be installed on scraper traps shall be designed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and equipped with safety locking devices in compliance with Section VIII, division 1, UG-35.2 of ASME Boiler and Pressure Vessel Code.

### 16.0 HYDROTESTING VENTS AND DRAINS

In terminal piping, high point vents and low point drains required for the purpose of hydro testing shall be of size 0.75". These vents & drains shall consist of gate valves with blind flange assembly.

### 17.0 PIPING SPECIALTY ITEMS

- Primary material Pipeline specialty items viz. flow tees, insulating joints, LR bends etc. shall be as per respective data sheets and specification.
- For mainline items, corrosion allowance shall be as per respective data sheet.

### 18.0 INSULATING GASKET, SLEEVE AND WASHER

The insulating gasket shall consist of a PTFE (Teflon) spring-energized face seal, or an elastomeric O-ring, seated in an isolating laminate, which shall be permanently bonded to a high strength metal gasket core. Due to this unique pressure activated sealing mechanism, the gasket requires far less bolt stress to seal than any other gasket. The gasket inner diameter shall be exactly matched to the flange bore to eliminate turbulent flow and flange face erosion/ corrosion. The seal elements shall be replaceable in the reusable gasket retainer. The core of gasket shall be made of annealed 316 stainless steel or other metals including duplex and Inconel etc.

|                                                                                                             |                                      |                        |            |
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Insulating gasket shall include the following applications,

- Flange isolation in conjunction with Cathodic protection.
- Isolation between dissimilar metals to prevent galvanic corrosion.
- Mating mismatched ring-joint to raised –face flanges.
- Eliminate fluid trap corrosion between ring-joint (RTJ) flanges where high concentrations of Co<sub>2</sub>, H<sub>2</sub>S and other aggressive hydrocarbon media are present.
- Eliminate turbulence and flow induced erosion between ring-joint (RTJ) flanges.
- Protect against coating impingement on coated flange faces.
- To seal between flanges subjected to vibration/ cavitation.

### 18.1 Insulating Gaskets, Sleeves and Washer Materials Properties

|                             |   |                                               |
|-----------------------------|---|-----------------------------------------------|
| Compressive Strength        | : | 65000 psi                                     |
| Average Dielectric Strength | : | 15 kV or more                                 |
| Electrical Resistance       | : | >1 MΩ (When tested with 500-1000 V DC merger) |
| Max. Operating Temperature  | : | 302°F (150°C)                                 |
| Min. Operating Temperature  | : | (-) 200°F (-129°C)                            |
| Water Absorption            | : | 5%                                            |
| Flexural Strength           | : | 70000 psi                                     |
| Tensile Strength            | : | 50000 psi                                     |
| Bond Strength               | : | 2600 lb.                                      |
| Shear Strength              | : | 22000 lb.                                     |

### 18.2 Seal Material

The sealing elements shall intend to provide an impervious barrier through which no contained media or other substance can penetrate. The composite retainer backing material behind the seal remains uncontaminated and thus permanently holds the seal in place in a static, fully encapsulated manner.

Viton as a seal material shall consist following properties,

- General purpose oilfield elastomer.
- Excellent resistance to aliphatic hydrocarbons, glycols and H<sub>2</sub>S.
- Good resistance to aromatic hydrocarbons.

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### Isolating Sleeve

Mylar as a seal material shall consist following properties,

- Spiral wound Mylar is a general-purpose material recommended for bolting application with flange temperatures below 250°F.
- Material shall be fair resistance to crushing, cracking, breaking and thread pinch.

Isolating washer: 1/8" (0.125) Thick washer

Steel Washer: ZPS standard – Zinc plated steel washers.

Butt weld (BW) ends of the insulating assembly shall be protected by metallic or high impact plastic bevel protectors.

The dimensions of insulating components (gaskets, sleeves and washers) shall be as indicated in Data Sheet. The insulating gasket and washers shall have adequate compressive strength to permit proper tightening of flange bolts for leak proof joint.

The insulating material shall be suitable for pressure and temperature indicated in Data Sheet under connecting pipeline details and shall be resistant to the fluid to be handled through the pipeline.

I.D. and O.D. of insulating washers shall be designed to fit over insulating sleeves and within spot faces on flanges.

After the hydrostatic test, insulating flange assembly shall be tested with air at 5 kg/cm<sup>2</sup> for 10 minutes. The tightness shall be checked by immersion or with a frothing agent. No leakage shall be accepted.

Insulating gasket, sleeve and washer after the field hydrostatic test shall be tested for dielectric integrity at 5000 V A.C., 50 Hz for one minute and the leakage current before and after shall be equal. Testing time, voltage and leakage shall be recorded and certified. The test shall be carried out in dry conditions.

### 19.0 CHARPY V-NOTCH TEST & HARDNESS TEST

All piping material like valves, fittings, flanges bolting etc. shall be Charpy impact tested. Charpy V-notch impact tests are required for the base metal weld metal and heat-affected zone (HAZ)

|                                                                                                           |                               |                        |     |
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# Appendix – A

## Piping Material Specification – Index

|                                                                                     |                                      |                        |            |
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| Sr. No. | Piping Class | Rating | C. A. (MM) | Spl. Reqt.                        | Basic Material | Service                                                                        | Remarks |
|---------|--------------|--------|------------|-----------------------------------|----------------|--------------------------------------------------------------------------------|---------|
| 1       | 15HC         | 150    | 1.5        | NON-IBR                           | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE<br>/NONFLAMMABLE, NON-LETHAL- HYDROCARBONS  | Page 17 |
| 2       | 15HLT        | 150    | 1.5        | LOW<br>TEMPER<br>ATURE<br>SERVICE | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE<br>/NON-FLAMMABLE, NON-LETHAL- HYDROCARBONS | Page 22 |
| 3       | 30HC         | 300    | 1.5        | NON-IBR                           | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE /<br>NONFLAMMABLE, NON-LETHAL- HYDROCARBONS | Page 28 |
| 4       | 30HLT        | 300    | 1.5        | LOW<br>TEMPER<br>ATURE<br>SERVICE | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE /<br>NONFLAMMABLE, NON-LETHAL- HYDROCARBONS | Page 35 |
| 5       | 60HC         | 600    | 1.5        | NON-IBR                           | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE /<br>NONFLAMMABLE, NON-LETHAL- HYDROCARBONS | Page 40 |
| 6       | 60HLT        | 600    | 1.5        | LOW<br>TEMPER<br>ATURE<br>SERVICE | CARBON STEEL   | NON-CORROSIVE<br>PROCESS-FLAMMABLE /<br>NONFLAMMABLE, NON-LETHAL- HYDROCARBONS | Page 47 |

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### Appendix – B

### Piping Class

|                                                                                                           |                               |                        |     |
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|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| <b>PIPE CLASS</b>   | <b>15HC</b>                                                                    |
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 150#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Non-IBR                                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |       |       |       |       |       |       |      |      |      |
|-------------|-------|-------|-------|-------|-------|-------|------|------|------|
| Temperature | -29   | 38    | 93    | 149   | 204   | 260   | 316  | 343  | 371  |
| Pressure    | 20.03 | 20.03 | 18.28 | 16.17 | 14.06 | 11.95 | 9.84 | 8.78 | 7.73 |

### NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:
  - Radiography : All butt welds 100%
  - MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
- All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
- For valves, refer valve data sheets.

| ITEM               | SIZE             | DESCRIPTION                              |
|--------------------|------------------|------------------------------------------|
| Maintenance joints | ALL              | Flanged, to be kept minimum              |
| Pipe joints        | 1.5" & BELOW     | SW coupling                              |
|                    | 2.0" & ABOVE     | Butt welded                              |
| Drains             | ON LINES <= 1.5" | Refer std. Drawing                       |
|                    | ON LINES >= 2.0" | As per P&ID or 0.75". Refer std. Drawing |
| Vents              | ON LINES <= 1.5" | Refer std Drawing                        |
|                    | ON LINES >= 2.0" | As per P&ID or 0.75". Refer std. Drawing |

|                        |                                      |                        |            |
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### Branch Table

## Sockolet

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Singh  
Date: 2026.04.01 11:29:21 IST



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| Item                 | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD    | Material (Charpy)             | Description     |
|----------------------|-------------------|-------------------|-------------|-------------|-------------------------------|-----------------|
| <b>PIPE GROUP</b>    |                   |                   |             |             |                               |                 |
| PIPE                 | 00.500            | 00.750            | S160        | B-36.10     | ASTM A 106 GR.B               | PE, SEAMLESS    |
| PIPE                 | 01.000            | 01.500            | XS          | B-36.10     | ASTM A 106 GR.B               | PE, SEAMLESS    |
| PIPE                 | 02.000            | 02.000            | XS          | B-36.10     | ASTM A 106 GR.B (Charpy)      | BE, SEAMLESS    |
| PIPE                 | 03.000            | 14.000            | STD         | B-36.10     | ASTM A 106 GR.B (Charpy)      | BE, SEAMLESS    |
| PIPE                 | 16.000            | 24.000            | STD         | B-36.10     | ASTM A 672 B65 CL-12 (Charpy) | BE, E.FS.W      |
| NIPPLE               | 00.500            | 01.500            | M           | B-36.10     | ASTM A 106 GR.B               | PBE, SEAMLESS   |
| <b>FLANGE GROUP</b>  |                   |                   |             |             |                               |                 |
| FLNG.SW              | 00.500            | 01.500            | M           | B-16.5      | ASTM A 105                    | 150, RF/125AARH |
| FLNG.WN              | 2.000             | 24.000            | M           | B-16.5      | ASTM A 105 (Charpy)           | 150, RF/125AARH |
| FLNG.BLIND           | 00.500            | 01.500            |             | B-16.5      | ASTM A 105                    | 150, RF/125AARH |
| FLNG.BLIND           | 00.500            | 24.000            |             | B-16.5      | ASTM A 105 (Charpy)           | 150, RF/125AARH |
| FLNG.FIG.8           | 00.500            | 08.000            |             | ASME B16.48 | ASTM A 105 (Charpy)           | 150, FF/125AARH |
| SPCR&BLND            | 10.000            | 24.000            |             | ASME B16.48 | ASTM A 105 (Charpy)           | 150, FF/125AARH |
| <b>FITTING GROUP</b> |                   |                   |             |             |                               |                 |
| ELBOW.90             | 00.500            | 01.500            |             | B-16.11     | ASTM A 105                    | SW, 6000        |
| ELBOW.90             | 02.000            | 12.000            | M           | B-16.9      | ASTM A 234 GR.WPB (Charpy)    | BW, 1.5D        |
| ELBOW.45             | 00.500            | 01.500            |             | B-16.11     | ASTM A 105                    | SW, 6000        |
| ELBOW.45             | 02.000            | 24.000            | M           | B-16.9      | ASTM A 234 GR.WPB (Charpy)    | BW, 1.5D        |
| T.EQUAL              | 00.500            | 01.500            |             | B-16.11     | ASTM A 105                    | SW, 6000        |
| T.EQUAL              | 02.000            | 24.000            | M           | B-16.9      | ASTM A 234 GR.WPB (Charpy)    | BW              |

|                        |                                      |                        |            |
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|       |        |        |  |         |            |          |
|-------|--------|--------|--|---------|------------|----------|
| T.RED | 00.500 | 01.500 |  | B-16.11 | ASTM A 105 | SW, 6000 |
|-------|--------|--------|--|---------|------------|----------|

| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD       | Material (Charpy)                               | Description                   |
|---------------------|-------------------|-------------------|-------------|----------------|-------------------------------------------------|-------------------------------|
| T.RED               | 02.000            | 24.000            | M, M        | B-16.9         | ASTM A 234 GR.WPB (Charpy)                      | BW                            |
| REDUC. CONC         | 02.000            | 24.000            | M, M        | B-16.9         | ASTM A 234 GR.WPB (Charpy)                      | BW                            |
| REDUC. ECC          | 02.000            | 24.000            | M, M        | B-16.9         | ASTM A 234 GR.WPB (Charpy)                      | BW                            |
| SWAGE. CONC         | 00.500            | 03.000            | M, M        | BS-3799        | ASTM A 105 (Charpy)                             | PBE                           |
| SWAGE.ECC           | 00.500            | 03.000            | M, M        | BS-3799        | ASTM A 105                                      | PBE                           |
| CAP                 | 00.500            | 00.750            |             | B-16.11        | ASTM A 105                                      | SCRF, 6000                    |
| CAP                 | 01.000            | 01.500            |             | B-16.11        | ASTM A 105                                      | SCRF, 3000                    |
| CAP                 | 02.000            | 24.000            | M           | B-16.9         | ASTM A 234 GR.WPB (Charpy)                      | BW                            |
| PLUG                | 00.500            | 00.750            |             | B-16.11        | ASTM A 105                                      | SCRM, 6000                    |
| <b>O'let</b>        |                   |                   |             |                |                                                 |                               |
| WELDOLET            | 02.000            | 06.000            | M, S160     | MSS-SP97       | ASTM A 105 (Charpy)                             | BW                            |
| SOCKOLET            | 00.500            | 00.750            |             | MSS-SP97       | ASTM A 105                                      | SCRF, 6000                    |
| SOCKOLET            | 01.000            | 01.500            |             | MSS-SP97       | ASTM A 105                                      | SW, 3000                      |
| <b>VALVES GROUP</b> |                   |                   |             |                |                                                 |                               |
| VLV.GLOBE           | 00.250            | 01.500            |             | BS EN 15015761 | BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL | SW, 800, 3000, B-16.11        |
| VLV.GLOBE           | 02.000            | 24.000            |             | BS-1873        | BODY-ASTM A 216 GR.WCB,TRIM- 13% CR.STEEL       | FLGD, 150, B-16.5, RF/125AARH |
| VLV.CHECK           | 00.250            | 01.500            |             | BS EN 15015761 | BODY-ASTM A 105,TRIM-STELLITED                  | SW, 800, 3000, B-16.11        |

|                        |                                      |                        |            |
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|-----------|--------|--------|--|--------|-------------------------------------------------|----------------------------------|
| VLV.CHECK | 02.000 | 24.000 |  | API-6D | BODY-ASTM A 216<br>GR.WCB,TRIM- 13%<br>CR.STEEL | FLGD, 150, B-16.5,<br>RF/125AARH |
|-----------|--------|--------|--|--------|-------------------------------------------------|----------------------------------|

|                                                                                                           |                               |                        |     |
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| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD             | Material (Charpy)                                                         | Description                   |
|---------------------|-------------------|-------------------|-------------|----------------------|---------------------------------------------------------------------------|-------------------------------|
| VLV.BALL            | 00.500            | 01.500            |             | BS EN 150 17292      | BODY-ASTM A 105,TRIM-13% CR.STEEL, SEAT-RPTFE                             | SW, 800, B-16.11, RF/125AARH  |
| VLV.BALL            | 02.000            | 24.000            |             | API-6D               | BODY-ASTM A216 GR.WCB,TRIM/BALL SEAT-(AISI 4140 + 0.003"ENP)/AISI 410     | FLGD, 150, B-16.5, RF/125AARH |
| VLV.BALL            | 02.000            | 24.000            |             | API-6D               | BODY-ASTM A 216 GR.WCB, TRIM-BALL, SEAT-(AISI 4140 + 0.003"ENP) /AISI 410 | BW, 150, B-16.25              |
| VLV.PLUG            | 00.500            | 01.500            |             | BS-5353              | BODY-ASTM A 105,PLUG - A105 + 0.003" ENP                                  | SW, 800, 3000, B-16.11,       |
| VLV.PLUG            | 02.000            | 24.000            |             | API-6D               | BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP                        | FLGD, 150, B-16.5, RF/125AARH |
| VLV.PLUG            | 02.000            | 24.000            | M           | API-6D               | BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP                     | BW, 150, B-16.25              |
| <b>BOLT GROUP</b>   |                   |                   |             |                      |                                                                           |                               |
| BOLT.STUD           | 00.500            | 48.000            |             | B-18.2               | BOLT:A193 GR.B7, NUT:A194 GR.2H                                           |                               |
| <b>GASKET GROUP</b> |                   |                   |             |                      |                                                                           |                               |
| GASKET              | 00.500            | 24.000            |             | B-16.20-ANSI B16.5   | SP.WND METTALIC WITH GRAPHITE FILLER                                      | SPIRAL, 150                   |
| GASKET              | 26.000            | 48.000            |             | B-16.20-ANSI B16.47A | SP.WND METTALIC WITH GRAPHITE FILLER                                      | SPIRAL, 150                   |

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

|                        |                                      |                        |            |
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|---------------------|--------------------------------------------------------------------------------|
| <b>PIPE CLASS</b>   | <b>15HLT</b>                                                                   |
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 150#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Low Temperature Service                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |       |       |       |
|-------------|-------|-------|-------|
| Temperature | -45   | 38    | 93    |
| Pressure    | 18.63 | 18.63 | 17.92 |

### NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:
  - Radiography : All butt welds 100%
  - MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 45°C.
- All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
- For valves, refer valve data sheets.

| ITEM               | SIZE             | DESCRIPTION                              |
|--------------------|------------------|------------------------------------------|
| Maintenance joints | ALL              | Flanged, to be kept minimum              |
| Pipe joints        | 1.5" & BELOW     | SW coupling                              |
|                    | 2.0" & ABOVE     | Butt welded                              |
| Drains             | ON LINES <= 1.5" | Refer std. Drawing                       |
|                    | ON LINES >= 2.0" | As per P&ID or 0.75". Refer std. Drawing |
| Vents              | ON LINES <= 1.5" | Refer std. Drawing                       |
|                    | ON LINES >= 2.0" | As per P&ID or 0.75". Refer std Drawing  |

|                        |                                      |                        |            |
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|                   |       |                                                                                 |
|-------------------|-------|---------------------------------------------------------------------------------|
| Temp. Connection  | 1.5"  | Flanged, installation as per std. Drawing, except skin temperature measurement. |
| Press. Connection | 0.75" | SW nipple with Plug/ Ball Valve to spec. as per Refer std. Drawing              |

**Branch Table**

|                      |      |   |     |   |   |   |   |      |                    |
|----------------------|------|---|-----|---|---|---|---|------|--------------------|
|                      |      |   |     |   |   |   | T | 6    | BRANCH PIPE (INCH) |
|                      |      |   |     |   |   |   | T | 4    |                    |
|                      |      |   |     |   |   | T | T | 3    |                    |
|                      |      |   |     |   | T | T | T | 2    |                    |
|                      |      |   |     | T | T | T | W | 1.5  |                    |
|                      |      |   | T   | T | T | T | S | 1    |                    |
|                      |      | T | T   | T | T | S | S | S    | 0.75               |
| T                    | T    | T | T   | S | S | S | S | 0.05 |                    |
| 0.05                 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 |      |                    |
| PIPE RUN Size (INCH) |      |   |     |   |   |   |   |      |                    |

**CODES**

|   |          |
|---|----------|
| T | Tees     |
| W | Weldolet |
| S | Sockolet |

**DESCRIPTION**

|                           |                                      |                        |            |
|---------------------------|--------------------------------------|------------------------|------------|
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| Item                 | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD    | Material (Charpy)  | Description     |
|----------------------|-------------------|-------------------|-------------|-------------|--------------------|-----------------|
| <b>PIPE GROUP</b>    |                   |                   |             |             |                    |                 |
| PIPE                 | 00.500            | 00.750            | S160        | B-36.10     | ASTM A 333 GR.6    | PE, SEAMLESS    |
| PIPE                 | 01.000            | 01.500            | XS          | B-36.10     | ASTM A 333 GR.6    | PE, SEAMLESS    |
| PIPE                 | 02.000            | 02.000            | XS          | B-36.10     | ASTM A 333 GR.6    | BE, SEAMLESS    |
| PIPE                 | 03.000            | 06.000            | STD         | B-36.10     | ASTM A 333 GR.6    | BE, SEAMLESS    |
| NIPPLE               | 00.500            | 01.500            | M           | B-36.10     | ASTM A 333 GR.6    | PBE, SEAMLESS   |
| <b>FLANGE GROUP</b>  |                   |                   |             |             |                    |                 |
| FLNG.WN              | 00.500            | 06.00             | M           | B-16.5      | ASTM A 350 GR.LF2  | 150, RF/125AARH |
| FLNG.BLIND           | 00.500            | 06.00             |             | B-16.5      | ASTM A 350 GR.LF2  | 150, RF/125AARH |
| FLNG.FIG.8           | 00.500            | 06.00             |             | ASME B16.48 | ASTM A 350 GR.LF2  | 150, FF/125AARH |
| <b>FITTING GROUP</b> |                   |                   |             |             |                    |                 |
| ELBOW.90             | 00.500            | 00.75             |             | B-16.11     | ASTM A 350 GR.LF2  | SW, 6000        |
| ELBOW.90             | 01.000            | 01.500            |             | B-16.11     | ASTM A 350 GR.LF2  | SW, 3000        |
| ELBOW.90             | 02.000            | 6.000             | M           | B-16.9      | ASTM A 420 GR.WPL6 | BW, 1.5D        |
| ELBOW.45             | 00.500            | 00.75             |             | B-16.11     | ASTM A 350 GR.LF2  | SW, 6000        |
| ELBOW.45             | 01.000            | 01.500            |             | B-16.11     | ASTM A 350 GR.LF2  | SW, 3000        |
| ELBOW.45             | 02.000            | 6.000             | M           | B-16.9      | ASTM A 420 GR.WPL6 | BW, 1.5D        |
| T.EQUAL              | 00.500            | 00.75             |             | B-16.11     | ASTM A 350 GR.LF2  | SW, 6000        |

|                        |                                      |                        |            |
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| Item          | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD | Material (Charpy)  | Description |
|---------------|-------------------|-------------------|-------------|----------|--------------------|-------------|
| T.EQUAL       | 01.000            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 3000    |
| T.EQUAL       | 02.000            | 06.000            | M           | B-16.9   | ASTM A 420 GR.WPL6 | BW          |
| T.RED         | 00.500            | 00.75             |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 6000    |
| T.RED         | 01.000            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 3000    |
| T.RED         | 02.000            | 06.000            | M, M        | B-16.9   | ASTM A 420 GR.WPL6 | BW          |
| REDUC. CONC   | 02.000            | 06.000            | M, M        | B-16.9   | ASTM A 420 GR.WPL6 | BW          |
| REDUC. ECC    | 02.000            | 06.000            | M, M        | B-16.9   | ASTM A 420 GR.WPL6 | BW          |
| SWAGE. CONC   | 00.500            | 03.000            | M, M        | BS-3799  | ASTM A 350 GR.LF2  | PBE         |
| SWAGE.ECC     | 00.500            | 03.000            | M, M        | BS-3799  | ASTM A 350 GR.LF2  | PBE         |
| CAP           | 00.500            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SCRIF, 3000 |
| CAP           | 02.000            | 06.000            | M           | B-16.9   | ASTM A 420 GR.WPL6 | BW          |
| PLUG          | 00.500            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SCRM, 3000  |
| COUPLING FULL | 00.500            | 00.75             |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 6000    |
| COUPLING FULL | 01.000            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 3000    |
| COUPLING HALF | 00.500            | 00.75             |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 6000    |
| COUPLING HALF | 01.000            | 01.500            |             | B-16.11  | ASTM A 350 GR.LF2  | SW, 3000    |

|                        |                                      |                        |            |
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| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD        | Material (Charpy)                                                  | Description                   |
|---------------------|-------------------|-------------------|-------------|-----------------|--------------------------------------------------------------------|-------------------------------|
| <b>O'let</b>        |                   |                   |             |                 |                                                                    |                               |
| WELDOLET            | 02.000            | 06.000            | M, XXS      | MSS-SP97        | ASTM A 350 GR.LF2                                                  | BW                            |
| SOCKOLET            | 00.500            | 00.750            |             | MSS-SP97        | ASTM A 350 GR.LF2                                                  | SW, 6000                      |
| SOCKOLET            | 01.000            | 01.500            |             | MSS-SP97        | ASTM A 350 GR.LF2                                                  | SW, 3000                      |
| <b>VALVES GROUP</b> |                   |                   |             |                 |                                                                    |                               |
| VLV.GLOBE           | 00.50             | 01.500            |             | BS EN 1SO 15761 | BODY-ASTM A 350 GR.LF2,TRIMSTELLIT ED, STEMSS304                   | SW, 800, 3000, B-16.11        |
| VLV.GLOBE           | 02.000            | 06.000            |             | BS-1873         | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB                         | FLGD, 150, B-16.5, RF/125AARH |
| VLV.CHECK           | 00.50             | 01.500            |             | BS EN 1SO 15761 | BODY-ASTM A 350 GR.LF2,                                            | SW, 800, 3000, B-16.11        |
| VLV.CHECK           | 02.000            | 06.000            |             | API-6D/BS-1868  | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB TRIM-STELLITED          | FLGD, 150, B-16.5, RF/125AARH |
| VLV.BALL            | 00.500            | 01.500            |             | BS EN 1SO 17292 | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,TRIM-BODY SEAT-RPTFE | SW, 800, 3000, B-16.11        |
| VLV.BALL            | 02.000            | 06.000            |             | API-6D          | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                     | FLGD, 150, B-16.5, RF/125AARH |
| VLV.BALL            | 02.000            | 06.000            |             | API-6D          | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                     | BW, 150, B-16.25              |

|                        |                                      |                        |            |
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| BOLT GROUP   |        |       |  |                           |                                   |             |
|--------------|--------|-------|--|---------------------------|-----------------------------------|-------------|
| BOLT.STUD    | 00.500 | 6.000 |  | B-18.2                    | BOLT:A320 GR.L7,<br>NUT:A194 GR.4 |             |
| GASKET GROUP |        |       |  |                           |                                   |             |
| GASKET       | 00.500 | 6.000 |  | B-16.20-<br>ANSI<br>B16.5 | SP.WND SS316+<br>GRAFOIL          | SPIRAL, 150 |

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

|                        |                                      |                        |            |
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## CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA

|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| <b>PIPE CLASS</b>   | <b>30HC</b>                                                                    |
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 300#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Non-IBR                                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |       |       |       |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|-------|-------|
| Temperature | -29   | 38    | 93    | 149   | 204   | 260   | 316   |
| Pressure    | 52.02 | 52.02 | 47.45 | 46.05 | 44.64 | 42.18 | 40.66 |

### NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:  
Radiography : All butt welds 100%  
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. Corrosion allowance of 1.5 mm has been considered for terminal piping.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets as enclosed.
8. Design Factor 0.5
9. 9. Ball Valve to be used in main pipeline shall have butt welded ends.

| ITEM               | SIZE             | DESCRIPTION                 |
|--------------------|------------------|-----------------------------|
| Maintenance joints | ALL              | Flanged, to be kept minimum |
| Pipe joints        | 1.5" & BELOW     | SW coupling                 |
|                    | 2.0" & ABOVE     | Butt welded                 |
| Drains             | ON LINES <= 1.5" | Refer std. drawing          |

|                                                                                                             |                                      |                        |            |
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|                   |                      |                                                                                 |
|-------------------|----------------------|---------------------------------------------------------------------------------|
|                   | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Vents             | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                   | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Temp. Connection  | 1.5"                 | Flanged, installation as per std. drawing, except skin temperature measurement. |
| Press. Connection | 0.75"                | SW nipple with Plug/ Ball Valve to spec. as per Refer std drawing               |

|                                                                                     |                                      |                        |            |
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**Branch Table**

|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |      |                    |
|----------------------|------|---|-----|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|------|--------------------|
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    | T  | 42   | BRANCH PIPE (INCH) |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    | T  | 36   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 32   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 30   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 24   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 20   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 18   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 16   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 14   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 12   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 10   |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 8    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 6    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 4    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 3    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 2    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 1.5  | 0.75               |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 1    |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 0.75 |                    |
|                      |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    | T  | T  | 0.50 |                    |
| 0.05                 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 32 | 36 | 42 |      |                    |
| PIPE RUN SIZE (INCH) |      |   |     |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |      |                    |

| CODES | DESCRIPTION |
|-------|-------------|
| T     | Tees        |
| W     | Weldolet    |
| S     | Sockolet    |

|                        |                               |                        |     |
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| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch ./ Thk | Dmn. STD      | Material (Charpy)                | Description     |
|---------------------|-------------------|-------------------|------------|---------------|----------------------------------|-----------------|
| <b>PIPE GROUP</b>   |                   |                   |            |               |                                  |                 |
| PIPE                | 00.500            | 00.750            | S160       | B-36.10       | ASTM A 106 GR.B                  | PE, SEAMLESS    |
| PIPE                | 01.000            | 01.500            | XS         | B-36.10       | ASTM A 106 GR.B                  | PE, SEAMLESS    |
| PIPE                | 02.000            | 02.000            | XS         | B-36.10       | ASTM A 106 GR.B (CHARPY)         | BE, SEAMLESS    |
| PIPE                | 03.000            | 14.000            | STD        | B-36.10       | ASTM A 106 GR.B (CHARPY)         | BE, SEAMLESS    |
| PIPE                | 16.000            | 20.000            | XS         | B-36.10       | ASTM A 672 Gr B65 CL-12 (CHARPY) | BE, E.FS.W      |
| PIPE                | 24.000            | 24.000            | S30        | B-36.10       | ASTM A 672 Gr B65 CL-12 (CHARPY) | BE, E.FS.W      |
| NIPPLE              | 00.500            | 01.500            | M          | B-36.10       | ASTM A 106 GR.B                  | PBE, SEAMLESS   |
| <b>FLANGE GROUP</b> |                   |                   |            |               |                                  |                 |
| FLNG.SW             | 00.500            | 01.500            | M          | B-16.5        | ASTM A 105                       | 300, RF/125AARH |
| FLNG.WN             | 02.000            | 24.000            | M          | B-16.5        | ASTM A 105 (CHARPY)              | 300, RF/125AARH |
| FLNG.BLIND          | 00.500            | 01.500            |            | B-16.5        | ASTM A 105                       | 300, RF/125AARH |
| FLNG.BLIND          | 02.000            | 24.000            |            | B-16.5        | ASTM A 105 (CHARPY)              | 300, RF/125AARH |
| FLNG.FIG.8          | 00.500            | 01.500            |            | ASME- B 16.48 | ASTM A 105                       | 300, FF/125AARH |

| Item                 | Lower Size (Inch) | Upper Size (Inch) | Sch ./ Thk | Dmn. STD      | Material (Charpy)   | Description     |
|----------------------|-------------------|-------------------|------------|---------------|---------------------|-----------------|
| FLNG.FIG.8           | 02.000            | 08.000            |            | ASME- B 16.48 | ASTM A 105 (CHARPY) | 300, FF/125AARH |
| SPCR&BLND            | 10.000            | 24.000            |            | ASME- B 16.48 | ASTM A 105 (CHARPY) | 300, FF/125AARH |
| <b>FITTING GROUP</b> |                   |                   |            |               |                     |                 |
| ELBOW.90             | 00.500            | 00.750            |            | B-16.11       | ASTM A 105          | SW, 6000        |

|                              |                                      |                        |            |
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|                |        |        |      |         |                               |            |
|----------------|--------|--------|------|---------|-------------------------------|------------|
| ELBOW.90       | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SW, 3000   |
| ELBOW.90       | 02.000 | 24.000 | M    | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW, 1.5D   |
| ELBOW.45       | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SW, 6000   |
| ELBOW.45       | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SW, 3000   |
| ELBOW.45       | 02.000 | 24.000 | M    | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW, 1.5D   |
| T.EQUAL        | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SW, 6000   |
| T.EQUAL        | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SW, 3000   |
| T.EQUAL        | 02.000 | 24.000 | M    | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW         |
| T.RED          | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SW, 6000   |
| T.RED          | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SW, 3000   |
| T.RED          | 02.000 | 24.000 | M, M | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW         |
| REDUC.<br>CONC | 02.000 | 24.000 | M, M | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW         |
| REDUC. ECC     | 02.000 | 24.000 | M, M | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW         |
| SWAGE.<br>CONC | 00.500 | 03.000 | M, M | BS-3799 | ASTM A 105 (CHARPY)           | PBE        |
| SWAGE.<br>ECC  | 00.500 | 03.000 | M, M | BS-3799 | ASTM A 105 (CHARPY)           | PBE        |
| CAP            | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SCRF, 6000 |
| CAP            | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SCRF, 3000 |
| CAP            | 02.000 | 24.000 | M    | B-16.9  | ASTM A 234 GR.WPB<br>(CHARPY) | BW         |
| PLUG           | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SCRM, 6000 |
| PLUG           | 01.000 | 01.500 |      | B-16.11 | STM A 105                     | SCRM, 3000 |
| CPLNG.FULL     | 00.500 | 00.750 |      | B-16.11 | ASTM A 105                    | SW, 6000   |
| CPLNG.FULL     | 01.000 | 01.500 |      | B-16.11 | ASTM A 105                    | SW, 3000   |
| CPLNG.HALF     | 00.500 | 0.750  |      | B-16.11 | ASTM A 105                    | SW, 6000   |

|                        |                                      |                        |            |
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|--------------------|-------------------|-------------------|-------------|--------------------|-----------------------------------------------------------|-------------------------------|
| CPLNG.HALF         | 01.000            | 01.500            |             | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| CPLNG.LH           | 00.500            | 00.750            |             | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| CPLNG.LH           | 01.000            | 01.500            |             | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| CPLNG.RED          | 00.500            | 00.750            |             | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| CPLNG.RED          | 01.000            | 01.500            |             | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| <b>O'let</b>       |                   |                   |             |                    |                                                           |                               |
| SOCKOLET           | 00.500            | 00.750            |             | MSS-SP97           | ASTM A 105                                                | SW, 6000                      |
| SOCKOLET           | 01.000            | 01.500            |             | MSS-SP97           | ASTM A 105                                                | SW, 3000                      |
| WELDOLET           | 02.000            | 08.000            | M, XX       | MSS-SP97           | ASTM A 105 (CHARPY)                                       | BW                            |
| <b>VALVE GROUP</b> |                   |                   |             |                    |                                                           |                               |
| VLV.GATE           | 00.500            | 01.500            |             | API-602            | BODY-ASTM A 105, TRIM- STELLITED, STEM 13%                | SW, 800, 3000, B-16.11        |
| VLV.GATE           | 02.000            | 24.000            |             | API 600/ ISO 10434 | BODY-ASTM A 105/ ASTM A 216 GR.WCB STELLITED, STEM- SS304 | FLGD, 300, B-16.5, RF/125AARH |
| VLV.GLOBE          | 00.500            | 01.500            |             | BS EN ISO 15761    | BODY-ASTM A 105, TRIM- STELLITED, STEM- 13%               | SW, 800, 3000, B-16.11        |
| VLV.GLOBE          | 02.000            | 24.000            |             | BS 1873            | BODY-ASTM A 105 / ASTM A 216 GR.WCB , TRIM-13% CR.STEEL   | FLGD, 300, B-16.5, RF/125AARH |
| VLV.CHECK          | 00.500            | 01.500            |             | BS EN ISO 15761    | BODY-ASTM A 105, TRIM- STELLITED                          | SW, 800, 3000, B-16.11        |
| VLV.CHECK          | 02.000            | 24.000            |             | API-6D/BS-1868     | BODY-ASTM A 105 / ASTM A 216 GR.WCB                       | FLGD, 300, B-16.5, RF/125AARH |

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| Item              | Lower Size (Inch) | Upper Size (Inch) | Sch . /Thk . | Dmn. STD             | Material (Charpy)                                     | Description                   |
|-------------------|-------------------|-------------------|--------------|----------------------|-------------------------------------------------------|-------------------------------|
| VLV.BALL          | 00.500            | 01.500            |              | BS EN 150 17292      | BODY-ASTM A 105,                                      | SW, 800, B-16.11, RF/125AARH  |
| VLV.BALL          | 02.000            | 24.000            |              | API-6D               | BODY-ASTM A 216 GR.WCB/ ASTM 105                      | FLGD, 300, B-16.5, RF/125AARH |
| VLV.BALL          | 02.000            | 24.000            | M            | API-6D               | BODY-ASTM A 216 GR.WCB/ASTM 105,                      | BW, 300, B-16.25              |
| VLV.PLUG          | 00.500            | 01.500            |              | BS-5353              | BODY-ASTM A 105, PLUG- A105 +0.003" ENP               | SW, 800#, 3000, B-16.11       |
| VLV.PLUG          | 02.000            | 24.000            |              | API-6D               | BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP    | FLGD, 300, B-16.5, RF/125AARH |
| VLV.PLUG          | 02.000            | 24.000            | M            | API-6D               | BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP | BW, 300, B-16.25              |
| <b>BOLT GROUP</b> |                   |                   |              |                      |                                                       |                               |
| BOLT.STUD         | 00.500            | 30.000            |              | B-18.2               | BOLT:A193 GR.B7, NUT:A194 GR.2H                       |                               |
| <b>GASKET</b>     |                   |                   |              |                      |                                                       |                               |
| GASKET            | 00.500            | 24.000            |              | B-16.20-ANSI B16.5   | SP.WND METTALIC WITH GRAPHITEFILLER                   | SPIRAL, 300                   |
| GASKET            | 26.000            | 30.000            |              | B-16.20-ANSI B16.47A | SP.WND METTALIC WITH GRAPHITEFILLER                   | SPIRAL, 300                   |

Note: For Valve Material, valve data sheet shall also be referred, stringent requirement among data sheet and above details shall be followed.

|                        |                                      |                        |            |
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### PIPE CLASS

**30HLT**

|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 300#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Low Temperature Service                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |       |       |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|-------|
| Temperature | -45   | 38    | 93    | 120   | 149   | 204   |
| Pressure    | 48.86 | 48.86 | 46.05 | 45.54 | 44.99 | 43.59 |

### NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:  
Radiography : All butt welds 100%  
MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
- Flanged end shall be as per ASME B 16.5 for valve up to 24" (excluding 22"), for 22" as per MSS-SP-44.
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 45°C.
- All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
- For valves, refer valve data sheets.

| ITEM               | SIZE             | DESCRIPTION                              |
|--------------------|------------------|------------------------------------------|
| Maintenance joints | ALL              | Flanged, to be kept minimum              |
| Pipe joints        | 1.5" & BELOW     | SW coupling                              |
|                    | 2.0" & ABOVE     | Butt welded                              |
| Drains             | ON LINES <= 1.5" | Refer std. drawing                       |
|                    | ON LINES >= 2.0" | As per P&ID or 0.75". Refer std. drawing |

|                                                                                                             |                                      |                        |            |
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|                   |                      |                                                                                 |
|-------------------|----------------------|---------------------------------------------------------------------------------|
| Vents             | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                   | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Temp. Connection  | 1.5"                 | Flanged, installation as per std. drawing, except skin temperature measurement. |
| Press. Connection | 0.75"                | SW nipple with Plug/ Ball Valve to spec. as per Refer std. drawing              |

**Branch Table**

|                      |      |   |     |   |   |   |   |   |    |    |    |    |   |      |                    |
|----------------------|------|---|-----|---|---|---|---|---|----|----|----|----|---|------|--------------------|
|                      |      |   |     |   |   |   |   |   |    |    |    |    | T | 16   | BRANCH PIPE (INCH) |
|                      |      |   |     |   |   |   |   |   |    |    |    | T  | T | 14   |                    |
|                      |      |   |     |   |   |   |   |   |    |    | T  | T  | T | 12   |                    |
|                      |      |   |     |   |   |   |   |   |    | T  | T  | T  | T | 10   |                    |
|                      |      |   |     |   |   |   |   |   | T  | T  | T  | T  | T | 8    |                    |
|                      |      |   |     |   |   |   |   | T | T  | T  | T  | T  | T | 6    |                    |
|                      |      |   |     |   |   |   | T | T | T  | T  | W  | W  | W | 4    |                    |
|                      |      |   |     |   |   | T | T | T | W  | W  | W  | W  | W | 3    |                    |
|                      |      |   |     |   | T | T | T | W | W  | W  | W  | W  | W | 2    |                    |
|                      |      |   |     | T | T | T | S | S | S  | S  | S  | S  | S | 1.5  |                    |
|                      |      |   | T   | T | T | S | S | S | S  | S  | S  | S  | S | 1    |                    |
|                      |      | T | T   | T | T | S | S | S | S  | S  | S  | S  | S | 0.75 |                    |
| T                    | T    | T | T   | S | S | S | S | S | S  | S  | S  | S  | S | 0.05 |                    |
| 0.05                 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |   |      |                    |
| PIPE RUN Size (INCH) |      |   |     |   |   |   |   |   |    |    |    |    |   |      |                    |



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| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD      | Material (Charpy)  | Description     |
|---------------------|-------------------|-------------------|-------------|---------------|--------------------|-----------------|
| <b>PIPE GROUP</b>   |                   |                   |             |               |                    |                 |
| PIPE                | 00.500            | 00.750            | S160        | B-36.10       | ASTM A 333 GR.6    | PE, SEAMLESS    |
| PIPE                | 01.000            | 01.500            | XS          | B-36.10       | ASTM A 333 GR.6    | PE, SEAMLESS    |
| PIPE                | 02.000            | 02.000            | XS          | B-36.10       | ASTM A 333 GR.6    | BE, SEAMLESS    |
| PIPE                | 03.000            | 14.000            | STD         | B-36.10       | ASTM A 333 GR.6    | BE, SEAMLESS    |
| NIPPLE              | 00.500            | 00.750            | M           | B-36.10       | ASTM A 333 GR.6    | PBE, SEAMLESS   |
| NIPPLE              | 01.000            | 01.500            | M           | B-36.10       | ASTM A 333 GR.6    | PBE, SEAMLESS   |
| <b>FLANGE GROUP</b> |                   |                   |             |               |                    |                 |
| FLNG.SW             | 00.500            | 01.500            | M           | B-16.5        | ASTM A 350 GR.LF2  | 300, RF/125AARH |
| FLNG.WN             | 02.000            | 14.000            | M           | B-16.5        | ASTM A 350 GR.LF2  | 300, RF/125AARH |
| FLNG.BLIN D         | 00.500            | 14.000            |             | B-16.5        | ASTM A 350 GR.LF2  | 300, RF/125AARH |
| FLNG.FIG.8          | 00.500            | 08.000            |             | ASME- B 16.48 | ASTM A 350 GR.LF2  | 300, FF/125AARH |
| SPCR&BLN D          | 10.000            | 14.000            |             | ASME- B16.48  | ASTM A 350 GR.LF2  | 300, FF/125AARH |
| <b>FITTINGS</b>     |                   |                   |             |               |                    |                 |
| ELBOW.90            | 00.500            | 00.750            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 6000        |
| ELBOW.90            | 01.000            | 01.500            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 3000        |
| ELBOW.90            | 02.000            | 14.000            | M           | B-16.9        | ASTM A 420 GR.WPL6 | BW, 1.5D        |
| ELBOW.45            | 00.500            | 00.750            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 6000        |
| ELBOW.45            | 01.000            | 01.500            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 3000        |
| ELBOW.45            | 02.000            | 14.000            | M           | B-16.9        | ASTM A 420 GR.WPL6 | BW, 1.5D        |
| T.EQUAL             | 00.500            | 00.750            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 6000        |
| T.EQUAL             | 01.000            | 01.500            |             | B-16.11       | ASTM A 350 GR.LF2  | SW, 3000        |

|                        |                                      |                        |            |
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| Item               | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD           | Material (Charpy)                                                | Description                   |
|--------------------|-------------------|-------------------|-------------|--------------------|------------------------------------------------------------------|-------------------------------|
| T.EQUAL            | 02.000            | 14.000            | M           | B-16.9             | ASTM A 420 GR.WPL6                                               | BW                            |
| <b>VALVE GROUP</b> |                   |                   |             |                    |                                                                  |                               |
| VLV.BALL           | 00.500            | 01.500            |             | BS EN ISO 17292    | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                   | SW, 800, 3000, B-16.11        |
| VLV.BALL           | 02.000            | 14.000            |             | API-6D             | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                   | FLGD, 300, B-16.5, RF/125AARH |
| VLV.GATE           | 00.500            | 01.500            |             | API-602            | BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS                   | SW, 800, 3000, B-16.11        |
| VLV.GATE           | 02.000            | 14.000            |             | API 600/ ISO 10434 | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB STELLITED,STEM- SS304 | FLGD, 300, B-16.5, RF/125AARH |
| VLV.GLOBE          | 00.500            | 01.500            |             | BS EN ISO 15761    | BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS304                | SW, 800, 3000, B-16.11        |
| VLV.GLOBE          | 02.000            | 14.000            |             | BS-1873            | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB                       | FLGD, 300, B-16.5, RF/125AARH |
| VLV.CHECK          | 00.500            | 01.500            |             | BS EN ISO 15761    | BODY-ASTM A 350 GR.LF2,TRIM- STELLITED                           | SW, 800, 3000, B-16.11        |
| VLV.CHECK          | 02.000            | 14.000            |             | API-6D/BS-1868     | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB TRIM-STELLITED        | FLGD, 300, B-16.5, RF/125AARH |
| VLV.PLUG           | 00.500            | 01.500            |             | BS-5353            | BODY-ASTM A 350 GR.LF2, PLUG: A350 GR.LF2 + 0.003" ENP           | SW, 800, 3000, B-16.11        |
| VLV.PLUG           | 02.000            | 14.000            |             | API-6D             | BODY-ASTM A 352 GR.LCB / A350 GR.LF2,                            | FLGD, 300, B-16.5, RF/125AARH |

|                               |                                      |                        |            |
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|                          |        |        |  |                    |                                          |                  |
|--------------------------|--------|--------|--|--------------------|------------------------------------------|------------------|
| VLV.PLUG                 | 02.000 | 14.000 |  | API-6D             | BODY-ASTM A 352 GR.LCB/ ASTM A350GR.LF2, | BW, 300, B-16.25 |
| <b>BOLT &amp; GASKET</b> |        |        |  |                    |                                          |                  |
| BOLT.STUD                | 00.500 | 14.000 |  | B-18.2             | BOLT:A320 GR.L7, NUT:A194 GR.4           |                  |
| GASKET                   | 00.500 | 14.000 |  | B-16.20-ANSI B16.5 | SP.WND METTALIC WITH GRAPHITEFILLER      | SPIRAL, 300      |

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

|                        |                                      |                        |            |
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|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| <b>PIPE CLASS</b>   | <b>60HC</b>                                                                    |
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 600#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Non-IBR                                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |        |        |       |       |
|-------------|--------|--------|-------|-------|
| Temperature | (-)29  | 38     | 93    | 149   |
| Pressure    | 104.05 | 104.05 | 94.91 | 92.45 |

### NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:  
Radiography : All butt welds 100%  
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. Corrosion allowance of 1.5 mm has been considered for terminal piping.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets as enclosed.
8. Design Factor 0.5
9. 9. Ball Valve to be used in main pipeline shall have butt welded ends.

| ITEM               | SIZE | DESCRIPTION                 |
|--------------------|------|-----------------------------|
| Maintenance joints | ALL  | Flanged, to be kept minimum |

|                                                                                                             |                                      |                        |            |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------|------------|
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|                   |                      |                                                                                 |
|-------------------|----------------------|---------------------------------------------------------------------------------|
| Pipe joints       | 1.5" & BELOW         | SW coupling                                                                     |
|                   | 2.0" & ABOVE         | Butt welded                                                                     |
| Drains            | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                   | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Vents             | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                   | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Temp. Connection  | 1.5"                 | Flanged, installation as per std. drawing, except skin temperature measurement. |
| Press. Connection | 0.75"                | SW nipple with Plug/ Ball Valve to spec. as per Refer std drawing               |

|                                                                                     |                                      |                        |            |
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[illegible]

| <b>CODES</b> | <b>DESCRIPTION</b> |
|--------------|--------------------|
| T            | Tees               |
| W            | Weldolet           |
| S            | Sockolet           |

|                                                                                                           |                                      |                        |            |
|-----------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------|------------|
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| Item                | Lower Size (Inch) | Upper Size (Inch) | Sch . / Thk   | Dmn. STD      | Material (Charpy)        | Description     |
|---------------------|-------------------|-------------------|---------------|---------------|--------------------------|-----------------|
| <b>PIPE GROUP</b>   |                   |                   |               |               |                          |                 |
| PIPE                | 00.500            | 00.750            | S160          | B-36.10       | ASTM A 106 GR.B          | PE, SEAMLESS    |
| PIPE                | 01.000            | 01.500            | XS            | B-36.10       | ASTM A 106 GR.B          | PE, SEAMLESS    |
| PIPE                | 02.000            | 08.000            | XS            | B-36.10       | ASTM A 106 GR.B (CHARPY) | BE, SEAMLESS    |
| PIPE                | 10.000            |                   | 14.27         | B-36.10       | ASTM A 106 GR.B (CHARPY) | BE, SEAMLESS    |
| PIPE                | 12.000            |                   | 17.48         | B-36.10       | ASTM A 106 GR.B (CHARPY) | BE, SEAMLESS    |
| PIPE                | 14.000            |                   | As Calculated | B-36.10       | ASTM A 106 GR.B (CHARPY) | BE, E.FS.W      |
| PIPE                | 16.000            |                   | As Calculated | B-36.10       | ASTM A 106 GR.B (CHARPY) | BE, E.FS.W      |
| NIPPLE              | 00.500            | 01.500            | M             | B-36.10       | ASTM A 106 GR.B          | PBE, SEAMLESS   |
| <b>FLANGE GROUP</b> |                   |                   |               |               |                          |                 |
| FLNG.SW             | 00.500            | 01.500            | M             | B-16.5        | ASTM A 105               | 600, RF/125AARH |
| FLNG.WN             | 02.000            | 24.000            | M             | B-16.5        | ASTM A 105 (CHARPY)      | 600, RF/125AARH |
| FLNG.BLIND          | 00.500            | 01.500            |               | B-16.5        | ASTM A 105               | 600, RF/125AARH |
| FLNG.BLIND          | 02.000            | 24.000            |               | B-16.5        | ASTM A 105 (CHARPY)      | 600, RF/125AARH |
| FLNG.FIG.8          | 00.500            | 01.500            |               | ASME- B 16.48 | ASTM A 105               | 600, FF/125AARH |

|                        |                                      |                        |            |
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| Item                 | Lower Size (Inch) | Upper Size (Inch) | Sch ./ Thk | Dmn. STD      | Material (Charpy)          | Description     |
|----------------------|-------------------|-------------------|------------|---------------|----------------------------|-----------------|
| FLNG.FIG.8           | 02.000            | 08.000            |            | ASME- B 16.48 | ASTM A 105 (CHARPY)        | 600, FF/125AARH |
| SPCR&BLND            | 10.000            | 24.000            |            | ASME- B 16.48 | ASTM A 105 (CHARPY)        | 600, FF/125AARH |
| <b>FITTING GROUP</b> |                   |                   |            |               |                            |                 |
| ELBOW.90             | 00.500            | 00.750            |            | B-16.11       | ASTM A 105                 | SW, 6000        |
| ELBOW.90             | 01.000            | 01.500            |            | B-16.11       | ASTM A 105                 | SW, 3000        |
| ELBOW.90             | 02.000            | 24.000            | M          | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW, 1.5D        |
| ELBOW.45             | 00.500            | 00.750            |            | B-16.11       | ASTM A 105                 | SW, 6000        |
| ELBOW.45             | 01.000            | 01.500            |            | B-16.11       | ASTM A 105                 | SW, 3000        |
| ELBOW.45             | 02.000            | 24.000            | M          | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW, 1.5D        |
| T.EQUAL              | 00.500            | 00.750            |            | B-16.11       | ASTM A 105                 | SW, 6000        |
| T.EQUAL              | 01.000            | 01.500            |            | B-16.11       | ASTM A 105                 | SW, 3000        |
| T.EQUAL              | 02.000            | 24.000            | M          | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW              |
| T.RED                | 00.500            | 00.750            |            | B-16.11       | ASTM A 105                 | SW, 6000        |
| T.RED                | 01.000            | 01.500            |            | B-16.11       | ASTM A 105                 | SW, 3000        |
| T.RED                | 02.000            | 24.000            | M, M       | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW              |
| REDUC. CONC          | 02.000            | 24.000            | M, M       | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW              |
| REDUC. ECC           | 02.000            | 24.000            | M, M       | B-16.9        | ASTM A 234 GR.WPB (CHARPY) | BW              |
| SWAGE. CONC          | 00.500            | 03.000            | M, M       | BS-3799       | ASTM A 105 (CHARPY)        | PBE             |
| SWAGE. ECC           | 00.500            | 03.000            | M, M       | BS-3799       | ASTM A 105 (CHARPY)        | PBE             |
| CAP                  | 00.500            | 00.750            |            | B-16.11       | ASTM A 105                 | SCRf, 6000      |
| CAP                  | 01.000            | 01.500            |            | B-16.11       | ASTM A 105                 | SCRf, 3000      |

|                        |                                      |                        |            |
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| CAP         | 02.000            | 24.000            | M            | B-16.9             | ASTM A 234 GR.WPB (CHARPY)                                | BW                            |
|-------------|-------------------|-------------------|--------------|--------------------|-----------------------------------------------------------|-------------------------------|
| PLUG        | 00.500            | 00.750            |              | B-16.11            | ASTM A 105                                                | SCRM, 6000                    |
| PLUG        | 01.000            | 01.500            |              | B-16.11            | STM A 105                                                 | SCRM, 3000                    |
| CPLNG.FULL  | 00.500            | 00.750            |              | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| CPLNG.FULL  | 01.000            | 01.500            |              | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| CPLNG.HALF  | 00.500            | 0.750             |              | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| Item        | Lower Size (Inch) | Upper Size (Inch) | Sch . /Thk . | Dmn. STD           | Material (Charpy)                                         | Description                   |
| CPLNG.HALF  | 01.000            | 01.500            |              | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| CPLNG.LH    | 00.500            | 00.750            |              | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| CPLNG.LH    | 01.000            | 01.500            |              | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| CPLNG.RED   | 00.500            | 00.750            |              | B-16.11            | ASTM A 105                                                | SW, 6000                      |
| CPLNG.RED   | 01.000            | 01.500            |              | B-16.11            | ASTM A 105                                                | SW, 3000                      |
| O'let       |                   |                   |              |                    |                                                           |                               |
| SOCKOLET    | 00.500            | 00.750            |              | MSS-SP97           | ASTM A 105                                                | SW, 6000                      |
| SOCKOLET    | 01.000            | 01.500            |              | MSS-SP97           | ASTM A 105                                                | SW, 3000                      |
| WELDOLET    | 02.000            | 08.000            | M, XX        | MSS-SP97           | ASTM A 105 (CHARPY)                                       | BW                            |
| VALVE GROUP |                   |                   |              |                    |                                                           |                               |
| VLV.GATE    | 00.500            | 01.500            |              | API-602            | BODY-ASTM A 105, TRIM- STELLITED, STEM 13%                | SW, 800, 3000, B-16.11        |
| VLV.GATE    | 02.000            | 24.000            |              | API 600/ ISO 10434 | BODY-ASTM A 105/ ASTM A 216 GR.WCB STELLITED, STEM- SS304 | FLGD, 600, B-16.5, RF/125AARH |
| VLV.GLOBE   | 00.500            | 01.500            |              | BS EN ISO 15761    | BODY-ASTM A 105, TRIM- STELLITED, STEM- 13%               | SW, 800, 3000, B-16.11        |

|                        |                                      |                        |            |
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| VLV.GLOBE         | 02.000            | 24.000            |              | BS 1873            | BODY-ASTM A 105 / ASTM A 216 GR.WCB , TRIM-13% CR.STEEL | FLGD, 600, B-16.5, RF/125AARH |
|-------------------|-------------------|-------------------|--------------|--------------------|---------------------------------------------------------|-------------------------------|
| VLV.CHECK         | 00.500            | 01.500            |              | BS EN 15015761     | BODY-ASTM A 105, TRIM- STELLITED                        | SW, 800, 3000, B-16.11        |
| VLV.CHECK         | 02.000            | 24.000            |              | API-6D/BS-1868     | BODY-ASTM A 105 / ASTM A 216 GR.WCB                     | FLGD, 600, B-16.5, RF/125AARH |
| Item              | Lower Size (Inch) | Upper Size (Inch) | Sch . /Thk . | Dmn. STD           | Material (Charpy)                                       | Description                   |
| VLV.BALL          | 00.500            | 01.500            |              | BS EN 15017292     | BODY-ASTM A 105,                                        | SW, 800, B-16.11, RF/125AARH  |
| VLV.BALL          | 02.000            | 24.000            |              | API-6D             | BODY-ASTM A 216 GR.WCB/ ASTM 105                        | FLGD, 600, B-16.5, RF/125AARH |
| VLV.BALL          | 02.000            | 24.000            | M            | API-6D             | BODY-ASTM A 216 GR.WCB/ASTM 105,                        | BW, 600, B-16.25              |
| VLV.PLUG          | 00.500            | 01.500            |              | BS-5353            | BODY-ASTM A 105, PLUG- A105 +0.003" ENP                 | SW, 800#, 3000, B-16.11       |
| VLV.PLUG          | 02.000            | 24.000            |              | API-6D             | BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP      | FLGD, 600, B-16.5, RF/125AARH |
| VLV.PLUG          | 02.000            | 24.000            | M            | API-6D             | BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP   | BW, 600, B-16.25              |
| <b>BOLT GROUP</b> |                   |                   |              |                    |                                                         |                               |
| BOLT.STUD         | 00.500            | 30.000            |              | B-18.2             | BOLT:A193 GR.B7, NUT:A194 GR.2H                         |                               |
| <b>GASKET</b>     |                   |                   |              |                    |                                                         |                               |
| GASKET            | 00.500            | 24.000            |              | B-16.20-ANSI B16.5 | SP.WND METTALIC WITH GRAPHITEFILLER                     | SPIRAL, 600                   |

|                        |                                      |                        |            |
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|        |        |        |  |                         |                                     |             |
|--------|--------|--------|--|-------------------------|-------------------------------------|-------------|
| GASKET | 26.000 | 30.000 |  | B-16.20-ANSI<br>B16.47A | SP.WND METTALIC WITH GRAPHITEFILLER | SPIRAL, 600 |
|--------|--------|--------|--|-------------------------|-------------------------------------|-------------|

Note: For Valve Material, valve data sheet shall also be referred, stringent requirement among data sheet and above details shall be followed.

### PIPE CLASS

### 60HLT

|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| DESIGN CODE         | ASME B31.8                                                                     |
| RATING              | 600#                                                                           |
| BASE MATERIAL       | CARBON STEEL                                                                   |
| CA                  | 1.5 MM                                                                         |
| SPECIAL REQUIREMENT | Low Temperature Service                                                        |
| SERVICE             | Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide) |

### Temperature (Deg. C) and Pressure (Kg/cm<sup>2</sup>g) Ratings

|             |       |       |       |       |
|-------------|-------|-------|-------|-------|
| Temperature | -45   | 38    | 93    | 120   |
| Pressure    | 98.07 | 98.07 | 92.79 | 91.27 |

### NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:
  - Radiography : All butt welds 100%
  - MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
- Flanged end shall be as per ASME B 16.5 for valve up to 24" (excluding 22"), for 22" as per MSS-SP-44.
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 45°C.

|                        |                                      |                        |            |
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6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets.

| ITEM               | SIZE                 | DESCRIPTION                                                                     |
|--------------------|----------------------|---------------------------------------------------------------------------------|
| Maintenance joints | ALL                  | Flanged, to be kept minimum                                                     |
| Pipe joints        | 1.5" & BELOW         | SW coupling                                                                     |
|                    | 2.0" & ABOVE         | Butt welded                                                                     |
| Drains             | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                    | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Vents              | ON LINES $\leq 1.5"$ | Refer std. drawing                                                              |
|                    | ON LINES $\geq 2.0"$ | As per P&ID or 0.75". Refer std. drawing                                        |
| Temp. Connection   | 1.5"                 | Flanged, installation as per std. drawing, except skin temperature measurement. |
| Press. Connection  | 0.75"                | SW nipple with Plug/ Ball Valve to spec. as per Refer std. drawing              |

**Branch Table**

|  |  |  |  |  |  |  |  |  |  |  |   |    |                    |    |    |    |   |   |   |   |     |
|--|--|--|--|--|--|--|--|--|--|--|---|----|--------------------|----|----|----|---|---|---|---|-----|
|  |  |  |  |  |  |  |  |  |  |  | T | 16 | BRANCH PIPE (INCH) |    |    |    |   |   |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | 14 |    |    |   |   |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | 12 |    |   |   |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | T  | 10 |   |   |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | T  | T  | 8 |   |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | T  | T  | T | 6 |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | W  | W  | W | 4 |   |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | W  | W  | W | W | 3 |   |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | W  | W  | W | W | W | 2 |     |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | S  | S  | S | S | S | S | 1.5 |
|  |  |  |  |  |  |  |  |  |  |  | T | T  |                    | T  | S  | S  | S | S | S | S | S   |

|                           |                                      |                        |            |
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|----------------------|------|---|-----|---|---|---|---|---|----|----|----|----|------|--|
|                      | T    | T | T   | T | S | S | S | S | S  | S  | S  | S  | 0.75 |  |
| T                    | T    | T | T   | S | S | S | S | S | S  | S  | S  | S  | 0.05 |  |
| 0.05                 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |      |  |
| PIPE RUN Size (INCH) |      |   |     |   |   |   |   |   |    |    |    |    |      |  |

### CODES

T  
W  
S

### DESCRIPTION

Tees  
Weldolet  
Sockolet

| Item         | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD      | Material (Charpy) | Description     |
|--------------|-------------------|-------------------|-------------|---------------|-------------------|-----------------|
| PIPE GROUP   |                   |                   |             |               |                   |                 |
| PIPE         | 00.500            | 00.750            | S160        | B-36.10       | ASTM A 333 GR.6   | PE, SEAMLESS    |
| PIPE         | 01.000            | 01.500            | XS          | B-36.10       | ASTM A 333 GR.6   | PE, SEAMLESS    |
| PIPE         | 02.000            | 08.000            | XS          | B-36.10       | ASTM A 333 GR.6   | BE, SEAMLESS    |
| PIPE         | 10.000            |                   | 14.27       | B-36.10       | ASTM A 333 GR.6   | BE, SEAMLESS    |
| PIPE         | 12.000            |                   | 17.48       | B-36.10       | ASTM A 333 GR.6   | PBE, SEAMLESS   |
| NIPPLE       | 00.500            | 00.750            | M           | B-36.10       | ASTM A 333 GR.6   | PBE, SEAMLESS   |
| NIPPLE       | 01.000            | 01.500            | M           | B-36.10       | ASTM A 333 GR.6   | PBE, SEAMLESS   |
| FLANGE GROUP |                   |                   |             |               |                   |                 |
| FLNG.SW      | 00.500            | 01.500            | M           | B-16.5        | ASTM A 350 GR.LF2 | 600, RF/125AARH |
| FLNG.WN      | 02.000            | 14.000            | M           | B-16.5        | ASTM A 350 GR.LF2 | 600, RF/125AARH |
| FLNG.BLIN D  | 00.500            | 14.000            |             | B-16.5        | ASTM A 350 GR.LF2 | 600, RF/125AARH |
| FLNG.FIG.8   | 00.500            | 08.000            |             | ASME- B 16.48 | ASTM A 350 GR.LF2 | 600, FF/125AARH |
| SPCR&BLN D   | 10.000            | 14.000            |             | ASME- B16.48  | ASTM A 350 GR.LF2 | 600, FF/125AARH |
| FITTINGS     |                   |                   |             |               |                   |                 |

|                        |                                      |                        |            |
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| ELBOW.90    | 00.500            | 00.750            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 6000                      |
|-------------|-------------------|-------------------|-------------|--------------------|------------------------------------------------------------------|-------------------------------|
| ELBOW.90    | 01.000            | 01.500            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 3000                      |
| ELBOW.90    | 02.000            | 14.000            | M           | B-16.9             | ASTM A 420 GR.WPL6                                               | BW, 1.5D                      |
| ELBOW.45    | 00.500            | 00.750            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 6000                      |
| ELBOW.45    | 01.000            | 01.500            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 3000                      |
| ELBOW.45    | 02.000            | 14.000            | M           | B-16.9             | ASTM A 420 GR.WPL6                                               | BW, 1.5D                      |
| T.EQUAL     | 00.500            | 00.750            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 6000                      |
| T.EQUAL     | 01.000            | 01.500            |             | B-16.11            | ASTM A 350 GR.LF2                                                | SW, 3000                      |
| Item        | Lower Size (Inch) | Upper Size (Inch) | Sch. / Thk. | Dmn. STD           | Material (Charpy)                                                | Description                   |
| T.EQUAL     | 02.000            | 14.000            | M           | B-16.9             | ASTM A 420 GR.WPL6                                               | BW                            |
| VALVE GROUP |                   |                   |             |                    |                                                                  |                               |
| VLV.BALL    | 00.500            | 01.500            |             | BS EN ISO 17292    | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                   | SW, 800, 3000, B-16.11        |
| VLV.BALL    | 02.000            | 14.000            |             | API-6D             | BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,                   | FLGD, 600, B-16.5, RF/125AARH |
| VLV.GATE    | 00.500            | 01.500            |             | API-602            | BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS                   | SW, 800, 3000, B-16.11        |
| VLV.GATE    | 02.000            | 14.000            |             | API 600/ ISO 10434 | BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB STELLITED,STEM- SS304 | FLGD, 600, B-16.5, RF/125AARH |
| VLV.GLOBE   | 00.500            | 01.500            |             | BS EN ISO 15761    | BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS304                | SW, 800, 3000, B-16.11        |

|                                                                                                           |                                      |                        |            |
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| VLV.GLOBE                | 02.000 | 14.000 |  | BS-1873                | BODY-ASTM A 350<br>GR.LF2,/ ASTM A 352<br>GR.LCB                    | FLGD, 600,<br>B-16.5,<br>RF/125AARH |
| VLV.CHECK                | 00.500 | 01.500 |  | BS EN ISO<br>15761     | BODY-ASTM A 350<br>GR.LF2,TRIM- STELLITED                           | SW, 800, 3000,<br>B-16.11           |
| VLV.CHECK                | 02.000 | 14.000 |  | API-6D/BS-<br>1868     | BODY-ASTM A 350<br>GR.LF2,/ ASTM A 352<br>GR.LCB TRIM-<br>STELLITED | FLGD, 600,<br>B-16.5,<br>RF/125AARH |
| VLV.PLUG                 | 00.500 | 01.500 |  | BS-5353                | BODY-ASTM A 350<br>GR.LF2, PLUG: A350<br>GR.LF2 + 0.003" ENP        | SW, 800, 3000,<br>B-16.11           |
| VLV.PLUG                 | 02.000 | 14.000 |  | API-6D                 | BODY-ASTM A 352<br>GR.LCB / A350<br>GR.LF2,                         | FLGD, 600,<br>B-16.5,<br>RF/125AARH |
| VLV.PLUG                 | 02.000 | 14.000 |  | API-6D                 | BODY-ASTM A 352<br>GR.LCB/ ASTM<br>A350GR.LF2,                      | BW, 600, B-16.25                    |
| <b>BOLT &amp; GASKET</b> |        |        |  |                        |                                                                     |                                     |
| BOLT.STUD                | 00.500 | 14.000 |  | B-18.2                 | BOLT:A320 GR.L7,<br>NUT:A194 GR.4                                   |                                     |
| GASKET                   | 00.500 | 14.000 |  | B-16.20-<br>ANSI B16.5 | SP.WND METTALIC WITH<br>GRAPHITEFILLER                              | SPIRAL, 600                         |

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

|                                                                                                           |                                      |                        |            |
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# DATA SHEET

|                                                                                    |                                           |                                                                         |            |                                           |      |                                                                                     |                |
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|   |                                           | <b>CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA</b> |            |                                           |      |  |                |
| CLIENT                                                                             |                                           | HPOIL GAS PRIVATE LIMITED (HOGPL)                                       |            |                                           |      |                                                                                     |                |
| PMC                                                                                |                                           | VCS QUALITY SERVICES PVT. LTD.                                          |            |                                           |      |                                                                                     |                |
| <b>DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED</b>                  |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| <b>GENERAL SPECIFICATION</b>                                                       |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| Process Fluid                                                                      | NG                                        | ANSI Pressure Rating                                                    |            | 800#                                      |      |                                                                                     |                |
| Design Temperature                                                                 | (-)29°C to 65°C                           | Design Pressure                                                         |            | 49 barg                                   |      |                                                                                     |                |
| Size, Inch (DN)                                                                    | Less than 2" (50)                         |                                                                         |            |                                           |      |                                                                                     |                |
| Valve Type                                                                         | Full Bore, Floating Ball                  |                                                                         |            |                                           |      |                                                                                     |                |
| End Connection Type                                                                | Socket Welded                             | Design Standard                                                         |            | BS EN ISO 17292                           |      |                                                                                     |                |
| Face Finish                                                                        | Not Applicable                            | Locking Arrangement                                                     |            |                                           |      |                                                                                     |                |
| <b>VALVE DESIGN CONDITIONS</b>                                                     |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| Corrosion Allowance                                                                | 1.5 mm                                    | Design Factor                                                           |            | 0.4                                       |      |                                                                                     |                |
| Installation                                                                       | Above Ground                              | Stem Ext Length (mm)                                                    |            | Not Applicable                            |      |                                                                                     |                |
| <b>VALVE OPERATION</b>                                                             |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| Actuation Type                                                                     | Not Applicable                            | Type of Actuator                                                        |            | Not Applicable                            |      |                                                                                     |                |
| <b>PUP PIECE DETAILS</b>                                                           |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| 100mm extension pups in ASTM A106 Gr.B, Sch 160 (for 3/4") and Sch XS (for 1 1/2") |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| <b>VALVE MATERIAL SPECIFICATION</b>                                                |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| PART DESCRIPTION                                                                   | MATERIAL SPECIFIED                        |                                                                         |            | MATERIAL OFFERED (Equivalent or Higher)   |      |                                                                                     |                |
| Body                                                                               | ASTM A105                                 |                                                                         |            |                                           |      |                                                                                     |                |
| Ball                                                                               | 13% Cr Steel                              |                                                                         |            |                                           |      |                                                                                     |                |
| Body Seat                                                                          | RPTFE/ DELRIN                             |                                                                         |            |                                           |      |                                                                                     |                |
| Gland                                                                              | 13% Cr Steel                              |                                                                         |            |                                           |      |                                                                                     |                |
| Stem (No Casting)                                                                  | 13% Cr Steel                              |                                                                         |            |                                           |      |                                                                                     |                |
| Body Seal                                                                          | Grafoil                                   |                                                                         |            |                                           |      |                                                                                     |                |
| Stem Seal                                                                          | Grafoil                                   |                                                                         |            |                                           |      |                                                                                     |                |
| Body Studs/ Nuts                                                                   | ASTM A193 Gr. B7/ A194 Gr. 2H             |                                                                         |            |                                           |      |                                                                                     |                |
| <b>TESTING REQUIREMENT</b>                                                         |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| Hydrostatic Test Pressure & Time                                                   | Body: 210 kg/cm <sup>2</sup> & 30 Minutes |                                                                         |            | Seat: 155 kg/cm <sup>2</sup> & 30 Minutes |      |                                                                                     |                |
| Pneumatic Test Pressure & Time                                                     | 7 kg/cm <sup>2</sup> & 15 Minutes         |                                                                         |            |                                           |      |                                                                                     |                |
| Hardness Test                                                                      | 248 HV10 max.                             |                                                                         |            |                                           |      |                                                                                     |                |
| Charpy Impact Test @ Temperature                                                   | Yes (at -29°C)                            |                                                                         |            |                                           |      |                                                                                     |                |
| Anti-Static Testing Requirement                                                    | As per BS EN ISO 17292                    |                                                                         |            |                                           |      |                                                                                     |                |
| Fire Safe Test                                                                     | API 607 / API 6FA                         |                                                                         |            |                                           |      |                                                                                     |                |
| DOCUMENT NO.                                                                       |                                           |                                                                         |            |                                           |      |                                                                                     |                |
| C261162-00-PP-DS-2001A                                                             |                                           |                                                                         |            |                                           |      |                                                                                     |                |
|                                                                                    |                                           | D1                                                                      | 27.01.2026 | AS                                        | PA   | DK                                                                                  | ISSUED FOR BID |
| SHEET NO.                                                                          | 1 OF 2                                    | REV                                                                     | DATE       | PRPD                                      | CHKD | APVD                                                                                | REMARKS        |





|                                                                                    |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------|-----------------------------------------------|------|-------------------------------------------------------------------------------------|----------------|
|   |                                                                                    | <b>ITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA</b> |            |                                               |      |  |                |
| CLIENT                                                                             |                                                                                    | HOGPL (HPOIL GAS PVT. LTD.)                                            |            |                                               |      |                                                                                     |                |
| PMC                                                                                |                                                                                    | VCS QUALITY SERVICES PVT. LTD.                                         |            |                                               |      |                                                                                     |                |
| <b>DATA SHEET : GLOBE VALVE (LESS THAN 2.0 INCH) SOCKET WELDED</b>                 |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| <b>GENERAL SPECIFICATION</b>                                                       |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| Process Fluid                                                                      | NG                                                                                 | ANSI Pressure Rating                                                   |            | 800#                                          |      |                                                                                     |                |
| Design Temperature                                                                 | (-)29°C to 65°C                                                                    | Design Pressure                                                        |            | 49 barg                                       |      |                                                                                     |                |
| Size, Inch (DN)                                                                    | Less than 2" (50)                                                                  |                                                                        |            |                                               |      |                                                                                     |                |
| Valve Type                                                                         | Rising Stem                                                                        |                                                                        |            |                                               |      |                                                                                     |                |
| End Connection Type                                                                | Socket Welded                                                                      | Design Standard                                                        |            | BS 5352                                       |      |                                                                                     |                |
| Face Finish                                                                        | Not Applicable                                                                     | Locking Arrangement                                                    |            |                                               |      |                                                                                     |                |
| <b>VALVE DESIGN CONDITIONS</b>                                                     |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| Corrosion Allowance                                                                | 1.5 mm                                                                             | Design Factor                                                          |            | 0.4                                           |      |                                                                                     |                |
| Installation                                                                       | Above Ground                                                                       | Stem Ext Length (mm)                                                   |            | Not Applicable                                |      |                                                                                     |                |
| <b>VALVE OPERATION</b>                                                             |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| Actuation Type                                                                     | Not Applicable                                                                     | Type of Actuator                                                       |            | Not Applicable                                |      |                                                                                     |                |
| <b>PUP PIECE DETAILS</b>                                                           |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| 100mm extension pups in ASTM A106 Gr.B, Sch 160 (for 3/4") and Sch XS (for 1 1/2") |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| <b>VALVE MATERIAL SPECIFICATION</b>                                                |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| PART DESCRIPTION                                                                   | MATERIAL SPECIFIED                                                                 |                                                                        |            | MATERIAL OFFERED (Equivalent or Higher)       |      |                                                                                     |                |
| Body                                                                               | ASTM A105                                                                          |                                                                        |            |                                               |      |                                                                                     |                |
| Bonnet (Bolted)                                                                    | ASTM A105                                                                          |                                                                        |            |                                               |      |                                                                                     |                |
| Disc (Loose Plug/ Ball Type)                                                       | SS316 + Stellite                                                                   |                                                                        |            |                                               |      |                                                                                     |                |
| Stem (Rising)                                                                      | 13% Cr Steel (No Casting)                                                          |                                                                        |            |                                               |      |                                                                                     |                |
| Body Seat Ring                                                                     | SS316 + Stellite                                                                   |                                                                        |            |                                               |      |                                                                                     |                |
| Stem Packing (Renewable with valve open on stream)                                 | Corrosion inhibited die formed flexible graphite with braided anti extrusion rings |                                                                        |            |                                               |      |                                                                                     |                |
| Hand Wheel (Rising)                                                                | Malleable Iron/ Cast Steel/ Fab. Steel                                             |                                                                        |            |                                               |      |                                                                                     |                |
| Bonnet Gasket                                                                      | Spiral Wound SS316 + Grafoil                                                       |                                                                        |            |                                               |      |                                                                                     |                |
| Body Studs/ Nuts                                                                   | ASTM A193 Gr. B7/ A194 Gr. 2H                                                      |                                                                        |            |                                               |      |                                                                                     |                |
| <b>TESTING REQUIREMENT</b>                                                         |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| Hydrostatic Test Pressure & Time                                                   | Body: 210 kg/cm <sup>2</sup> & as per BS 5352                                      |                                                                        |            | Seat: 155 kg/cm <sup>2</sup> & as per BS 5352 |      |                                                                                     |                |
| Pneumatic Test Pressure & Time                                                     | 7 kg/cm <sup>2</sup> & as per BS 5352                                              |                                                                        |            |                                               |      |                                                                                     |                |
| Hardness Test                                                                      | 248 HV10 max.                                                                      |                                                                        |            |                                               |      |                                                                                     |                |
| Charpy Impact Test @ Temperature                                                   | Yes (at -29°C)                                                                     |                                                                        |            |                                               |      |                                                                                     |                |
| Fire Safe Test                                                                     | API 607 / ISO10497                                                                 |                                                                        |            |                                               |      |                                                                                     |                |
| DOCUMENT NO.                                                                       |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
| C261162-00-PP-DS-2001B                                                             |                                                                                    |                                                                        |            |                                               |      |                                                                                     |                |
|                                                                                    |                                                                                    | D1                                                                     | 27.01.2026 | AS                                            | PA   | DK                                                                                  | ISSUED FOR BID |
| SHEET NO.                                                                          | 1 OF 2                                                                             | REV                                                                    | DATE       | PRPD                                          | CHKD | APVD                                                                                | REMARKS        |



|                        |        |     |            |      |      |      |                |
|------------------------|--------|-----|------------|------|------|------|----------------|
| DOCUMENT NO.           |        |     |            |      |      |      |                |
| C261162-00-PP-DS-2001B |        |     |            |      |      |      |                |
|                        |        | D1  | 27.01.2026 | AS   | PA   | DK   | ISSUED FOR BID |
| SHEET NO.              | 2 OF 2 | REV | DATE       | PRPD | CHKD | APVD | REMARKS        |

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Singh  
Date: 2026.04.01 11:29:21 IST

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|--------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--|
| <br>Energising Quality |                                           | <b>DATA SHEET OF FE/BW, AG &amp; UG, MANUAL BALL VALVE<br/>DN 50 TO DN 400 (NPS 2" to NPS 16"), RATING 300# ,<br/>PIPING CLASS - 30HC, SPLIT /WELDED BODY DESIGN</b> |                | DOC. NO.: C261162-00-PP-DS-2001C                                                                                                                                                                          |                                                         |  |
|                                                                                                        |                                           |                                                                                                                                                                      |                | No. of Pages :<br>02                                                                                                                                                                                      | Revision                                                |  |
|                                                                                                        |                                           |                                                                                                                                                                      |                |                                                                                                                                                                                                           | C1                                                      |  |
|                                                                                                        |                                           |                                                                                                                                                                      |                | 27.01.2026                                                                                                                                                                                                |                                                         |  |
| <b>Location</b>                                                                                        |                                           | -                                                                                                                                                                    |                | <b>MR No.</b>                                                                                                                                                                                             |                                                         |  |
| <b>Sr. No.</b>                                                                                         |                                           | -                                                                                                                                                                    |                | <b>P.O No.</b>                                                                                                                                                                                            |                                                         |  |
|                                                                                                        |                                           |                                                                                                                                                                      |                | #                                                                                                                                                                                                         |                                                         |  |
| 1                                                                                                      | GENERAL                                   | Valve Manufacturer                                                                                                                                                   |                |                                                                                                                                                                                                           |                                                         |  |
| 2                                                                                                      |                                           | Tag Numbers / Material Requisition Item No.                                                                                                                          |                |                                                                                                                                                                                                           |                                                         |  |
| 3                                                                                                      |                                           | Company's Specification No.                                                                                                                                          |                | VCS-SS-PP-2004                                                                                                                                                                                            |                                                         |  |
| 4                                                                                                      |                                           | Category                                                                                                                                                             |                | Station Piping Ball Valve                                                                                                                                                                                 |                                                         |  |
| 5                                                                                                      |                                           | Pipeline Line No                                                                                                                                                     |                | Not Required                                                                                                                                                                                              |                                                         |  |
| 6                                                                                                      |                                           | Class                                                                                                                                                                |                | 30HC                                                                                                                                                                                                      |                                                         |  |
| 7                                                                                                      | DESIGN AND TEST REQUIREMENTS              | Size                                                                                                                                                                 |                | DN 50 (NPS 2") to DN 400 (NPS 16")                                                                                                                                                                        |                                                         |  |
| 8                                                                                                      |                                           | Type of Valve                                                                                                                                                        |                | Trunnion Mounted, Double Block and Bleed, Antistatic, Vent Drain/ Flush Connection with Anti Blowout Stem, Split Body Design/ Fully Welded Body Design as specified in MR, Tight Shut Off (As Applicable) |                                                         |  |
| 9                                                                                                      |                                           | Type of Port (Full/ Reduced)                                                                                                                                         |                | Refer P& ID                                                                                                                                                                                               |                                                         |  |
| 10                                                                                                     |                                           | Design Temperature (°C)                                                                                                                                              | Maximum        | 65                                                                                                                                                                                                        |                                                         |  |
| 11                                                                                                     |                                           |                                                                                                                                                                      | Minimum        | -29                                                                                                                                                                                                       |                                                         |  |
| 12                                                                                                     |                                           | Corrosion Allowance (mm)                                                                                                                                             |                | 1.5                                                                                                                                                                                                       |                                                         |  |
| 13                                                                                                     |                                           | Installation (Aboveground/Underground)                                                                                                                               |                | AboveGround/UnderGround                                                                                                                                                                                   |                                                         |  |
| 14                                                                                                     |                                           | Service                                                                                                                                                              |                | Natural Gas (NG)                                                                                                                                                                                          |                                                         |  |
| 15                                                                                                     |                                           | End Connection                                                                                                                                                       |                | Refer P& ID                                                                                                                                                                                               |                                                         |  |
| 16                                                                                                     |                                           | Flange Face Finish                                                                                                                                                   |                | RF/125AARH for Flanged Ends (As applicable)                                                                                                                                                               |                                                         |  |
| 17                                                                                                     |                                           | Design Standards                                                                                                                                                     |                | API 6D                                                                                                                                                                                                    |                                                         |  |
| 18                                                                                                     |                                           | End Connection Standard                                                                                                                                              |                | ANSI B16.5 for Flanged Ends (As applicable)/<br>ANSI 16.25 for Butt Welded Ends (As applicable)                                                                                                           |                                                         |  |
| 19                                                                                                     |                                           | ASME Class                                                                                                                                                           |                | 300#                                                                                                                                                                                                      |                                                         |  |
| 20                                                                                                     |                                           | Stem Extension Requirement (If required, Note - 20)                                                                                                                  |                | Note -20                                                                                                                                                                                                  |                                                         |  |
| 21                                                                                                     |                                           | Length of Stem Extension                                                                                                                                             |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 22                                                                                                     |                                           | Orientation of Stem                                                                                                                                                  |                | Perpendicular to Valve axis                                                                                                                                                                               |                                                         |  |
| 23                                                                                                     |                                           | Type of Valve Operator                                                                                                                                               |                | DN ≤ 100 mm (4") - Wrench / Lever - Pull Force 350N max.<br>DN ≥ 150 mm (6") - Gear Operated                                                                                                              |                                                         |  |
| 24                                                                                                     |                                           | Valve Actuator Operating Time                                                                                                                                        |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 25                                                                                                     |                                           | Requirement of Locking Mechanism (LO / LC)                                                                                                                           |                | Refer Material Requisition                                                                                                                                                                                |                                                         |  |
| 26                                                                                                     |                                           | Length of Pup Piece / Nipple (mm), (If Required) (Note-16)<br>(Integrally welded to the BW valve on each side)                                                       |                | Required for Welded End Valves, as per Standard Valve Specification                                                                                                                                       |                                                         |  |
| 27                                                                                                     |                                           | Pup Piece Size / Material Grade / Schdeule/ Thickness (Note-16)                                                                                                      |                | As per Piping Material Specification                                                                                                                                                                      |                                                         |  |
| 28                                                                                                     |                                           | Operator Specification No.                                                                                                                                           |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 29                                                                                                     |                                           | Valve Design Pressure (kg/cm <sup>2</sup> )                                                                                                                          |                | 49 kg/cm <sup>2</sup>                                                                                                                                                                                     |                                                         |  |
| 30                                                                                                     |                                           | Hydrostatic Test Pressure (kg/cm <sup>2</sup> ) & Time                                                                                                               |                | Body : 73.5 kg/cm <sup>2</sup> & Test Duration - 30 Minutes                                                                                                                                               | Seat : 54 kg/cm <sup>2</sup> & Test Duration 30 Minutes |  |
| 31                                                                                                     |                                           | Pneumatic Test Pressure (kg/cm <sup>2</sup> ) & Time                                                                                                                 |                | 7.0 kg/cm <sup>2</sup> & Test Duration - 15 Minutes                                                                                                                                                       |                                                         |  |
| 32                                                                                                     |                                           | Charpy Impact Test (° C)                                                                                                                                             |                | Yes (at -29 °C)                                                                                                                                                                                           |                                                         |  |
| 33                                                                                                     |                                           | Fire Safe Design (Note-25)                                                                                                                                           |                | API 6FA / ISO10497                                                                                                                                                                                        |                                                         |  |
| 34                                                                                                     |                                           | Anti Static Testing Requirement                                                                                                                                      |                | As per API 6D Latest Edition                                                                                                                                                                              |                                                         |  |
| 35                                                                                                     |                                           | Hardness Test                                                                                                                                                        |                | 248 HV10 max                                                                                                                                                                                              |                                                         |  |
| 36                                                                                                     |                                           | Painting (Note-21)                                                                                                                                                   |                | As per specification (Suitable for Highly Corrosive Environment) Note-21                                                                                                                                  |                                                         |  |
| 37                                                                                                     | Operator Data Sheet No.                   |                                                                                                                                                                      | Not Applicable |                                                                                                                                                                                                           |                                                         |  |
| 38                                                                                                     | PROCESS DATA<br>(Applicable for Actuator) | Flow (Min/Nor/Max) (m <sup>3</sup> /hr)                                                                                                                              |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 39                                                                                                     |                                           | Pressure (Min/Nor/Max) (barg)                                                                                                                                        |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 40                                                                                                     |                                           | Temperature (Min/Nor/Max) (° C)                                                                                                                                      |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 41                                                                                                     |                                           | Max Shutoff DP (barg)                                                                                                                                                |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 42                                                                                                     |                                           | Viscosity (cP)                                                                                                                                                       |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 43                                                                                                     |                                           | Density (Kg/m <sup>3</sup> )                                                                                                                                         |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 44                                                                                                     |                                           | Mol . Wt                                                                                                                                                             |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 45                                                                                                     |                                           | Sp Heat Ratio (Cp/Cv)                                                                                                                                                |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 46                                                                                                     |                                           | Compressibility (Z)                                                                                                                                                  |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 47                                                                                                     |                                           | Ambient Temperature                                                                                                                                                  |                | Not Applicable                                                                                                                                                                                            |                                                         |  |
| 48                                                                                                     | CONNECTING PIPE DETAIL                    | Outside Diameter (Inch)                                                                                                                                              |                | DN 50 (NPS 2") to DN 400 (NPS 16")                                                                                                                                                                        |                                                         |  |
| 49                                                                                                     |                                           | Thickness (mm) / Schedule                                                                                                                                            |                | As per Piping Material Specification                                                                                                                                                                      |                                                         |  |
| 50                                                                                                     |                                           | Pipe Material                                                                                                                                                        |                | As per Piping Material Specification                                                                                                                                                                      |                                                         |  |
| 51                                                                                                     |                                           | Design Code                                                                                                                                                          |                | ASME B31.8                                                                                                                                                                                                |                                                         |  |
| 52                                                                                                     |                                           | ASME Rating                                                                                                                                                          |                | 300#                                                                                                                                                                                                      |                                                         |  |
| 53                                                                                                     |                                           | Piping Class                                                                                                                                                         |                | 30HC                                                                                                                                                                                                      |                                                         |  |
| 54                                                                                                     |                                           | Orientation of Pipe                                                                                                                                                  |                | Suitable for all orientation                                                                                                                                                                              |                                                         |  |

|                                                                                                        |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              |                                         |                         |  |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------|-------------------------|--|
| <br>Energising Quality |                                                                                                | <b>DATA SHEET OF FE/BW, AG &amp; UG, MANUAL BALL VALVE<br/>DN 50 TO DN 400 (NPS 2" to NPS 16"), RATING 300# ,<br/>PIPING CLASS - 30HC, SPLIT /WELDED BODY DESIGN</b>                                                                                                                                                                                                                                                                                  |                                                                              | <b>DOC. NO.: C261162-00-PP-DS-2001C</b> |                         |  |
|                                                                                                        |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              | <b>No. of Pages :</b><br>02             | <b>Revision</b>         |  |
|                                                                                                        |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              |                                         | <b>C1</b><br>27.01.2026 |  |
| <b>Location</b>                                                                                        |                                                                                                | -                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                              | <b>MR No.</b>                           |                         |  |
| <b>Sr. No.</b>                                                                                         |                                                                                                | -                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                              | <b>P.O No.</b>                          |                         |  |
|                                                                                                        |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              | #                                       |                         |  |
| 55                                                                                                     | VALVE MATERIAL                                                                                 | <b>Part Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Material Specified</b>                                                    | <b>Material Offered (By Bidder)</b>     |                         |  |
| 56                                                                                                     |                                                                                                | Body                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ASTM A216 GR. WCB/ASTM 105                                                   |                                         |                         |  |
| 57                                                                                                     |                                                                                                | Ball<br>(Single Piece, Solid Construction)                                                                                                                                                                                                                                                                                                                                                                                                            | SS-304 / SS-316 (Solid) OR<br>(ASTM A105/ ASTM A216 Gr. WCB) + 75 micron ENP |                                         |                         |  |
| 58                                                                                                     |                                                                                                | Seat Rings<br>(No Casting)                                                                                                                                                                                                                                                                                                                                                                                                                            | (AISI 4140 +75 micron ENP)/ AISI 410/ SS 304/ SS 316                         |                                         |                         |  |
| 59                                                                                                     |                                                                                                | Seat Seal                                                                                                                                                                                                                                                                                                                                                                                                                                             | Primary Devlon V/ PEEK/ Viton with Secondary Metal to Metal                  |                                         |                         |  |
| 60                                                                                                     |                                                                                                | Stem (No Casting)                                                                                                                                                                                                                                                                                                                                                                                                                                     | (AISI 4140 +75 micron ENP)/ AISI 410 / SS 304 / SS 316                       |                                         |                         |  |
| 61                                                                                                     |                                                                                                | Stem Seal                                                                                                                                                                                                                                                                                                                                                                                                                                             | GRAFOIL / R-PTFE                                                             |                                         |                         |  |
| 62                                                                                                     |                                                                                                | Body Seal                                                                                                                                                                                                                                                                                                                                                                                                                                             | GRAFOIL / R-PTFE                                                             |                                         |                         |  |
| 63                                                                                                     |                                                                                                | Gland                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 13% Cr. Steel/ SS 316 / SS 304 / ASTM A105                                   |                                         |                         |  |
| 64                                                                                                     |                                                                                                | Stud Bolts/Nut                                                                                                                                                                                                                                                                                                                                                                                                                                        | ASTM A 193 Gr. B7/ ASTM A 194 Gr. 2H                                         |                                         |                         |  |
| 65                                                                                                     |                                                                                                | Handle / Lever / Hand Wheel                                                                                                                                                                                                                                                                                                                                                                                                                           | Carbon Steel                                                                 |                                         |                         |  |
| 66                                                                                                     | DATA TO BE PROVIDED BY VENDOR (if Applicable)                                                  | Valve Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              | *                                       |                         |  |
| 67                                                                                                     |                                                                                                | Flow Coefficient, Kv (Cubic Meters per Hour)                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                              | *                                       |                         |  |
| 68                                                                                                     |                                                                                                | Valve Cavity Volume(CC)                                                                                                                                                                                                                                                                                                                                                                                                                               | Open position                                                                | *                                       |                         |  |
| 69                                                                                                     |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Closed position                                                              | *                                       |                         |  |
| 70                                                                                                     |                                                                                                | Operator Manufacturer / Model No.                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                              | *                                       |                         |  |
| 71                                                                                                     |                                                                                                | Break-away Torque Under Max. Diff Pressure(Nm)                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              | *                                       |                         |  |
| 72                                                                                                     |                                                                                                | Running Torque (Open - Close/Close - Open) (Nm)                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              | *                                       |                         |  |
| 73                                                                                                     | NOTES                                                                                          | <b>NOTES:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                              |                                         |                         |  |
| 74                                                                                                     |                                                                                                | 1. Bidder to submit in offer, Soft Seal details and type, grade & class selected with manufacturer's recommendation like Pressure-Temperature Curve/Table for not to damage the soft seal during welding of valve ends at site.                                                                                                                                                                                                                       |                                                                              |                                         |                         |  |
| 75                                                                                                     |                                                                                                | 2. This Data Sheet shall be read in conjunction with Material Requisition, Piping Material Specification, valve Specification & other Tender Documents.                                                                                                                                                                                                                                                                                               |                                                                              |                                         |                         |  |
| 76                                                                                                     |                                                                                                | 3. Dimension / Input Data as & where marked " * " shall be supplied by Vendor.                                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                         |                         |  |
| 77                                                                                                     |                                                                                                | 4. Manufacturer shall have valid API 6D license to use API monogram. API monogram is required.                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                         |                         |  |
| 78                                                                                                     |                                                                                                | 5. Valve design shall ensure repair of stem seals / packing under full line pressure.                                                                                                                                                                                                                                                                                                                                                                 |                                                                              |                                         |                         |  |
| 79                                                                                                     |                                                                                                | 6. 100.0 % Valve castings shall undergo Radiographic Examination.                                                                                                                                                                                                                                                                                                                                                                                     |                                                                              |                                         |                         |  |
| 80                                                                                                     |                                                                                                | 7. Valves shall have support foot & lifting lugs as per valve Specification.                                                                                                                                                                                                                                                                                                                                                                          |                                                                              |                                         |                         |  |
| 81                                                                                                     |                                                                                                | 8. Valve design shall ensure repair of stem seals / packing under full line pressure.                                                                                                                                                                                                                                                                                                                                                                 |                                                                              |                                         |                         |  |
| 82                                                                                                     |                                                                                                | 9. Wrench operated valves shall be supplied with wrench.                                                                                                                                                                                                                                                                                                                                                                                              |                                                                              |                                         |                         |  |
| 83                                                                                                     |                                                                                                | 10. The Charpy Impact temperature shall be -29°C as specified in data sheet and it shall superceded the Specification (VCS-SS-PP-2004) requirement at 0°C                                                                                                                                                                                                                                                                                             |                                                                              |                                         |                         |  |
| 84                                                                                                     |                                                                                                | 11. A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.                                                                                                                                                                                          |                                                                              |                                         |                         |  |
| 85                                                                                                     |                                                                                                | 12. Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) is not liable to be damaged. The manufacture shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.                                                                              |                                                                              |                                         |                         |  |
| 86                                                                                                     |                                                                                                | 13. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease                                                                                                                                                                                                                                                                     |                                                                              |                                         |                         |  |
| 87                                                                                                     |                                                                                                | 14. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N.                                                                                                                                                                                                           |                                                                              |                                         |                         |  |
| 88                                                                                                     |                                                                                                | 15. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The numbers of turn shall not exceed 250 for valves sizes up to 24" and 450 for valve size above 24".                                                                                                                                               |                                                                              |                                         |                         |  |
| 89                                                                                                     |                                                                                                | 16. Adequacy for Length of pup piece/ Nipple shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. These nipples shall be welded to the valve body by the manufacturer before fitting the packings, seats & seals.                                                                                                                                                                      |                                                                              |                                         |                         |  |
| 90                                                                                                     |                                                                                                | 17. Name plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25                                                                                                                                                                                                                                                                                                                                                           |                                                                              |                                         |                         |  |
| 91                                                                                                     |                                                                                                | 18. Valve body & other pressure containing parts shall be designed as per ASME Sec-VIII Div-I. Minimum thickness shall not be less than ASME B16.34.                                                                                                                                                                                                                                                                                                  |                                                                              |                                         |                         |  |
| 92                                                                                                     |                                                                                                | 19. For tag No./ Fluid Data/ Operating Data refer Process Document , P&IDs                                                                                                                                                                                                                                                                                                                                                                            |                                                                              |                                         |                         |  |
| 93                                                                                                     |                                                                                                | 20. Stem extension length shall be finalized during drawing approval stage after award of order.                                                                                                                                                                                                                                                                                                                                                      |                                                                              |                                         |                         |  |
| 94                                                                                                     |                                                                                                | 21. For the valves to be installed underground the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy(Powercrete R-95) with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating                                                                                                                                                                                         |                                                                              |                                         |                         |  |
| 95                                                                                                     |                                                                                                | 22. Bidder shall clearly write all / any deviation against each part material of valve in the space provided for. Wherever bidder agrees with company's spec bidder shall indicate "agreed". Flanges of flanged end cast/ forged body shall be integrally cast/ forged with the body of valve.                                                                                                                                                        |                                                                              |                                         |                         |  |
| 96                                                                                                     |                                                                                                | 23. All Elastomeric material used for pressure tight sealing or drip sealing shall be of anti Explosive Decompression type and must be certified according to testing Procedures. Manufacturer shall submit test certificate confirming conformance with Anti Explosive Decompression. Manufacturer shall confirm the suitability of soft sealing and seating material for the pressure and temperature & service mentioned above in this data sheet. |                                                                              |                                         |                         |  |
| 97                                                                                                     |                                                                                                | 24. Not only during commissioning, but also during life cycle of all valves, sediments/corrosion deposits/ silica/ mill scale of less than 40 mesh percent in process fluid have to be tolerated by all valves with malfunctioning.                                                                                                                                                                                                                   |                                                                              |                                         |                         |  |
| 98                                                                                                     |                                                                                                | 25. Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.                                                                                                                                                                                                                                                                                                              |                                                                              |                                         |                         |  |
| 99                                                                                                     |                                                                                                | 26. Flanges of flanged end cast/ forged body shall be integrally cast/ forged with the body of valve. Vendor to guarantee the suitability of seat/ seal material for the given service condition                                                                                                                                                                                                                                                      |                                                                              |                                         |                         |  |
| 100                                                                                                    |                                                                                                | 27. Minimum all pressure containing and controlling parts of the valve shall be provided with EN 10204-3.2 certificate.                                                                                                                                                                                                                                                                                                                               |                                                                              |                                         |                         |  |
| 101                                                                                                    |                                                                                                | 28. Cyclic test is required. The valve shall be subjected to at least 200 open close cycle with maximum differential pressure corresponding to valve rating.                                                                                                                                                                                                                                                                                          |                                                                              |                                         |                         |  |
| 102                                                                                                    |                                                                                                | 29. Stem seal / body seal, gland packing materials shall be provided with corrosion inhibitor.                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                         |                         |  |
| 103                                                                                                    | 30. Vendor to guarantee the suitability of seat/ seal material for the given service condition |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              |                                         |                         |  |

|                                                                                                        |                                                   |                                                                                                                                           |                |                                                                  |                                                           |  |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------|-----------------------------------------------------------|--|
| <br>Energising Quality |                                                   | <b>DATA SHEET OF FLANGED / BW, AG &amp; UG, GLOBE VALVE<br/>DN 50 TO DN 200 (NPS 2" TO NPS 8"), RATING 300# ,<br/>PIPING CLASS - 30HC</b> |                | DOC. NO.: C261162-00-PP-DS-2001D                                 |                                                           |  |
|                                                                                                        |                                                   |                                                                                                                                           |                | No. of Pages :<br>02                                             | Revision                                                  |  |
|                                                                                                        |                                                   |                                                                                                                                           |                |                                                                  | C1                                                        |  |
|                                                                                                        |                                                   | 27.01.2026                                                                                                                                |                |                                                                  |                                                           |  |
| <b>Location</b>                                                                                        |                                                   | -                                                                                                                                         |                | <b>MR No.</b>                                                    |                                                           |  |
| <b>SR.NO</b>                                                                                           |                                                   | -                                                                                                                                         |                | <b>P.O No.</b>                                                   |                                                           |  |
|                                                                                                        |                                                   |                                                                                                                                           |                | #                                                                |                                                           |  |
| 1                                                                                                      | <b>GENERAL</b>                                    | Valve Manufacturer                                                                                                                        |                |                                                                  |                                                           |  |
| 2                                                                                                      |                                                   | Tag Numbers / Material Requisition Item No.                                                                                               |                |                                                                  |                                                           |  |
| 3                                                                                                      |                                                   | Company's Specification No.                                                                                                               |                | VCS-SS-PP-2504                                                   |                                                           |  |
| 4                                                                                                      |                                                   | Category                                                                                                                                  |                | -                                                                |                                                           |  |
| 5                                                                                                      |                                                   | Pipeline Line No                                                                                                                          |                | Not Required                                                     |                                                           |  |
| 6                                                                                                      |                                                   | Class                                                                                                                                     |                | 30HC                                                             |                                                           |  |
| 7                                                                                                      | <b>DESIGN AND TEST REQUIREMENTS</b>               | Size                                                                                                                                      |                | DN 50 (NPS 2") to DN 200 (NPS 8")                                |                                                           |  |
| 8                                                                                                      |                                                   | Type of Valve                                                                                                                             |                | Rising Stem, Plug type disc, OS & Y , Straight Pattern           |                                                           |  |
| 9                                                                                                      |                                                   | Type of Port (Full / Reduced)                                                                                                             |                | Not Applicable                                                   |                                                           |  |
| 10                                                                                                     |                                                   | Design Temperature (° C)                                                                                                                  | Maximum        | 65                                                               |                                                           |  |
| 11                                                                                                     |                                                   |                                                                                                                                           | Minimum        | -29                                                              |                                                           |  |
| 12                                                                                                     |                                                   | Corrosion Allowance (mm)                                                                                                                  |                | 1.5                                                              |                                                           |  |
| 13                                                                                                     |                                                   | Installation (Aboveground/Underground)                                                                                                    |                | Aboveground/UnderGround                                          |                                                           |  |
| 14                                                                                                     |                                                   | Service                                                                                                                                   |                | Natural Gas (NG)                                                 |                                                           |  |
| 15                                                                                                     |                                                   | End Connection                                                                                                                            |                | As per P& ID                                                     |                                                           |  |
| 16                                                                                                     |                                                   | Flange Face Finish                                                                                                                        |                | RF/125AARH for Flanged Ends                                      |                                                           |  |
| 17                                                                                                     |                                                   | Design Standards                                                                                                                          |                | BS 1873, ASME 16.34 & API 598                                    |                                                           |  |
| 18                                                                                                     |                                                   | End Connection Standard                                                                                                                   |                | ASME B16.5 - Flanged End<br>ASME B16.25 - Butt Welded End        |                                                           |  |
| 19                                                                                                     |                                                   | ASME Class                                                                                                                                |                | 300#                                                             |                                                           |  |
| 20                                                                                                     |                                                   | Stem Extension Requirement                                                                                                                |                | Note - 15                                                        |                                                           |  |
| 21                                                                                                     |                                                   | Length of Stem Extension (If required, Note - 15)                                                                                         |                | Note - 15                                                        |                                                           |  |
| 22                                                                                                     |                                                   | Orientation of Stem                                                                                                                       |                | Perpendicular to Valve Axis                                      |                                                           |  |
| 23                                                                                                     |                                                   | Type of Valve Operator                                                                                                                    |                | As per Standard Specification                                    |                                                           |  |
| 24                                                                                                     |                                                   | Valve Actuator Operating Time                                                                                                             |                | Not Applicable                                                   |                                                           |  |
| 25                                                                                                     |                                                   | Requirement of Locking Mechanism (LO / LC)                                                                                                |                | As per P&ID                                                      |                                                           |  |
| 26                                                                                                     |                                                   | Length of Pup Piece / Nipple (mm), (If Required)<br>(Integrally welded to the BW valve on each side)                                      |                | Not Applicable                                                   |                                                           |  |
| 27                                                                                                     |                                                   | Pup Piece Size / Material Grade / Schdeule/ Thickness                                                                                     |                | Note - 19                                                        |                                                           |  |
| 28                                                                                                     |                                                   | Operator Specification No.                                                                                                                |                | Not Applicable                                                   |                                                           |  |
| 29                                                                                                     |                                                   | Valve Design Pressure (kg/cm <sup>2</sup> )                                                                                               |                | 49 (kg/cm <sup>2</sup> )                                         |                                                           |  |
| 30                                                                                                     |                                                   | Hydrostatic Test Pressure (kg/cm <sup>2</sup> ) & Time                                                                                    |                | Body : 73.5 kg/cm <sup>2</sup> & Test Duration - 30 Minutes      | Body : 54 kg/cm <sup>2</sup> & Test Duration - 30 Minutes |  |
| 31                                                                                                     |                                                   | Pneumatic Test Pressure (kg/cm <sup>2</sup> ) & Time                                                                                      |                | 7.0 kg/cm <sup>2</sup> & Test Duration - 15 Minutes              |                                                           |  |
| 32                                                                                                     |                                                   | Charpy Impact Test (°C)                                                                                                                   |                | Yes (at -29 °C)                                                  |                                                           |  |
| 33                                                                                                     |                                                   | Fire Safe Design (Note- 16 & 17)                                                                                                          |                | API 6FA / ISO10497                                               |                                                           |  |
| 34                                                                                                     |                                                   | Anti Static Testing Requirement                                                                                                           |                | As per BS-1873 Latest Edition                                    |                                                           |  |
| 35                                                                                                     |                                                   | Hardness Test                                                                                                                             |                | 248 HV10 max                                                     |                                                           |  |
| 36                                                                                                     |                                                   | Painting (Note-14)                                                                                                                        |                | As per specification (Suitable for Highly Corrosive Environment) |                                                           |  |
| 37                                                                                                     | Operator Data Sheet No.                           |                                                                                                                                           | Not Applicable |                                                                  |                                                           |  |
| 38                                                                                                     | <b>PROCESS DATA<br/>(Applicable for Actuator)</b> | Flow (Min/Nor/Max) (m <sup>3</sup> /hr)                                                                                                   |                | Not Applicable                                                   |                                                           |  |
| 39                                                                                                     |                                                   | Pressure (Min/Nor/Max) (barg)                                                                                                             |                | Not Applicable                                                   |                                                           |  |
| 40                                                                                                     |                                                   | Temperature (Min/Nor/Max) (° C)                                                                                                           |                | Not Applicable                                                   |                                                           |  |
| 41                                                                                                     |                                                   | Max Shutoff DP (barg)                                                                                                                     |                | Not Applicable                                                   |                                                           |  |
| 42                                                                                                     |                                                   | Viscosity (cP)                                                                                                                            |                | Not Applicable                                                   |                                                           |  |
| 43                                                                                                     |                                                   | Density (Kg/m <sup>3</sup> )                                                                                                              |                | Not Applicable                                                   |                                                           |  |
| 44                                                                                                     |                                                   | Mol . Wt                                                                                                                                  |                | Not Applicable                                                   |                                                           |  |
| 45                                                                                                     |                                                   | Sp Heat Ratio (Cp/Cv)                                                                                                                     |                | Not Applicable                                                   |                                                           |  |
| 46                                                                                                     |                                                   | Compressibility (Z)                                                                                                                       |                | Not Applicable                                                   |                                                           |  |
| 47                                                                                                     |                                                   | Ambient Temperature                                                                                                                       |                | Not Applicable                                                   |                                                           |  |
| 48                                                                                                     | <b>CONNECTING PIPE DETAIL</b>                     | Outside Diameter (Inch)                                                                                                                   |                | DN 50 (NPS 2") to DN 200 (NPS 8")                                |                                                           |  |
| 49                                                                                                     |                                                   | Thickness (mm) / Schedule                                                                                                                 |                | As per Piping Material Specification                             |                                                           |  |
| 50                                                                                                     |                                                   | Pipe Material                                                                                                                             |                | As per Piping Material Specification                             |                                                           |  |
| 51                                                                                                     |                                                   | Design Code                                                                                                                               |                | ASME B31.8                                                       |                                                           |  |
| 52                                                                                                     |                                                   | ASME Rating                                                                                                                               |                | 300#                                                             |                                                           |  |
| 53                                                                                                     |                                                   | Piping Class                                                                                                                              |                | 30HC                                                             |                                                           |  |
| 54                                                                                                     |                                                   | Orientation of Pipe                                                                                                                       |                | Suitable for all orientation                                     |                                                           |  |

|                                                                                                                          |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |   |                                  |          |   |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------|----------|---|
| <div><div>Energising Quality</div></div> |                                                                                                                                                                                                                                                                                 | DATA SHEET OF FLANGED / BW, AG & UG, GLOBE VALVE<br>DN 50 TO DN 200 (NPS 2" TO NPS 8"), RATING 300# ,<br>PIPING CLASS - 30HC                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               |   | DOC. NO.: C261162-00-PP-DS-2001D |          |   |
|                                                                                                                          |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |   | No. of Pages :<br>02             | Revision |   |
|                                                                                                                          |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |   |                                  | C1       |   |
|                                                                                                                          |                                                                                                                                                                                                                                                                                 | 27.01.2026                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                               |   |                                  |          |   |
| Location                                                                                                                 |                                                                                                                                                                                                                                                                                 | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |   | MR No.                           |          | - |
| SR.NO                                                                                                                    |                                                                                                                                                                                                                                                                                 | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |   | P.O No.                          |          | # |
| 55                                                                                                                       | VALVE MATERIAL                                                                                                                                                                                                                                                                  | Part Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Material Specified                                                                                                            |   | Material Offered (By Bidder)     |          |   |
| 56                                                                                                                       |                                                                                                                                                                                                                                                                                 | Body<br>(Forged / Cast)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ASTM A216 GR. WCB/ASTM 105                                                                                                    |   |                                  |          |   |
| 57                                                                                                                       |                                                                                                                                                                                                                                                                                 | Bonnet<br>(Bolted Type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ASTM A216 GR. WCB/ASTM 105                                                                                                    |   |                                  |          |   |
| 58                                                                                                                       |                                                                                                                                                                                                                                                                                 | Disc<br>(Plug Type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hard faced (Trim 5), Loose Plug, Conical                                                                                      |   |                                  |          |   |
| 59                                                                                                                       |                                                                                                                                                                                                                                                                                 | Stem (Rising)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SS - 304 / SS - 316 ( NO CASTING)                                                                                             |   |                                  |          |   |
| 60                                                                                                                       |                                                                                                                                                                                                                                                                                 | Body Seat Ring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | STELLITED-6                                                                                                                   |   |                                  |          |   |
| 61                                                                                                                       |                                                                                                                                                                                                                                                                                 | Gland / Stem Packing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Corrosion inhibited die formed flexible graphite<br>with braided anti-extrusion ring<br>(Renewable with valve open on stream) |   |                                  |          |   |
| 62                                                                                                                       |                                                                                                                                                                                                                                                                                 | Bonnet Gasket                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Soft Iron (Max 90 BHN)/ Graphite with<br>Braided Anti ExtrusionRing                                                           |   |                                  |          |   |
| 63                                                                                                                       |                                                                                                                                                                                                                                                                                 | Body Stud                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ASTM A 193 Gr. B7                                                                                                             |   |                                  |          |   |
| 64                                                                                                                       |                                                                                                                                                                                                                                                                                 | Body Nut                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ASTM A 194 Gr. 2H                                                                                                             |   |                                  |          |   |
| 65                                                                                                                       |                                                                                                                                                                                                                                                                                 | Handle / Lever /<br>Hand Wheel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Carbon Steel                                                                                                                  |   |                                  |          |   |
| 66                                                                                                                       | DATA TO BE PROVIDE BY<br>VENDOR (if Applicable)                                                                                                                                                                                                                                 | Valve Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               | * |                                  |          |   |
| 67                                                                                                                       |                                                                                                                                                                                                                                                                                 | Flow Coefficient, Kv (Cubic Meters per Hour)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               | * |                                  |          |   |
| 68                                                                                                                       |                                                                                                                                                                                                                                                                                 | Valve Cavity Volume(CC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Open position                                                                                                                 | * |                                  |          |   |
| 69                                                                                                                       |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Closed position                                                                                                               | * |                                  |          |   |
| 70                                                                                                                       |                                                                                                                                                                                                                                                                                 | Operator Manufacturer / Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               | * |                                  |          |   |
| 71                                                                                                                       |                                                                                                                                                                                                                                                                                 | Break-away Torque Under Max. Diff Pressure(Nm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                               | * |                                  |          |   |
| 72                                                                                                                       | Running Torque (Open - Close/Close - Open) (Nm)                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | *                                                                                                                             |   |                                  |          |   |
| 73                                                                                                                       | NOTES                                                                                                                                                                                                                                                                           | NOTES:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                               |   |                                  |          |   |
| 74                                                                                                                       |                                                                                                                                                                                                                                                                                 | 1. This Data Sheet shall be read in conjunction with Tender Documents & Specifications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                               |   |                                  |          |   |
| 75                                                                                                                       |                                                                                                                                                                                                                                                                                 | 2. Dimension / Input Data as & where marked " * " shall be supplied by Vendor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                               |   |                                  |          |   |
| 76                                                                                                                       |                                                                                                                                                                                                                                                                                 | 3.All tests shall be carried out as per BS 1873 & BSEN 12266 part-1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                               |   |                                  |          |   |
| 77                                                                                                                       |                                                                                                                                                                                                                                                                                 | 4. Gland packing assembly shall permit repair of gland packing under full line pressure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                               |   |                                  |          |   |
| 78                                                                                                                       |                                                                                                                                                                                                                                                                                 | 5. Valve design shall ensure repair of stem seals / packing under full line pressure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               |   |                                  |          |   |
| 79                                                                                                                       |                                                                                                                                                                                                                                                                                 | 6. 100.0 % Valve castings shall undergo Radiographic Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |   |                                  |          |   |
| 80                                                                                                                       |                                                                                                                                                                                                                                                                                 | 7. Valves shall have support foot & lifting lugs as per valve Specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               |   |                                  |          |   |
| 81                                                                                                                       |                                                                                                                                                                                                                                                                                 | 8. Valve design shall ensure repair of stem seals / packing under full line pressure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               |   |                                  |          |   |
| 82                                                                                                                       |                                                                                                                                                                                                                                                                                 | 9. Wrench operated valves shall be supplied with wrench.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                               |   |                                  |          |   |
| 83                                                                                                                       |                                                                                                                                                                                                                                                                                 | 10. The Charpy Impact temperature shall be -29°C as specified in data sheet and it shall superceded the Specification (VCS-SS-PP-2504) requirement at 0°C                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                               |   |                                  |          |   |
| 84                                                                                                                       |                                                                                                                                                                                                                                                                                 | 11. Design of Welded Valves shall be such that during field welding operation, the soft or plastic components of valve are not liable to be damages.                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                               |   |                                  |          |   |
| 85                                                                                                                       |                                                                                                                                                                                                                                                                                 | 12. Gasket Material Graphite Shall Be Provided With Corrosion Inhibitor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                               |   |                                  |          |   |
| 86                                                                                                                       |                                                                                                                                                                                                                                                                                 | 13. Valve wall thickness shall be as per ANSI B16.34 / API 623. Manufacturer shall have valid API 623 license to use API monogram. API monogram is required.                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               |   |                                  |          |   |
| 87                                                                                                                       |                                                                                                                                                                                                                                                                                 | 14 .For the valves to be installed underground the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy (Powercrete R-95) with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating                                                                                                                                                                                                                                                                                                                    |                                                                                                                               |   |                                  |          |   |
| 88                                                                                                                       |                                                                                                                                                                                                                                                                                 | 15. Stem extension length shall be finalized during drawing approval stage after award of order.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                               |   |                                  |          |   |
| 89                                                                                                                       |                                                                                                                                                                                                                                                                                 | 16. For Metal Seated Valves, Bidder to Confirm that in offered valves, there shall not be any external leakage during fire and valve is capable of handling fire for the mentioned time as specified in API 6FA/ ISO 10497/API 6FD. Bidder also to confirm that in case of fire, the valve shall be unseated from the closed position against the high test pressure and moved to the fully open position i.e. In case of fire, valve shall complete one open-close cycle. For Soft Seated Valves, Bidder to carry out Fire Safe Design & test as per API 6FA/ ISO 10497/API 6FD. |                                                                                                                               |   |                                  |          |   |
| 90                                                                                                                       |                                                                                                                                                                                                                                                                                 | 17. The offered valve shall deemed to have been fire-tested if vendor submit Fire Test Certificate (Approved & Certified by Governing TPIA) of earlier tested valve of similar design & size.( Qualification Size as per API 6FA/ ISO 10497/API 6FD Codes)                                                                                                                                                                                                                                                                                                                        |                                                                                                                               |   |                                  |          |   |
| 91                                                                                                                       | 18. Minimum all pressure containing and controlling parts of the valve shall be provided with EN 10204-3.2 certificate.                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |   |                                  |          |   |
| 92                                                                                                                       | 19. Adequacy for Length of pup piece/ Nipple shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment.These nipples shall be welded to the valve body by the manufacturer before fitting the packings, seats & seals. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |   |                                  |          |   |



Energising Quality

**PROJECT NUMBER: C261162**



**DATA SHEET FOR INSULATING JOINT**

TOTAL SHEET

05

**DOCUMENT NO**

C261162

CGD

PL

DS

2001

C1

27.01.2026

ISSUED FOR CLIENT REVIEW

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**DATE**

**DESCRIPTION**

**PREP**

**CHK**

**APPR**



**CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT  
OF NAGALAND GA**

|                                                            |                                                                                                                           |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| IJ Material Requisition (MR).                              |                                                                                                                           |
| IJ Specification No.                                       | VCS-SS-PP-2029                                                                                                            |
| <b><u>DESIGN DATA FOR INSULATING JOINT FOR CS LINE</u></b> |                                                                                                                           |
| Service, Design Life (Minimum)                             | Natural Gas, 25 yrs.                                                                                                      |
| Size (OD), mm                                              | 114.3 (4")                                                                                                                |
| Design Pressure                                            | 49 kg/cm <sup>2</sup>                                                                                                     |
| ANSI Rating / Design Factor                                | 300# / 0.4                                                                                                                |
| Design Temperature (°C)                                    | -29 to 65                                                                                                                 |
| Corrosion Allowance (mm)                                   | 0.5                                                                                                                       |
| Design Code (Pipeline / Insulating Joint)                  | ASME B31.8 / ASME Sec VIII Div -I                                                                                         |
| End Connection/End Finish                                  | Butt weld ends. Bevelled as per Line pipe Specification /API 5L                                                           |
| Insulating Joint type                                      | Monolithic                                                                                                                |
| Installation                                               | Above ground                                                                                                              |
| Piggability                                                | Non Piggable                                                                                                              |
| Bevel end protection                                       | Required, metallic or high impact plastic bevel protectors;                                                               |
| <b><u>TESTING</u></b>                                      |                                                                                                                           |
| Charpy Impact Test                                         | Required, at (-)29° C                                                                                                     |
| Hardness Test                                              | Required, maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10 |
| Di-Electric test                                           | 5 KV AC, 50 Hz for One Minute Minimum                                                                                     |
| Insulation Resistance Test                                 | Min. 25 Mega Ohms, when checked with 500-1000 v dc                                                                        |
| Hydrostatic Test                                           | At 75 Kg/Cm <sup>2</sup> for Minimum Time 15 Minute                                                                       |
| Pneumatic Test                                             | 7 Kg/cm <sup>2</sup> for minimum Time 10 Minutes.                                                                         |
| Internal Vacuum Sustainability                             | Five (5) Millibar for 5 minutes.                                                                                          |
| Torsional Test                                             | Required, as per Manufacturer Std                                                                                         |
| Chemical Test                                              | Required, as per Specification                                                                                            |

|  |                                        |                        |            |
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**CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT  
OF NAGALAND GA**

|                             |                                                                                                                                                                                                                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Allowable Force and Moments | Vendor to Specify                                                                                                                                                                                                                                                                                                 |
| Dimensional Check           | Required, as per Specification & Approved Drawings/ITP                                                                                                                                                                                                                                                            |
| Visual Inspection           | Required, As per Specification & Approved ITP                                                                                                                                                                                                                                                                     |
| Other Testing               | Required, As per Specification                                                                                                                                                                                                                                                                                    |
| NDE                         | <ul style="list-style-type: none"> <li>Wet MPI on 100% Forged Surfaces (MSS SP 53)</li> <li>100% RT of Butt Weld (API 1104)</li> <li>100% UT / MPI of fillet welds (As per ASME SEC. VIII) , Refer spec for Fillets Thickness</li> <li>100 % UT of Finished Bevel Ends</li> <li>DP of Butt Weld - 100%</li> </ul> |

**SURFACE PREPARATION, PAINTING & MARKING**

|                                                                    |                                                                                                                                                                                                                    |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Surface Preparation                                                | Shot Blasting to SP10 in accordance with "Steel Structures Painting Council- Visual Standard SSPC-VIS-I                                                                                                            |
| Painting (Internal Coating)                                        | Two-pack (solvent free) non-conducting epoxy compound (cold or hot curing).<br>Total DFT –200 micron.<br>Shade Brown                                                                                               |
| Painting- External<br>(Non-conducting epoxy :3 Layer Paint System) | Primer: Two Pack Non-Conducting Epoxy,<br>(Total DFT – 200 -micron)<br>Finish Coat: Polyurethane Epoxy – DFT 100-micron, Shade Orange,<br><br>The coating shall end approximately 75mm from the ends of the joint. |
| Final Colour Shade                                                 | Canary Yellow                                                                                                                                                                                                      |
| Marking                                                            | On stainless-steel name plate as per Specification                                                                                                                                                                 |

**INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)**

| Part                        | Material of Construction                                                                                              |         |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------|---------|
|                             | Specified                                                                                                             | Offered |
| Body                        | <ul style="list-style-type: none"> <li>ASTM 694 F52 CHARPY</li> </ul>                                                 |         |
| Pups                        | <ul style="list-style-type: none"> <li>API 5L Gr X-52, PSL-2 THK. 6.4 mm (Thk. match with connecting pipe)</li> </ul> |         |
| Epoxy resin Filler Material | <ul style="list-style-type: none"> <li>CIBA Araldite CY-220 &amp; Araldite HT-951 hardener.</li> </ul>                |         |



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# CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT OF NAGALAND GA

|                                   |                                                                                                                                                                                                                                                              |  |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Spacing Ring<br>(Insulating Ring) | <ul style="list-style-type: none"> <li>Epoxy glass fiber reinforced laminate (comply with ASTM D 709 Type TV, Group G-11 properties)<br/>Average dielectric strength shall be minimum 15 KV.<br/>(Compressive Strength <math>\geq</math> 450 MPa)</li> </ul> |  |
| Sealing Ring /Gasket              | <ul style="list-style-type: none"> <li>Hardness test, Viton ASTM D2000 or as per Vendor Recommendation</li> </ul>                                                                                                                                            |  |
| Sealant Material                  | <ul style="list-style-type: none"> <li>Cold Curing Thermosetting Resin + Hardner.<br/>(Compressive Strength <math>\geq</math> 150 Mpa)</li> </ul>                                                                                                            |  |
| Test Lugs                         | <ul style="list-style-type: none"> <li>IS2062</li> </ul>                                                                                                                                                                                                     |  |
| External Coat                     | <ul style="list-style-type: none"> <li>Aliphatic Polyurethane-300 Micron DFT</li> </ul>                                                                                                                                                                      |  |
| Internal Coat                     | <ul style="list-style-type: none"> <li>High Solids Epoxy-300 Micron DFT</li> </ul>                                                                                                                                                                           |  |
| Double Seal Requirement           | <ul style="list-style-type: none"> <li>Yes</li> </ul>                                                                                                                                                                                                        |  |

## CONNECTING PIPE DETAILS

| S. No. | Outside Diameter, OD mm (inch) | Wall Thickness, (mm)/ Schedule | Material              |
|--------|--------------------------------|--------------------------------|-----------------------|
| 1      | 114.3 (4")                     | 6.4                            | API 5L Gr. X-52 PSL-2 |

## Notes:

- The internal diameter of Insulating Joint shall be uniform through out the entire length and shall not be less than specified internal diameter of connecting Pipeline.
- Insulating joint shall comply the requirement of Project Specification VCS-SS-PP-2029.
- The Charpy Impact temperature shall be (-)29° C as specified in data sheet and shall supersede the temperature requirement specified in Specification
- For the welding end, the out of roundness and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in line Pipe Specification & API 5L.

|  |                                 |                        |     |
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**CITY GAS DISTRIBUTION PROJECT IN DIMAPUR DISTRICT  
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5. Insulating Joint shall be suitable for all type of pigging operation.
6. Insulating Joint shall be monolithic boltless.
7. Vendor to ensure that all material specified herein/ offered is suitable for specified fluid type & design & operating Condition.
8. All applicable test (Impact, hardness, Chemical, mechanical etc) shall also be carried out on pup piece.
9. Overall isolating joint's length shall be such that the heat generated by field welding is not detrimental to the insulating, filler materials, and internal/external coating.
10. Vendor shall furnish the allowable forces & moments for the axial, lateral & transverse (i.e., X, Y & Z) directions
11. Manufacturing shall not commence until materials, dimension (including the calculation sheet), drawings, manufacturing process and welding procedure qualification selected by the Manufacturer are approved by COMPANY.
12. Manufacturer shall ensure that the wall thickness (W.T.) of all parts of insulating joint shall be adequate to sustain design pressure and selected W.T. shall be suitable for welding with W.T. of connected pipeline.

|                                                                                     |                                        |                        |            |
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# **STANDARD SPECIFICAION**



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR PIPELINE CONSTRUCTION (ONSHORE)

VCS – SS – PP - 2001

|         |            |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 03      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                    | GW                                                                                    |
| 02      | 03.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                    | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                           | Authorized By                                                                         |

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                                                        |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                         | Revision Description                                                                                                   |
| 00              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Issued as Standard Specification                                                                                       |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                    | (Document formatting, Cover Page, Doc numbering updated from SS-PL-015 to VPC-SS-PL-0015 keeping Revision Number Same) |
| 01              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Document numbering updated from VPC-SS-PL-0015 to VPC-SS-PP-2001                                                       |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                    |                                                                                                                        |
| 02              | 03.01.2022    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Revised as marked                                                                                                      |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                    |                                                                                                                        |
| 03              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                    |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                    |                                                                                                                        |

## ABBREVIATIONS:

|        |                                                           |
|--------|-----------------------------------------------------------|
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society of Testing and Materials                 |
| API    | American Petroleum Institute                              |
| BS     | British Standards                                         |
| ISO    | International Organization for Standardization            |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| NACE   | National Association of Corrosion Engineers               |
| OISD   | Oil Industry Safety Directorate                           |
| SSPC   | Steel Structures Painting Council                         |

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## 1. SCOPE

- 1.1 This specification covers the minimum requirements for the various activities to be carried out by Contractor for or about the construction of cross-country onshore pipelines and associated facilities.
- 1.2 This specification shall be read in conjunction with scope of work and requirements indicated in specifications and documents included in the contract between Company and Contractor.
- 1.3 Contractor shall take full responsibility for the stability, suitability and safety of all operations and methods involved in the work.
- 1.4 The Contractor shall be deemed to have visited, inspected and examined the work area(s) and its surroundings and to have satisfied himself with the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, accessibility to the work area(s), the extent and nature of the work and materials and equipment necessary for the completion of the work.
- 1.5 The Contractor shall be deemed to have obtained all necessary information and provided for all risks, contingencies and all other circumstances, which may influence the work.
- 1.6 Contractor, as part of his Scope of work, shall investigate and establish any new development which may have taken place since the topographical survey was carried out by the Company during feasibility stage and shall submit detailed documentation to support any proposed realignment of the surveyed pipeline route resulting from the actual conditions encountered during his investigations or as required by the relevant Local Authorities. Any realignment of the surveyed pipeline route shall be subject to Company approval prior to implementation.
- 1.7 Requirements related to pipeline construction including, but not limited to, clearing and grading of Right-of-Use (ROU), staking of the pipeline route, handling, hauling, stringing of pipes along ROU, storing of all materials, trenching, cold field bending of pipes, line-up, welding, lowering, backfilling, tie-in, installation of associated facilities and pipeline appurtenances, testing, clean-up and restoration, maintenance during defect liability period, etc. are addressed in this specification.

## 2. REFERENCE CODE & STANDARDS

Reference code and Standards latest version has been followed for specification, in case of conflict between the requirement of this standard specification and the reference codes and regulations mentioned below, the more stringent requirement shall apply unless otherwise agreed by Company.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons  
and Other Liquids.
- B 31.8 : Gas Transmission and Distribution Piping Systems.
- B 16.5 : Pipe Flanges and Flanged Fittings.

- B 16.9 : Factory made Wrought Butt Welding Fittings.
- B 31.3 : Process Piping.

#### **AMERICAN PETROLEUM INSTITUTE (API)**

- 5L 1 : Recommended practice for rail road transportation of line pipe.
- 1104 : Welding of Pipeline and related Facilities.
- 1105 : Bulletin on construction Practices for oil and related facilities.
- 1109 : Marking Liquid Petroleum Pipeline facilities.
- 1110 : Recommended Practice for Pressure Testing of Petroleum Pipeline.
- 1102 : Steel Pipelines Crossing Railroads and High way.

#### **BRITISH STANDARDS (BS)**

- 8010 Part 2 : Pipeline on Land Design, Construction and Installation.

#### **PNGRB REGULATIONS:**

G.S.R 808(E) T4S: Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S: Regulations for CGD Network

#### **INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)**

- Part 192 : Transportation of natural gas by Pipeline (US Department of Title 49 transportation–Pipeline Safety standards).
- Part 195 : Transportation of liquid by Pipeline (US Department of Transportation–Pipeline safety standards).

### **3. GENERAL REQUIREMENT**

- 3.1.** Contractor shall, with due care and diligence, execute the work in compliance with all laws, by laws, ordinances, regulations etc. of the land and provide all services and labor, inclusive of supervision thereof, supply of all materials, excluding the materials indicated as "Company Supplied Materials" in the contract, equipment, appliances or other things of whatsoever nature required for the execution of the work, whether of a temporary or permanent in nature.
- 3.2.** In case, the Company will get the surveys and soil investigations carried out along pipeline route, the details of the surveys, soil investigations and other data collected by the Company shall be presented in the drawings and documents enclosed with the Contract for

the information of the Contractor. The Contractor shall be deemed to have reviewed and satisfied himself with regard to the details provided in the Contract. Contractor shall not be entitled for any compensation in terms of time or cost in case of any variation in actual site conditions from the data furnished in the Contract.

- 3.3.** Where in the Contractor's opinion the survey and investigation data are not found to be sufficient in detail, it shall be the responsibility of the Contractor to assess, requirement of any additional surveys and/ or soil investigations or any other data collection that may be deemed necessary for proper execution of the works. The Contractor shall be responsible for carrying out all such surveys and collect additional data/ information at no extra cost to Company.
- 3.4.** Details of the permissions/ clearances obtained by the Company from agencies/ authorities having jurisdiction in the area where the work is to be performed are indicated in the documents enclosed with the Contract for the information of the Contractor. It shall be the responsibility of the Contractor to comply with all the conditions and requirements issued by the agencies/ authorities. In case any other permit/ authorization is required to be obtained from the relevant authorities for performance of the work, the same shall be obtained by the Contractor.
- 3.5.** Compliance with the requirements of this specification or the Company's approval of any aspect of any operations covered by this specification shall in no way relieve the Contractor of his ultimate responsibility for the satisfactory completion of the work authorized under this Contract.
- 3.6.** The Contractor shall provide full access to the Company Representative for monitoring of all work areas during all phases of work.
- 3.7.** The Contractor shall provide and maintain all lights, guards, fencing, watchmen, etc., when and where necessary or required by Company or by any duly constituted authority and/ or by the authorities having jurisdiction thereof for the protection of the work and properties or for the safety and the convenience of public and/ or others.
- 3.8.** The Contractor shall take full responsibility for the suitability and safety of all operations and methods involved in the work.

For the purpose of this specification the following definitions apply:

- Words 'Shall' and 'Must' where used indicate that a provision is mandatory.
- Words 'Should' and 'Will' where used indicate that a provision is not mandatory but is recommended as good practice.
- 'May' used as a verb to indicate that a provision.

### **3.9. WORKING SPREAD LIMITATIONS**

Contractor shall, in general, observe the following maximum distances between the working mainline spread:

|                                               |   |        |
|-----------------------------------------------|---|--------|
| Between ROU grading, clearing and backfilling | : | 25 Kms |
| Between backfilling and final clean-up        | : | 10 Kms |

## 4. ROUTE SURVEY & MARKING

- 4.1** Having been granted the accessibility of the route the contractor shall inspect and analysis the entire pipeline route within the designated corridor including Major crossing, Terminal/ Despatch Station and Terminal/ Receipt Station and if any spur lines to other pipeline/ station before commencement of construction.
- 4.2** These inspection reports shall state the condition of the item potentially affected by construction and record the mutual approval of all parties concerned
- 4.3** Contractor shall establish reference points in every 500 meters along the pipeline route. The reference points shall be positioned at 25 meters offset from pipeline centerline.
- 4.4** The contractor shall stake markers in the centerline of the pipeline in 100 m intervals. In areas where it is difficult to follow the centerline when staked at 100 m intervals, the stakes shall be set at 50 m intervals or less to ensure unobstructed visibility.

## 5. RIGHT-OF-USE (ROU)

Company shall make available the ROU acquired for the works covered in the Contract to the Contractor. The Contractor shall carry out the construction activities within the ROU acquired by Company. In case any additional land is required for carrying out the works, it shall be the responsibility of the Contractor to make arrangement for all such additional land at no extra cost to Company.

### 5.1 STAKINGS

Company has surveyed and marked the centreline of the pipeline route with stone pillars at every 250 meters and also provided pillars at all turning points. In addition, Company also has established survey bench marks along the route. However, it is possible that some of the pillars may have been removed or shifted since their installation. The Contractor shall locate and/ or re-establish benchmarks, turning points and intermediate points by field survey prior to commencement of grading and clearing.

The Contractor shall stake markers in the centreline of the pipeline at a distance of maximum 100 m for straight line sections and maximum 10 m for horizontal bends.

The width of the pipeline ROU acquired by Company and the location of the pipeline centreline within the ROU is shown on the Alignment Sheets. The Contractor shall stake ROU boundary line, so as to prepare the strip for laying the pipeline. Two ROU markers shall be staked at every 100 m, one on either side of the surveyed centerline, for this purpose by the Contractor.

In addition, the Contractor shall also install distinct markers for special points such as obstacle crossing, change of wall thickness along with chainage and contract limits.

Chainage markers shall be installed at every 250 meters.

Any deviation from the approved alignment shall be executed by Contractor after seeking Company approval in writing prior to clearing operations.

### 5.2 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall give due consideration to the interests of property owners and tenants wherever involved, adhere to all ROU restrictions and permits, and exert all reasonable efforts

to maintain the goodwill of the tenants and Land Owners for the benefit of the Company.

The Contractor shall provide temporary approaches to and from crossings of public roads, private roads and entrances that may be opened for construction, and maintain them in a safe condition.

Warning signs shall be erected on both sides of highway/ road crossing. The signs shall state that the pipeline ROU is a private work area and that unauthorized entry is prohibited.

### **5.3 FENCING**

- 5.3.1 Prior to clearing and grading of the Right-of-Use or stringing of pipe, Contractor shall open fences on or crossing the construction Right-of-Use and install temporary gate. Before such fences are cut and opened, Contractor shall notify the land owner or tenant, and where practicable, the opening of the fences shall be in accordance with the wishes of said owner and tenant. In all cases where Contractor removes fences to obtain work room, Contractor shall provide and install temporary fencing, and on completion of construction shall restore such fencing to its original condition.
- 5.3.2 Contractor shall install temporary fencing on either side of ROU where in Company's opinion, it is considered essential to ensure safety and non-interference, especially in areas like grazing lands, villages etc.
- 5.3.3 Fencing shall be removable type wherever necessary, to permit crossing of traffic. The type of fencing must be suitable for the situation in accordance with user. The pole distance shall not be greater than 6m. The minimum height of the fencing shall be 1.2 m above grade. Fencing can consist of one or more rows of smooth wire and/ or of barbed wire.
- 5.3.4 Fencing shall be continuously maintained and the thorough-ways inspected to be shut during the execution of the work.

### **5.4 CARE OF SERVICES AND PROPERTY**

- 5.4.1 When ingress and egress of equipment interferes with existing services, the necessary arrangements shall be made to preserve the continuous use of the existing services during construction of the pipeline.
- 5.4.2 Temporary culverts shall be installed in all drainage ditches, creeks, and other drainage courses where blockage might result in damage to property. All temporary culverts shall be removed when no longer required. Continuity of water supplies for both domestic and agricultural purposes shall be maintained.
- 5.4.3 In the event of damage to a facility, the Owner of the facility concerned shall be immediately informed and the facility repaired as necessary (where permitted by the Owner) to allow for its proper function until such time as permanent repairs can be made.

### **5.5 RESTRICTED WIDTH OF ROU**

In certain areas restricted width of ROU shall be available and it shall be Contractor's responsibility to arrange its equipment etc. in such a manner as not to cause any hindrance to the movement of manpower or machinery and at the same time not to cause any damage to other's property.

## 5.6 ACTIVITIES IN FLOODED FIELDS

Where the pipeline is constructed across agricultural land where regular flooding is necessary, such as rice paddocks. Contractor shall ensure that the water supply and access to land on either side of the ROU is maintained, and that the landowner's farming activities are not restrained in any way.

## 5.7 DUST CONTROL

Adequate dust control measures shall be adopted, including water sprinkling, to ensure that dust does not affect the work or the health and safety of personnel working and travelling on the ROU, adjacent landowners or tenants, animals, crops or pastures.

## 6. CLEARING, GRADING AND BACKFILLING OF ROU

- 6.1.1 ROU shall be cleared of all trees, bush, hedges or other obstacles lying within the width of ROU that may hinder the construction of pipeline.
- 6.1.2 Before clearing operations are started, the Contractor shall familiarize itself with all special provisions included in the ROU secured by the Company and the Contractor shall comply with these provisions.
- 6.1.3 Wherever the pipeline ROU runs across, through or alongside farm yards, built-up areas, groves, plantations, forests, horticultural spreads, gardens, plantations or grass-fields, ditches, dikes, roads, paths, railways or any other area with restrictions, the Contractor shall grade only the width of the ROU necessary for digging the pipeline trench and constructing. The Contractor shall carry out the work in such a way that damage resulting from the pipeline construction is kept to a minimum.
- 6.1.4 Permission for felling of "Scheduled Trees" as per applicable tree felling Acts shall be obtained by the Contractor prior to felling of the trees.
- 6.1.5 All stumps shall be grubbed on a continuous strip, with a width equal to trench top width plus two meters on either side centered on the pipeline centreline. In addition, all stumps shall be grubbed from areas of the construction. Outside of these areas to be graded, the stumps may either be grubbed or cut off to ground level. Any stump cut off must be left in a condition suitable for rubber-tyred pipeline equipment movement. Whenever stumps are grubbed and a hole is left in the ground, the Contractor shall back-fill the hole-and compact it to prevent water from gathering in it and making a big hole.
- 6.1.6 The ROU shall be graded to establish the working platform as required for efficient pipeline construction. The Contractor shall grade the pipeline ROU as required for installation of the pipeline and for providing access to the pipeline during construction.
- 6.1.7 The Contractor shall grade sharp points or low points to allow the pipe to be bent and laid within the limits set forth in this specifications and alignment sheets with regards to the minimum elastic curvature permitted. All grading shall be done as is necessary to minimize the necessity of sag and over bends.
- 6.1.8 Temporary or permanent deposit of any kind of material resulting from clearing and grading shall not be permitted in the approach to roads, railways, streams, ditches, drainage ditches and any other position which may hinder the passage and/ or the natural water drainage.



- 6.1.9** The ROU clearing and grading operations, however, shall in no case involve embankment/ structures of any type without prior approval of the authorities having jurisdiction over the same.
- 6.1.10** In the case of natural or artificial deposits of loose soil, sand, heaps of earth or other fill materials, these shall be removed till stable natural ground level is reached so as to ensure the construction of the pipeline ditch in stable ground.
- 6.1.11** No filling of the ground over the pipeline centreline to achieve the minimum depth of cover shall be permitted. In locations where the ground is filled for access or other reason, the natural surface profile shall be surveyed to ensure that compliance with the minimum cover requirements can be demonstrated.
- 6.1.12** Grading of the ROU shall be kept to a minimum in order to preserve as much of rootstock as possible.
- 6.1.13** Cleared materials shall be stockpiled and preserved for use during restoration and final clean up. In no case shall it be left to interfere with the grading and laying operations.
- 6.1.14** Entire clearing and grading operations shall comply with Environment Management Plan.

## **6.2 GRADING IN STEEP AND ROCKY AREAS**

- 6.2.1** In the case of ROU clearing and grading on the hillside or in steep slope areas, barriers or other arrangements shall be provided to prevent the removed materials from rolling downhill. Slope of side hill faces shall be stabilized to prevent landslides.
- 6.2.2** Grading operations in rocky terrain should normally be carried out by drilling, wedging, mechanical excavators or manually. In certain areas where solid rock cannot be removed until loosened by blasting, in order to make an adequate working space along the pipeline, blasting may have to be resorted to. Contractor shall identify such areas and take prior approval of concerned authorities before resorting to any blasting operations.

## **6.3 PROVISION OF DETOURS**

- 6.3.1** Contractor shall do all necessary grading and bridging at road, water and other crossings and at other locations where needed, to permit the passage of its men and equipment. It is understood that the Contractor has recognized such restrictive features of the Right-of-Use and shall provide the necessary detours and execute the works without any extra cost to Company. Public travel shall not be inconvenienced nor shall it be wholly obstructed at any point.
- 6.3.2** In rough or steep terrain, Contractor may have to grade access roads and temporary bypass roads for its own use. Where such access roads do not fall on the Right-of-Use; Contractor shall obtain necessary written permission from land owners and tenants and be responsible for all damages caused by the construction and use of such roads, and at no extra cost to Company.
- 6.3.3** Contractor at his own cost shall furnish and maintain watchman detours, lanterns, traffic lights, barricades, signs, wherever necessary to fully protect the public.
- 6.3.4** Contractor shall be responsible for moving its equipment and men across or around watercourses. This may require the construction of temporary bridges or culverts.

Temporary bridging required for Right-of-Use crossing water courses shall be constructed in consultation with concerned Authorities. Contractor shall ensure that such temporary works shall not interfere with normal water flow, avoid overflows, keep the existing morphology unchanged and shall not unduly damage the banks of water courses. No public ditches or drains shall be filled or bridged for passage of equipment until Contractor has secured written approval of the Authorities having jurisdiction over the same. Contractor shall furnish Company a copy of such approval.

#### **6.4 OFF RIGHT-OF-USE DAMAGES**

Contractor shall confine all its operations within limits of the Right-of-Use. Any-damage to property outside ROU shall be restored or settled to the Contractor's account.

Contractor shall promptly settle all off Right-of-Use damage claims. Should Contractor fail to do so, Company shall give written notice to Contractor that if Contractor does not settle such claims within seven days after such notice, Company shall have the authority to settle claims from the account of Contractor.

#### **6.5 DISPOSAL OF DEBRIS**

All grubbed stumps, timber, bush, undergrowth and roots cut or removed from the ROU, blasted rocks and boulders shall be disposed of in a manner and method satisfactory to Company, Land Owner and/ or tenant, and Government Authorities having jurisdiction and as soon as practical after the initial removal.

#### **6.6 CONSERVATION OF TOP SOIL**

**6.6.1** In cultivable lands and other areas specifically designated by the Company representative, top 300mm of the arable soil, excavated shall, be stockpiled separately; for; replacing in original position. Removed topsoil shall be stockpiled in a location that will minimize any loss due to erosion or mixing with other material.

**6.6.2** Any topsoil lost due to erosion or mixing with other material shall be replaced with imported topsoil that is compatible with the area subject to approval by Company representative.

### **7. HANDLING, HAULING, AND STRINGING OF LINE PIPES AND STORAGE OF OTHER MATERIAL**

#### **7.1 GENERAL**

The Contractor shall exercise utmost care in handling line pipe and other materials. Contractor shall be fully responsible for all materials and their identification until such time that the pipes and other materials are installed in permanent installation. Contractor shall be fully responsible for arranging and paying for temporary storage areas for the pipeline materials, however, method of storage shall be approved by Company.

Contractor shall reimburse the Company for the cost of replacement of all Company supplied materials damaged during the period in which such materials are in the custody of the Contractor. It shall be Contractor's responsibility to unpack any packings for the materials supplied by Company.

Pipe bevel protectors shall always be kept in position during all handling, transportation and stringing operations and shall be removed only prior to fit-up for welding. After



fabrication and welding, the Contractor shall arrange to return all such bevel protectors at Company's designated storage yard and as instructed by Company.

## 7.2 "TAKING-OVER" OF LINE PIPES

In case Company supplies line pipes to the Contractor as 'Free Issue Material', the Contractor shall receive and 'take over' against requisition, line pipes from the Company's designated place(s) of delivery as defined in the Contract. The Contractor shall, in the presence of Company Representative, visually inspect the entire surface of the bare pipes and coating of the coated pipes at the time of taking delivery and record all damages and exact length of pipes received.

In the case of coated pipes, the Contractor at his option may carry out holiday detection at a prescribed set voltage and record any holidays detected at the time of 'taking over', in the presence of Company Representative. However, if the Contractor proposes to perform only visual inspection, then repair of all holidays found at the time of laying the pipeline shall be carried out by the Contractor at no extra cost to Company as per relevant Specification.

The Contractor at his option may also carry out gauging of the pipes and record any dents detected at the time of 'taking over', in the presence of Company Representative. However, if the Contractor proposes to perform only visual inspection, then repair of all dents found at the time of laying the pipeline shall be carried out by the Contractor at no extra cost to Company. Repair of all damage occurring after taking over delivery of material shall be contractor's cost.

## 7.3 HANDLING OF LINE PIPES

### 7.3.1. BARE PIPES

Contractor shall unload, load, stockpile and transport the bare pipes using suitable means and, in a manner, to avoid denting, flattening, or other damages to pipes. Pipe shall not be allowed to drop or strike objects, which will damage the pipe but shall be lifted or lowered from one level to another by suitable equipment. Lifting hooks when used shall be equipped with a plate curved to fit the curvature of the pipe. In loading pipe on trucks each length shall be lowered to position without dropping and each succeeding length shall rest on special supports on the truck and shall be separated from the adjacent pipes. After loading, suitable chains and padding shall be used to tie the load securely to each bolster. Pipe, when stock piled, shall be placed on suitable skid to keep it clear of the ground and flood water. Care shall be exercised in handling or stock-piling pipes in order to avoid distortion, flattening, denting or other damages. The Contractor shall provide all necessary timber or other materials required for the stock-piling. While stacking, the number of allowable layers of bare pipes shall be calculated as per API RP 5L1 and shall be agreed with Company. The stacks must be properly secured against sliding and shall consist of pipes of the same diameter and wall thickness. Adjacent stacks of pipes having different dimensional characteristics shall be clearly separated.

Pipes which are damaged at the time of delivery or 'taking-over' (when line pipe is supplied by Company), particularly those which are dented, buckled, or otherwise permanently deformed, must be stacked separately and may be transported to the sites only when these defects have been repaired or eliminated.

### 7.3.2. CORROSION COATED PIPES

The Contractor shall load, unload, transport and stockpile the coated pipes using approved suitable means and, in a manner, to avoid damage to the pipe and coating. Contractor shall submit to Company a complete procedure indicating the manner and arrangement used for handling and stacking of coated pipes for Company approval prior to commencement of handling operations.

Use of vacuum lifting equipment's is preferred. Hooks may also be used for handling the pipes provided they have sufficient width and depth to fit the inside of the pipe and covered with soft material like rubber, Teflon or equivalent, so as not to cause damages to bevel or pipe ends. During hoisting cables/ wire ropes shall have sufficient inclination compared to pipe axis so that they do not come into contact with external coating.

Coated pipes may be handled by means of slings and belts of proper width (minimum 60 mm) made of non-metallic/ non-abrasive materials. In this case, pipes to be stacked shall be separated row by row to avoid damages by rubbing the coated surface in the process of taking off the slings. Use of round sectional slings is prohibited.

During handling, suitable handling equipment's with proper length of booms shall be used. Forklifts may be used provided that the arms of the forklifts are covered by suitable pads preferably rubber. Before lifting operations, it is essential to ensure that the pipe surface is free from foreign materials with sharp edges. Belts/ slings when used shall be cleaned to remove hard materials such as stone, gravel etc. Coated pipes shall not be bumped against any other pipe or any other objects. Rolling, skidding or dragging shall be strictly forbidden.

Coated pipes at all times shall be stacked completely clear from the ground so that the bottom row of pipes remains free from any surface water. The pipes shall be stacked at a slope so that during rain water does not collect inside the pipe.

The coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can, for example, consist of dry, germ free straw with a plastic film, otherwise foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes, particularly in case of small diameter pipes with low wall thickness. The pipes shall be stacked so that the uncoated beveled ends are in line at one end, thus making differences in lengths clearly noticeable.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damages to the coating. Each pipe section shall be separated by means of spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld bead of pipes shall be positioned in such a manner so as not to touch the adjacent pipes.

Coated Pipes stacked in open storage yards/ dump yards shall be suitably covered on top to decrease direct exposure to sunlight. The ends of the pipes during handling and stacking shall always be protected with bevel protectors.

The trailers/ rail wagons shall be equipped with adequate pipe supports having as many round hollow beds as the number of pipes to be placed on the bottom of the trailer bed. Supports shall be provided for at least 10% of the pipe length. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection shall be free from all nails and staples where pipes are in contact. The

second layer and all subsequent layers shall be separated from each other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.

All stanchions of trailers/ rail wagons used for transportation shall be covered by non-abrasive material like rubber belts or equivalent. Care shall be exercised to properly cover the top of the stanchions and convex portions such as reinforcement of the truck/ rail wagon body, rivets etc. to prevent damage to the coated surface.

#### **7.4 TEMPORARY STOCKPILES**

The Contractor at his own cost shall arrange for the land required for temporary stockpile of pipes, whenever the pipes are to be stockpiled prior to stringing. Pipes shall be stacked minimum 300 mm clear off the ground so that the bottom of pipes remain free from any surface water. The pipes shall be stacked at a slope so that rain water does not collect inside the pipe.

The coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can, for example, consist of dry, germ free straw covered with a sheet of plastic sheet or foam rubber. The supports spacing shall be such that prevents permanent bending of the pipes.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damages to the pipe as well as coating. Each pipe section shall be separated. The Contractor shall submit calculations for the number of tiers of pipes during stacking for approval by Company Representative. API RP 5L1 may be used as guidelines.

By means of spacers suitably spaced for the purpose, stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. Where applicable, the weld bead of pipes shall be positioned in such a manner so as not to touch the adjacent pipes.

The pipes shall be stacked in such a manner that the uncoated beveled ends are in line at one end, thus making differences in lengths clearly noticeable at the other end.

At such time as the temporary stockpile site is no longer needed, the site shall be cleaned up and the property restored to the satisfaction of the landowner and the clean-up as per of this Specification. The Contractor shall obtain letter from Land Owners clearly stating that the land has been returned and handed over to the Land Owners to their entire satisfaction.

#### **7.5 STRINGING OF LINE PIPE ALONG ROU**

**7.5.1** Pipes shall be unloaded from the stringing trucks and lowered to the ground by means of side boom, Hydra Crane or swinging crane or other suitable equipment using lifting devices as per this specification. Pipe shall not be rolled, dragged or dropped from the stringing truck.

**7.5.2** Stringing of pipe shall be carried out only in day light and after clearing and grading operations have been completed. Pipe shall not be strung on the ROU in rocky areas, where blasting may be required, until all blasting is complete and the area cleared of all debris. If pipe has already been strung in an area where blasting is subsequently found to be required, all previously strung pipe shall be removed to a safe area at Contractor's cost and time and protected from damage.

- 7.5.3** The stringing of the pipe on the ROU shall be done in such a manner as to cause the least interference with the normal use of the land crossed and to avoid damage to or interference with the pipes. The sequence of pipes must be interrupted at suitable intervals, spaced to coincide with passages, roads, railroads, water-bodies and at other places if requested by Land Owner or tenants to permit use of the land. Care shall be taken to provide safe working space between trench edge and the pipe.
- 7.5.4** Strung pipe shall be supported clear off the ground (minimum 300 mm) and in a manner that will not damage the pipe or coating. Pipe shall be strung on approved soft earth / sand filling bags & wedge.
- 7.5.5** Special precautions are to be taken and extreme care exercised where stringing operations are carried out in the vicinity of overhead power lines, including possible earthing of individual pipe joints.
- 7.5.6** The Contractor shall adequately anchor the pipe on steep slopes and where the ROU condition dictates, to prevent the pipe from sliding or rolling from skids.
- 7.5.7** It shall be the responsibility of the Contractor to ensure that pipe is strung in accordance with the approved drawings for the proper placement of pipe by size, thickness, grade and other specifications. Any additional handling of pipes resulting from failure to, comply with these requirements shall be at the Contractor's expense.
- 7.5.8** In case line pipe supply is by different Manufacturers, the, Contractor shall string all line pipe of one Manufacturer before commencing the stringing of the line pipe of another Manufacturer.
- 7.5.9** When parallel pipelines are being constructed, bumping against and contact with the strung sections of pipe shall be avoided, whether the stringing of the pipes for the individual lines is carried out separately or simultaneously.

## **7.6 REPAIR OF DAMAGED PIPES**

After the pipe has been strung on the Right-of-Use, it shall be inspected by the Contractor and the Company and all defective pipe ends repaired. Defective pipes shall be repaired or rejected as the Company may direct as per the requirements of this Specification.

## **7.7 MATERIALS OTHER THAN LINE PIPE**

- 7.7.1** Contractor shall receive and take over against requisition all Company supplied materials from Company's designated place(s) of delivery as defined in the contract. Contractor shall perform visual inspection and defects, if any noted, shall be recorded separately. The Contractor shall be entitled to extra compensation for repair and rectification of such defects at the rates set forth in the "contract". Contractor shall take permission from Company before start of such repair.
- 7.7.2** The Contractor shall perform the necessary loading, unloading, hauling from points designated by the Company and storing, if necessary, of all materials. The Contractor shall exercise care in handling, hauling, storing and distribution of materials in order to avoid damage and deterioration of these materials and prevent their theft or loss.
- 7.7.3** Materials excluding line pipe shall be stored in sheltered storage. Such materials shall not be strung on the Right-of-Use but shall be transported in covered conveyances for use only at

the time of installation.

- 7.7.4** Contractor shall ensure that all valves and whenever applicable, other materials are fitted with suitable end covers of the type approved by Company. Materials with worked surfaces such as flanges, pipe fittings etc. must be stacked and handled so as to avoid contact with the ground or with substances that could damage them.
- 7.7.5** The Manufacturer's instructions regarding temperature and procedure for storing materials, which are subject to alteration of the original properties and characteristics due to unsuitable storage, must be strictly complied with and, if required, an adequate heat conditioning shall be provided for these materials.
- 7.7.6** When material is supplied in containers and packages, it must not be thrown or dropped, nor handled using hooks which could damage the container or the materials, either during loading/ unloading or during successive handling, until their final use.
- 7.7.7** Coating materials, which are susceptible of deteriorating or suffering from damages especially due to humidity, exposure to high thermal excursions or other adverse weather conditions shall be suitably stored and protected. These materials shall be kept permanently in store, supported above the ground in a dry place protected against the weather and transported for use only at the time and in the quantities necessary for immediate application. Deteriorated materials shall not be used and replaced with no extra cost to Company.

## **8. TRENCHING**

### **8.1 LOCATION**

- 8.1.1** Contractor shall excavate and maintain the pipeline trench on the staked centerline of the pipeline taking into account the curves of the pipeline.
- 8.1.2** In case of common ROU, the centerline of the trench shall be established from the location of existing pipeline. In case of independent ROU, the centerline of the trench shall be established from the edge of ROU.

### **8.2 TRENCH EXCAVATION**

- 8.2.1** Trenching shall include all excavation, whether by trenching machine, back-hoe, power shovel, by hand, by blasting or by other methods which may be necessary to prepare a trench for the pipe with the minimum cover between top of pipe and immediate ground level as set forth in this specification.
- 8.2.2** Contractor shall, by any method approved by Company, dig the pipeline trench on the cleared and graded Right-of-Use.
- 8.2.3** In cultivable land and other areas specifically designated by the Company, top 300mm of the arable soil on the pipeline trench top width shall be excavated and stored separately, to be replaced in original position, after backfilling and compacting rest of the trench.
- 8.2.4** Suitable crossings shall be provided and maintained over the open ROU, where necessary, to permit general public, property owners or his tenants to cross or move stock or equipment from one side of the trench to the other.
- 8.2.5** Care shall be exercised to see that fresh soil recovered from trenching operation, intended

to be used for backfilling over the laid pipe in the trench, is not mixed with loose debris or foreign material. The excavated material shall never be deposited over or against the strung pipe.

- 8.2.6** In steep slope areas or on the hillside, before commencing the works, proper barriers or other protection shall be provided to prevent the removed materials from rolling downhill.
- 8.2.7** On slopes wherever there is danger of landslide, the pipeline trench shall be maintained open only for the time strictly necessary. Moreover, the Company may require manual excavation of trench, local route detouring and limiting the period of execution of the works. The Contractor shall make adequate arrangements for safe working of the personnel involved in manual excavation of trench.
- 8.2.8** In certain sloppy sections, before the trench cuts through the water table, proper drainage shall be ensured both near the ditch and the Right-of-Use in order to guarantee soil stability.
- 8.2.9** All sewers, drain ditches and other natural waterways involved in the execution of the works shall be maintained open and functional. The same applies to canals, irrigation canals, and pipelines and buried facilities crossed by the ditch for which temporary pipelines shall be laid, if required, and proper temporary installations provided.
- 8.2.10** All sewers drain ditches and other natural waterways involved in the execution of the works shall be maintained open and functional.

### 8.3 NORMAL COVER AND TRENCH DIMENSIONS

The trench shall be excavated to a minimum depth sufficient to provide the minimum cover as specified below. The dimensions in the table below shall govern except as noted herein or as shown on the job standards or detailed construction document/ drawings or as required by authorities having jurisdiction, whichever is stringent.

| Location |                                                               | Minimum Cover in (Mtr) |                 |
|----------|---------------------------------------------------------------|------------------------|-----------------|
|          |                                                               | Gas Pipeline           | Liquid Pipeline |
| <b>1</b> | Residential Area, Industrial, Commercial Area                 | 1                      | 1.2             |
| <b>2</b> | Minor water crossing/ steam/ drain nala/ canals               | 1.5                    |                 |
| <b>3</b> | River crossing for which scour depth is defined (below scour) | 2.5                    |                 |
| <b>4</b> | River crossing for Rocky strata                               | 1.5                    |                 |
| <b>5</b> | Uncased/ Cased Road Crossing/ Station approach                | 1.2                    |                 |
| <b>6</b> | Rocky Terrain                                                 | 1                      |                 |
| <b>7</b> | Cased Railway Crossing                                        | 1.7                    |                 |
| <b>8</b> | Marshy land and creek area                                    | 1.5                    |                 |



|    |                                             |     |
|----|---------------------------------------------|-----|
| 9  | Area under influence of tides               | 1.5 |
| 10 | Drainage, ditches at road/ railway crossing | 1.2 |

#### **Note**

- Minimum depth of cover shall be measured from the top of pipe corrosion/ concrete weight coating (as applicable) to the top of undisturbed surface of the soil or top of graded working strip or top of road or top of rail whichever is lower.
- Fill material in working strip shall not be considered to add to the depth of cover. However, surface of fill material placed to fill hollows may be used to determine the depth of cover subject to prior approval by Company.
- In case the Pipeline is located within 15 mtr from any dwelling unit, the cover shall be increased by 300mm over and above that specified.

### **8.4 EXTRA DEPTH AND CLEARANCE**

**8.4.1** At points where the contour of the earth may require extra depth to fit the minimum radius of the bend as specified or to eliminate unnecessary bending of the pipe or where a deep trench is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage ditches, and the like and in transition between normal trench and deep trench, the Contractor shall excavate such additional depth as may be necessary.

**8.4.2** The Contractor shall excavate to additional depth where the pipeline approaches and crosses other pipelines, sewers, drain pipes, water mains, telephone conduits and other underground structures, so that the pipeline may be laid with at least 500 mm free clearance from the obstacle or as specified in the standards, or greater as may be required by authorities having jurisdiction over it.

**8.4.3** In those areas where trench to be padded with select soil such as rocky areas, seismic zone crossings, station approaches etc. the trench shall be made deeper, to accommodate specified thickness of bedding and/ or padding, than otherwise required to maintain specified cover. Thickness of bedding and/ or padding required shall be as specified in the Contract drawings and documents.

### **8.5 TRENCHING AT CROSSING**

Before excavating the trench across thoroughfare such as roads, tracks, and wherever public access to be normally expected, approval of the crossing shall be obtained by the Contractor from the concerned authorities. Temporary diversions to permit the traffic shall be provided.

### **8.6 TRENCHING WITHIN OR ADJACENT TO OTHER UTILITIES**

**8.6.1** At locations, where pipeline is to be installed within the ROU or the body of a road, canal, dyke or other locations under jurisdiction of government/ public bodies, the Contractor shall perform such work, according to the requirement of concerned Authorities. When it becomes necessary, the Contractor shall resort to manual digging, well point drain, erection of sheet piling or any other special construction method in these areas without any extra cost to Company. The facilities damaged during trenching shall be restored; to their original

condition to the satisfaction of concerned authority.

- 8.6.2** In locations, where the pipeline has to be laid more or less parallel to an existing service such as pipeline, cable and/ or other utilities within the ROU, the Contractor shall carryout Trenching as per the requirements of the owners/ authorities of that service. At such locations; the Contractor shall perform the work in such a way that even under the worst weather and flooding conditions, the existing pipeline/ utilities remain stable.

## **8.7 ENCROACHMENTS AND WORKING NEAR EXISTING PIPELINE AND OTHER UTILITIES**

Contractor shall be liable for any damage occurring to, or resulting from damage to other pipelines, underground structures/ utilities, as laid down in clause of this specification. Contractor shall make trial pits at minimum intervals of 100 m along the straight route and at suitable less intervals along the curves in the pipeline route to establish the centerline clearing the existing utilities to avoid damage to the existing utilities during the construction of new pipeline.

The location of a new buried pipeline, when running parallel to an existing buried pipeline, should be at a minimum clear distance of 5.0 meters from the existing underground pipeline when heavy conventional construction equipment is expected to be utilized. This distance may be reduced after careful assessment of construction methodologies so that it does not result in unsafe conditions during construction. In any case the minimum clear distance shall not be less than 3.0 meters.

Existing pipeline should be clearly marked on the ground during construction so as to avoid any machinery movement or dumping of excavated earth over the existing pipelines. Bi-language (local language and Hindi / English) caution signs should be installed while working in such areas. In case the movement of machinery over the existing pipelines is unavoidable, the required area over the existing pipeline need to be prepared with earth to ensure an additional cover of 1m. The machinery movement shall be restricted to such area only. The contractor has to do all such preparation with no additional cost to the Company.

## **8.8 PROVISIONS FOR NEGATIVE BUOYANCY TO THE PIPE**

- 8.8.1** Contractor shall check if up-floating of Pipeline is present in open trench and then shall take appropriate measures to prevent up-floating such as applying soil dams and dewatering of trench or temporary filling of water into the line (in exceptional cases).
- 8.8.2** In the case of water on the ditch bottom when the pipeline is being laid, the ditch shall be drained to the extent and for the time required to make a visual inspection of the ditch bottom. After this inspection, the presence of water will be allowed provided its level does not cause sliding of the ditch sides and pipe floating before backfilling when no concrete weighing is provided.
- 8.8.3** The water pumped out of the ditch shall be discharged into a natural water course.
- 8.8.4** Whenever up-floating of the pipeline after backfilling is to be reckoned with, anti-buoyancy measures shall be provided by Contractor with Company's approval for such areas of



construction, using one or a combination of the following methods.

- Weighing by applying a continuous concrete coating around the pipe.
- Weighing by -installing gravel filled Geotextile bags.
- Installing of soil Bund over the pipeline in trench during lowering.
- Deeper burial of pipeline.
- Provision of select backfill material.

The above provisions shall be in accordance with the relevant specifications and/ or job standards/ drawings.

Contractor shall indicate the option(s) selected to Company for review and approval along with calculations, wherever applicable.

## **8.9 CUTTING AND REMOVAL OF PAVING**

**8.9.1** Whenever permitted by Authorities and/ or Company representative to open cut a trench in a paved road crossing or where the line is routed within the road pavement, the Contractor shall remove the paving in accordance with the restrictions and requirements of the Authorities having jurisdiction thereof or as directed by Company Representative. After laying the pipeline, in paved area, the trench shall be backfilled immediately to restore the area temporarily. Throughout the period of execution of work in such areas, the Contractor shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman, etc. as required by the local authorities having jurisdiction and/ or Company Representative.

**8.9.2** For all roads, paths, walkways etc. which are open-cut, the Contractor shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum of inconvenience and interruptions.

**8.9.3** The paving shall be restored to its original condition after the pipeline is installed to the entire satisfaction of concerned authorities.

## **8.10 GRADES, BENDS AND FINISH OF TRENCH**

**8.10.1** The trench is to be well made to provide a firm, uniform and continuous support for the pipe. Bends shall be made in the pipe at significant changes in grade of the trench. Company reserves the right to set the grade of the trench at location of the bends if so desired, in which case Contractor shall excavate, at no extra cost, the trench and bend the pipe to such a grade. Company desires reduce to a minimum the required number of cold field bends to lay the pipe to conform to the general contour of the ground and maintain a normal cover. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench in approaches to crossings. Such trenching work shall be done by Contractor at no extra cost to the Company.

**8.10.2** Company intends that there will be a minimum of hand grading of the trench bottom. However, to achieve this, Contractor will have to dig as square a bottom of the trench as possible with the equipment. This in part can be obtained by adjusting and adopting the crumbing shoe and digging teeth of the trenching machines and by use of a drag behind the trenching machines or manually dressing-up the same. Contractor shall do such hand work in the trench as is necessary to free the bottom of the trench from loose rock and hard clay

and to trim protruding roots from the bottom and side walls of the trench.

### 8.11 PADDING

- 8.11.1** In all cases where rock or gravel or marram/ hard soil is encountered in the bottom of the trench, trench padding shall be provided. The thickness of padding shall be at least 200 mm or more throughout the trench so that thickness of compacted padding shall not be less than 150mm. In those areas, trench shall be suitably excavated to keep min cover as required. Company will decide the extent of trench padding required.
- 8.11.2** Acceptable padding shall be placed under the pipeline before its installation, and around after installation to establish at both sides and on top of the pipe a permanent layer of padding. The thickness of compacted padding on top of pipe corrosion coating shall be at least 150mm.
- 8.11.3** Padding materials that are approved by Company shall be graded soil/ sand and/ or other soft materials containing no gravel, rock, or lumps of hard soil. Sand used for padding shall-pass through sieve size ASTM C33 No. 16.
- 8.11.4** When specified in the Contract, rock shield may be used in place of or in addition to sand padding as indicated above. Such rock shield shall be in accordance with the specification issued for the purpose and shall be subject to Company approval.
- 8.11.5** Padding shall also be required at other locations where select backfill is specified in the drawings and documents such as seismic zone crossings, station approaches, etc. Type of padding soil and thickness of padding in such areas shall be as specified in drawings and documents.

### 8.12 TRENCH PROTECTION

- 8.12.1** The trench shall be maintained in good condition till such time the pipeline is laid. When required, lumber, sheet-piling jacks or other materials that may be necessary to shore the trench, in order to prevent caving, shall be provided and removed by the Contractor.
- 8.12.2** The Contractor shall dewater the trench, if necessary, using well point system or other suitable systems, or do what else might be required to excavate the trench, install the pipe in it and backfill the trench as per approved procedure with no extra cost to company.

## 9. BLASTING

### 9.1 GENERAL

- 9.1.1** Contractor shall be responsible for carryout of trenching in rocky areas by controlled blasting and removal of scattered rock and debris caused by the blasting from the Right-of-Use and/ or adjacent property, as part of his work. All necessary precautions shall be taken to prevent stones from falling outside the ROU and in cultivated areas and to avoid any damage to the installations and properties existing nearby. Blasting and removal of debris shall be carried out prior to stringing the pipes.
- 9.1.2** The Contractor shall acquaint himself and comply with all the applicable local laws and regulations concerning storing, handling and the use of explosives. All such laws, regulations and rules etc., as enforced from time to time shall be binding upon the Contractor. National/ Local Laws and Regulations shall take precedence over this

specification in the event of conflict. The requirements stated herein, however, in no way relieve the Contractor of his responsibility of carrying out safe blasting operations and the Contractor shall be solely responsible for damages and claims thereof.

- 9.1.3** Every possible precaution shall be taken to prevent injuries and damages to persons and properties during blasting operations. The Contractor shall be responsible for removal of scattered rock and debris caused by the blasting from the ROU and/ or adjacent property.
- 9.1.4** The use of explosives requires an approval from the Chief Inspector of Explosives and/ or his authorized Inspector. It shall be the responsibility of the Contractor to obtain all such permits and observe all requirements regarding the safe storage handling and use of explosives.
- 9.1.5** Blasting and removal of debris shall be carried out prior to stringing the pipes.
- 9.1.6** Company reserves the right to refuse blasting where possible danger exists to property, existing utilities or other structures. In such locations other methods of extracting rock shall be proposed by Contractor and shall be approved by Company.

## **9.2 BLASTING CLOSE TO EXISTING SERVICES**

Contractor shall prepare a detailed blasting procedure incorporating the following:

- Loading of explosives.
- Drilling of new holes and extending existing holes.
- Handling of explosives at site.
- Tamping explosives into holes.
- Machines, tools and cables required.
- Initiation of blasting.
- Safety of personnel.
- Vibration control.
- Blast pattern and shot size establishment.
- Misfires.
- Emergency procedures
- Following approval by the Company representative, the procedures shall be closely followed by the Contractor and demos need to be shown by the contractor to assess the blasting impact on other existing services and / or facilities. Accordingly suitable modifications to be considered till the procedure is finally qualified and approved by the company. .

## **10. PIPE BEND/ BENDING**

### **10.1 GENERAL**

- 10.1.1** The Contractor shall preferably provide for changes of vertical and horizontal alignment by making elastic bends. Cold field bends may be provided, at the Contractor's option for change of direction and slope.
- 10.1.2** In general, elastic bends or one or more cold field bends will permit construction of most of the direction changes required, however where in the judgment of Company, due to site conditions, even cold field bends cannot be accommodated, the Company may allow use of

hot induction bends.

**10.1.3** Use of miter bends for change in direction and slope is not permitted.

## **10.2 ELASTIC BENDS**

The minimum allowable radius for elastic bends for corrosion coated as well as concrete coated buried pipeline shall be as indicated in relevant job standards document drawings elastic bend shall be continuously supported over its full length. A radius smaller than permitted in elastic bending shall require a cold field bend.

## **10.3 COLD FIELD BENDS**

**10.3.1** The minimum radius of cold field bends shall be as indicated in the below table:

| Nominal Pipe Size (Inch) | Minimum Bend Radius |
|--------------------------|---------------------|
| 12 and below             | 21D                 |
| 14 to 16                 | 30D                 |
| 18 and above             | 40D                 |

**10.3.2** Contractor shall use a pipe bending machine of adequate capacity and employ recognized and accepted methods of bending of coated pipe in accordance with good pipeline construction practice. However, bending machines shall be capable of making bends without wrinkles, buckles, stretching and with minimum damage to the coating.

**10.3.3** Contractor shall, before the start of the work, submit and demonstrate to Company a bending procedure, which shall conform to the recommendations of the manufacturer of the bending machine. The Qualification shall be done for the maximum bend angle in one pipe length. The procedure shall include amongst other steps-lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend. The bending procedure and the equipment used shall be subject to Company's approval with regard to the quality of bend in terms of wrinkles / buckles, stretches and any other damages.

**10.3.4** Pipes with longitudinal welds shall be bent in such a way that the weld lies in the plane passing through the neutral axis of the bend, which shall be installed positioning the longitudinal weld in the upper quadrants. If horizontal deviations are to be achieved by joining more adjacent bends, the bending of the pipe lengths shall be made by positioning the longitudinal welds alternatively 70mm above and below the plane passing through the neutral axis in-such a way that the bends are welded with the longitudinal welds displaced by about 150mm and situated in the upper quadrants. In case of vertical bends formed, from a number of pipe lengths, the longitudinal welds shall be positioned on the plane passing through the neutral axis of the bend to the right and left alternatively.

**10.3.5** The pads, dies and rolls of the bending equipment shall have relatively soft surfaces to avoid damage to the pipe coating. Where applicable, fully retaining bending shoes shall be used. Roller type bending machines are preferred.

**10.3.6** The ends of each bent length shall be straight and not involved anyway in the bending. The

length of the straight section shall permit easy joining. In no event shall the end of the bend be closer than 1.5m from the end of a pipe or within one meter of a girth weld.

**10.3.7** The ovality caused on each pipe by bending shall be less than 2.5% of the specified diameter at any point. Ovality is defined as the reduction or increase in the internal diameter, of the pipe compared with the nominal internal diameter. A check shall be performed on all bends in the presence of Company Representative by passing a gauge consisting of two metallic discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly together at a distance equal to 300mm.

**10.3.8** The wall thickness of finished bends, taking into account wall thinning at the outer radius, should not be less than the design thickness. An indication of wall thinning as a percentage is given by the following empirical formula.

$$\text{Wall thinning} = \frac{50}{n+1}$$

**10.3.9** Where 'n' is the inner bend radius divided by pipe diameter. Pipes with measured wall thickness greater than the nominal wall thickness (i.e. with +ve tolerance) shall normally be used for making cold field bends.

**10.3.10** Cold bend pipes on site shall have the corrosion coating carefully checked with the aid of a holiday detector for cracks in the coating down to the pipe wall. It must also be checked whether the coating has dis-bonded from the pipe wall during bending by beating with a wooden mallet along the outer radius. Any defects or dis-bonding of the coating caused during bending (also forced ridges in the coating) shall be repaired at the Contractor's expense in accordance with Company approved procedures.

**10.3.11** When pipelines are laid in parallel, the horizontal bends shall be concentric.

#### **10.4 MITER AND UNSATISFACTORY BENDS**

All bends showing buckling, wrinkles, cracks or other visible defects or which are in any way in disagreement, in whole or in part, with this specification shall be rejected.

No miter bends shall be permitted in the construction of the pipe line. Contractor shall cut out and remove any bend or bends, which do not meet the specifications and shall replace the same with bends complying with specification at no additional cost to the Company. In the event the contract provides for supply of line pipe by Company, the pipes required for replacement will be furnished by Company, but the cost of replacement of such pipes shall be borne by Contractor.

Cutting of cold field bends for any purpose are not permitted.

#### **10.5 HOT INDUCTION BENDS**

Use of Hot Induction bends is as indicated in alignment sheets, crossing drawings and station drawings. Cutting of factory made bends for any purpose is not permitted.

### **11. LINEUP AND WELDING**

#### **11.1 PIPE CLEANING**

Prior to aligning and welding of pipes, each length of pipe shall be thoroughly examined

internally and externally to make sure that it is free from visual defects, damage, severe corrosion, dirt, animals or any other foreign objects. Each length of the pipe shall be adequately swabbed, either by use of canvas belt disc of proper diameter, or by compressed air blowing or by other methods approved by Company Representative. Directions of Company Representative shall be followed in case of damaged/ corroded pipes. Each length of pipe shall be pulled through just before being welded.

## **11.2 REPAIR OF PIPE DEFECTS**

It is Contractor's responsibility to repair all internal and/ or external defects.

- 11.2.1** Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with latest edition of Company's own material specification or code ASME B31.8/ B31.4 whichever is more stringent.
- 11.2.2** The maximum permissible depth of dents in pipes shall be as per applicable line pipe specification issued by Company.
- 11.2.3** Dents, which contain a stress concentrator such as scratch, gauge, arc burn or groove, and dents located at the longitudinal, spiral or circumferential weld shall be removed by cutting out the damaged portion of pipe as a cylinder.
- 11.2.4** Repair on line pipe shall be executed as specified in Company's material specification or Code ASME B 31.8/ B 31.4, whichever is more stringent. A record of all repairs shall be maintained by Contractor. This record, provided with the pipe identification number shall be submitted to the Company.
- 11.2.5** If due to cutting or repairs, the pipe identification number is removed, it shall be reprinted immediately by Contractor in the presence of Company. In the event, the Contract provides for supply of line pipe by Company, Contractor shall be charged for any pipe length due to loss of identification number. No pipe without identification number shall be transported and/ or welded into the pipeline.
- 11.2.6** Repair of damaged pipe ends by hammering and/ or heating is not allowed. If the dented area is minor and at least 200mm away from the pipe end, and the steel is not stretched, severed, or split in the Company's opinion, the pipe may be straightened with a proper jack.

## **11.3 PIPE HANDLING AND SKID SPACING**

- 11.3.1** When lifting pipe, care must be taken not to kink or overstress it. Pipe slings approved by Company Representative shall be used. The Contractor shall submit the method of skidding and skid spacing to Company Representative for approval. A strip of soft material shall be placed in between skid and pipe to protect the external coating from damage.
- 11.3.2** Skids shall be used to raise the pipe sufficiently to accommodate welding and wrapping of joints. Skids shall be at least 1.20 meter long and of sufficient height to maintain pipe bottom at least 500 mm above ground. Width of skids in contact with the pipe shall be 200 mm and 150 mm for pipe with outside diameter (OD)  $\geq 324$  mm and OD  $< 324$  mm respectively.
- 11.3.3** Crosses shall be installed at frequent intervals, at least every 10th support with greater number required at bends and undulating ground.

## **11.4 WELDING**



**11.4.1** All rust and foreign matters shall be removed from the beveled ends by power operated brush. This shall be effected inside & outside and for a minimum distance of 25 mm from edge of bevel. The bevel shall be thoroughly inspected at this stage. Should laminations, spilt ends or manufacturing defects in the pipe observed, the length of the pipe containing such defects shall be removed from the line in accordance with relevant specification.

**11.4.2** The welding of the pipe ends shall be done strictly in compliance with the specification for welding.

**11.4.3** The Contractor shall cover the open end of the pipe string during welding to prevent draft. The ends of the pipe string shall be located such that water, mud and debris cannot enter the pipe.

## **11.5 NIGHT CAPS**

**11.5.1** At the end of each day's working or every time when joining and welding operations are interrupted, the open ends on the welded strings of pipes shall be capped with mechanical metal cap or plug, approved by Company Representative, so as to prevent the entry of dirt or any foreign matter into the pipeline. These covers shall be removed just before resuming welding operations. Night caps shall also be fixed to the welding completed pipeline section which shall be removed only during Tie-in welding. Whenever the welded strings of pipes are left to be tied in later and at road, railroad, river, marshy crossings, etc, night caps shall be welded to the ends of the pipe. Work at these locations, the end caps shall be cut as a cylinder bevel end prepared. Cut shall be made at least 25 mm from the end.

## **12. LOWERING-IN**

### **12.1 TRENCH CLEANING**

Lowering can start after removal from ditch bottom of all off cuts, pipe supports, stones, roots, debris, stakes, rock projections below underside of pipe and any other rigid materials which could lead to perforation or tearing of the coating. Sand padding, graded soil and/ or other materials containing no gravel, rock shall be provided as required in accordance with clause 8.12 of this specification in such a way to get an even surface for pipe laying.

### **12.2 LOWERING-IN**

**12.2.1** Lowering shall follow as soon as possible, after completion of the joint coating of the pipe string, after the trench bottom is prepared and levels checked for proper fit and cover.

**12.2.2** Before lowering in, visual inspection and holiday detection using a full circle holiday detector shall be carried out for the pipe coating as well as joint coating and all repairs carried out as per relevant Specification. All points on the pipeline where the coating has been in contact with either the skids or with the lifting equipment during lowering shall be carefully inspected for damages, dents or other defects and shall be completely repaired.

**12.2.3** The Pipeline section which is made ready for lowering shall be checked for debris and if necessary, cleaned from inside using Pig with dry compressed air to remove debris.

**12.2.4** The pipeline shall be lifted and lowered into trench using suitable equipment having flat belts of nonabrasive material. Care shall be exercised while removing the flat belts from around the coated pipe after it has been lowered into the trench to avoid any damage to coating. Lowering-in utilizing standard pipe cradles shall be permitted if the Contractor demonstrates

that pipe coating is not damaged. No sling shall be put around field joint coating.

- 12.2.5** Laying shall be carried out under safe conditions so as to avoid stresses and temporary deformations of the equipment's, which may cause damage to the pipeline itself and to the coating. In case of localized points where the right-of-use is restricted to the minimum necessary for the transit of mechanical equipment, the laying shall be carried out using other suitable means. The pipe shall be placed on the floor of the excavation, without jerking, falling, impact or other similar stresses. In particular, care must be taken that the deformation caused during the raising of the pipe from the supports, does not exceed the values for the minimum allowable radius of elastic curvature, so as to keep the stresses on the steel and on the coating within safe limits. The portion of the pipeline between trench and bank shall be supported by as many side-booms as required and approved by Company for holding the line in gentle S-curve maintaining minimum elastic bend radius -as specified in job standard. Lowering in and back-filling shall preferably be carried out at the highest ambient temperature.
- 12.2.6** Lowering-in shall preferably be carried out at the highest ambient temperature. Where water is present, no lowering is permitted until the ditch is drained to the extent and for the time necessary to make visual inspection possible of the bed. Following such inspection, the presence of water will be permitted, provided that it is not so high as to cause cave-in of the walls of the trench or floating of the pipeline before backfilling when anti-buoyancy measures are not provided for the pipe. Where water in the trench cannot be practically removed, the lowering-in of the pipeline shall be permitted only after ensuring pipe negative buoyancy is sufficiently increased by continuous concrete weight coating or by placement of gravel filled non degradable fabric bags as per requirements of the Contract and approved by Company representative. In any case, pipe shall not be lowered into a trench containing water until the longitudinal profile of the trench bottom has been fully surveyed by Contractor and approved by Company representative.
- 12.2.7** Contractor shall take precautions immediately after lowering in to prevent the movement of the pipe in trench.
- 12.2.8** Contractor shall close the two ends of the lowered section with night caps against ingress of water/ mud or any foreign material in the section.
- 12.2.9** When parallel pipelines are lowered into same trench, the minimum distances between the pipelines indicated in the approved drawings shall be maintained. Once the first pipeline has been positioned, it shall in no way be disturbed while lowering of the subsequent pipelines. At every seven meters along the trench sand/ earth filled bags shall be placed between the parallel pipelines so as to ensure maintenance of the minimum stipulated distance between the parallel lines.
- 12.2.10** Subsequent to lowering a pipe section, level of the trench bottom and level by the side of the trench shall be taken at those locations where levels were taken prior to lowering. Cover shall be ascertained based on the level difference. If the cover is not as per the requirements of this specification, the pipe section shall be removed from the trench and the trench rectified, so that the cover is as per the requirements of this specification is met.

### **12.3 OVERHEAD SECTIONS AND SECTIONS IN TUNNEL**

- 12.3.1** The following works shall be completed before proceeding with the assembly and laying of overhead pipeline.



- Construction of the pipe support structures.
- Paints and/ or coating of the pipe work, as indicated in the engineering specification.

**12.3.2** The erection of the supports shall be carried out taking care that the elevation and alignment is in accordance with the drawings.

In the case of metal work supports, pre-fabrication and/ or assembly shall take into account the maximum allowed free span and the supports shall not interfere with the pipeline welds.

**12.3.3** In case roller supports are used, the rollers shall be lubricated, and then checked for smooth rotation and, in case of seizure, the defect shall be repaired or roller shall be replaced. In the case of overhead section where the pipeline is slanting, the alignment of the end supports shall be made after placing the pipeline in position. Before installation of the pipe section, all the rollers shall be perfectly centered acting on the seat of the support's plates.

The above alignment operations shall be carried out before connecting the overhead section with the end of the buried section.

**12.3.4** Lifting, moving and laying of the pipeline shall be carried out in accordance with the provisions of clause.

An insulation sheet shall be installed to isolate the pipe from the support or support from the earth. The sheet shall be hard polyethylene at least 5mm thick. It shall extend at least to 1 cm outside the saddles or clamps.

**12.3.5** Moving supports, if any, shall be centered on their support and allow for a movement of at least 300mm in both directions.

**12.3.6** A comprehensive report/ method statement on the laying operation to be used shall be submitted to the Company well in advance for approval. The report as a minimum shall include, but not limited to the following:

- Method of installation by lifting (as a preferred method).
- Pulling method and related calculations, whenever lifting method cannot be used.
- Pulling device and its characteristics including available pull force and FOS/ margin available w.r.t. calculated pulling load.
- Method of anchoring the pulling device.
- Characteristics of the pulling rope.
- Braking device, if any.
- Pipeline assembly system.

## **13. BACKFILLING**

**13.1** Backfilling shall not be done until the pipe and appurtenances have the proper fit and the pipe is following the trench profile at the required depth that will provide the required cover and has a bed which is free of extraneous material and which allows the pipe to rest smoothly and evenly. Contractors shall take Company's approval before start of backfilling. If any backfilling is done without Company's approval, Company will have the right to require removal of the backfill for examination, and the cost of such uncovering and refilling shall be borne by Contractor. Backfilling of trench in water courses shall be carried out as per the relevant specifications issued for the purpose.

- 13.2** Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the Company Representative, so as to provide a natural anchorage for the pipeline, thus avoiding long exposure of coating to sliding down of trench side's, damage of coating and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 200mm of earth, free of rock and hard lumps shall be placed over and around the pipe and coating. On no account the top soil from the ROU be used for this purpose. In general, the trench shall be dry during backfilling. Deviations thereof must have prior approval of the Company.
- 13.3** The backfill material shall contain no extraneous material and/ or hard lumps of soil, which could damage the pipe and/ or coating or leave voids in the backfield trench.
- 13.4** After the initial backfill has been placed into the trench to a level slightly above the surrounding ground, Contractor shall compact the backfill material. The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench, to such a height, which will, in Company's opinion, provide adequately for future settlement of the trench backfill. The crown shall be high enough to prevent the formation of a depression in the soil when backfill has settled into its permanent position. Should depression occur after backfill, Contractor shall be responsible for remedial work at no extra cost to Company. Surplus material, including rock, left from this operation shall be disposed of to the satisfaction of land owner or authority having jurisdiction at no extra cost to the Company.
- 13.5** Rock, gravel, lumps of hard, soil or like materials shall not be backfield directly onto the pipe unless padding and/ or rock-shield has been provided as per the specification. Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a compacted height of 150mm above the top of the pipe.
- 13.6** In cases where pipeline crosses through seismic zone, as indicated in project document, the backfilling shall be done with select backfill as per the drawing provided elsewhere. Select backfill materials for padding that are acceptable to Company shall be soil, sand, clay or other material containing no gravel, rock or lumps of hard soil. All these works shall be carried out by Contractor at no extra cost to Company.
- 13.7** When the trench has been dug through driveways or roads, all backfills shall be executed with sand or a suitable material as approved by Company Representative and shall be thoroughly compacted. In certain cases, special compaction methods, such as moistening or ramming of the backfill in layers may be required by any public or private authority having jurisdiction over a road, street or driveway. Authorities may also require the top section of trench of such paved areas to be backfill with crushed rock or some other purchased material and surface repaved. The Contractor shall comply with said requirements at no extra cost to Company. Backfilling and compaction of trenches crossing public thoroughfares shall be carefully and expeditiously carried out so as to reduce to a minimum the time during which the public thoroughfare is out of service.
- 13.8** Trenches excavated in dikes which are the property of railways or which are parts of main roads shall be graded and backfield in their original profile and condition. If necessary, new and/ or special backfill materials shall be supplied and worked-up. The materials required may include gravel, special stabilization materials or stabilized mixtures. Moreover, special

processing and/ or compacting methods shall require the approval of Company and/ or competent authorities.

- 13.9** Stone-pitching/ cement lining of Dyke walls if dismantled during excavation shall be restored to its original condition after backfilling and compaction to the entire satisfaction of Company and concerned Authorities.
- 13.10** The trench in irrigated and paddy fields shall be backfilled to within 300mm of the top, then rammed and further backfilled until the trench is completely backfilled. Surplus material remaining after the operation shall be spread over the ROU.
- 13.11** At the end of each day's work, backfilling shall not be more than 500 meters behind the head end of lowered-in pipe, which has been padded and approved for backfill. The backfill shall be maintained by Contractor against washouts and spreading etc., until the completion and final acceptance of the work by Company.
- 13.12** The Contractor shall furnish materials and install breakers in the trench in steep areas (slope generally 10% and more) for the purpose of preventing erosion of the back fill. The type of breakers installed shall be as per applicable Contract drawings. Sacks filled with sand mixed with cement in the ratio of 6:1 shall be placed to act as a trench barrier. Such works shall be at no extra cost to Company. The Contractor shall pay attention to the direction of backfilling in such steep areas. Barrier consisting of two rows of sacks across the trench built on a staggered basis to provide maximum stability, and keyed into the trench wall may be used in gently sloping locations. The top of trench barriers shall be 200 mm - 300 mm below ground level. Trench barriers shall be bedded onto undisturbed ground. No voids shall be left in the trench barrier wall including between the wall and the pipe.
- 13.13** In addition to trench barriers when potential to backfill wash out exist due to water flow, shallow surface ditches shall be dug as necessary to channel water diverted by the trench barrier away from the pipe trench and into normal drainage followed before laying of the line. In no case, the water is to be drained via the trench or via channels other than those followed before the line was laid.
- 13.14** Stabilization of backfill shall be carried out by the Contractor in sandy areas and other such places, as directed by the Company representative. The Contractor shall carry out the stabilization to have a consolidated cover over the pipeline at no extra cost to Company.
- 13.15** The backfill shall be stabilized preferably with 150 mm layer of marl, mattresses of gatch other than straw or other stable materials. The width of stabilization shall be at least 3.0 meters on either side of the pipeline, plus one meter for every 10 meters height of sand dune (where the line passes through the dune areas).
- 13.16** Contractor shall leave the pipe uncovered at certain locations to allow Company to survey the top of the pipe and the level of the pipeline in the backfield trench. Within 48 hours after backfilling, Company shall have carried out such survey and informed Contractor of any realigning, if required. Thereafter Contractor shall compact the backfill.
- 13.17** Temporary markers shall be installed during backfilling and the survey as per specification to locate the pipeline axis. These markers shall then be replaced with permanent pipeline markers.
- 13.18** Backfilling shall be preferably carried out at the highest ambient temperature.

**13.19** In certain areas like U/G pipeline crossings, overhead power cable crossings etc., special care to be taken by putting concrete slab/ plastic grating before backfilling. Size and thickness of concrete slab/ plastic grating shall comply applicable job standard and approved by Company.

#### **14. TIE-IN**

**14.1** The unconnected sections of the pipeline at various locations have to be tied in after the sections are coated, lowered and backfilled. The sections to be connected shall have at the ends, sections of over lapping, uncovered pipe of sufficient length to absorb, without inducing excessive stresses in the steel, small displacements necessary for perfect alignment and connection of the ends.

**14.2** Tie-in shall preferably be carried out at ambient temperatures corresponding to the average operating temperature in the case of a pipeline conveying fluids at normal temperatures and at the maximum ambient temperature in the case where the pipeline is carrying fluids at high temperature.

**14.3** Contractor shall carry out tie-in-welding (including necessary cutting, beveling, grinding of pipe weld seams and line-up etc.) cleaning, priming, coating and backfilling for the tie-in portion as per relevant specifications. Contractor shall also excavate the required bell-holes for the welding. Bell holes made to facilitate welding shall provide adequate clearance to enable the welders to exercise normal welding ability and skill. All tie-in welds shall be radiographically examined.

**14.4** The tie-in should be done in such a way as to leave a minimum of strain in the pipe. If necessary, with respect to the trench, realigning of the pipe shall be done to eliminate force strain in the pipe by the Contractor at no extra cost to Company.

**14.5** If a pup end cannot be avoided for tie-in, the minimum length that shall be added is 1.0 meter and two or more such pups shall not be welded together. All cut-off lengths greater than 1.0 meter shall be moved ahead in order to be welded into the pipeline at a suitable location. Tie-in with two or more pups may be used provided that they each have minimum length of 1.0 meter and are separated by an entire length of pipe. In no case more than three (3) welds shall be permitted on a 10 meter length of pipeline.

**14.6** In connecting pipes, special items, fittings and equipment where different wall thicknesses are to be welded, Contractor shall follow the procedures indicated in ASME B31.8/ ASME B31.4, as applicable. The required tapering shall be done by Contractor at no extra cost to Company.

**14.7** For tie-in of adjacent sections of pipeline already pressure tested, the pup used for tie-in shall be of single length or off-cuts of pipe, which have already been hydrostatically tested. Contractor shall take care that sufficient number of pretested pipes with different wall. Thicknesses are readily available.

#### **15. SPECIAL INSTALLATIONS ON THE PIPELINE**

##### **15.1 GENERAL**

**15.1.1** In addition to constructing the pipeline, Contractor shall also install certain other auxiliary facilities and appurtenances.

**15.1.2** Contractor shall do all work necessary at each of the installations to provide facilities, which

are complete in all respects and ready for operations.

- 15.1.3** Without limiting the generality thereof, the work required to complete the installations shall, where applicable, include all site surveys, site preparation, filling, grading, fencing, foundations, installation of block valves, side valves, pipe work, pipe supports, pressure gauges, mechanical facilities, civil work, painting, installation of all electrical equipment's, motors, cables, conduit, wiring and fixtures and hooking up of same; installation of all instruments, piping, valves and fittings; mounting of all instruments and making all piping and electronic connections, etc.
- 15.1.4** On completion, all elements of each entire installation shall be checked out and tested for full and correct operation in the presence of, and to the satisfaction of Company. All work shall be carried out strictly in accordance with the appropriate codes, the approved drawings, and this and other related specifications.
- 15.1.5** Contractor shall fabricate all piping and install valves and fittings as required by the detailed engineering fabrication drawings prepared by him and approved by Company. Piping fabrication drawings shall be prepared by Contractor based on AFC drawings and approved by Company Representative at site.
- 15.1.6** Stainless steel lines will be "swaged" using permanent fittings installed with a hydraulic device.

## **15.2 MAINLINE VALVES STATIONS (MLV'S)**

- 15.2.1** The Contractor shall install Mainline Valve assemblies as shown in the approved for construction drawings issued for the purpose and requirements of this specification. The Contractor shall completely assemble, test and make the MLV assembly including all related instruments etc. fully functional prior to installation in the pipeline.
- 15.2.2** The valve stem shall be installed in the vertical position. Valves with flow arrows shall be installed according to the normal flow in the pipeline. During welding the valve shall be in open position. Care shall be taken to avoid entry of sand particles etc. to valve body, seals etc. during assembly and installation.
- 15.2.3** Valve shall be installed in the pipeline in horizontal position only unless indicated otherwise in approved drawings. Installation shall be done in such a way that there is no strain in the welded joint while the pipeline at upstream and downstream side is straight.
- 15.2.4** The equipment and tools used for lifting and handling shall never be driven through hand wheel, valve stem, flange joints and other parts, which may cause damage / misalignment.
- 15.2.5** Entire MLV assembly, after fabrication, shall be tested hydrostatically ex-situ as per applicable specifications to a test pressure equal to 1.25/ 1.5 times the design pressure as applicable. As applicable all weld joints and piping components shall be inspected for leakage. Leakages if any shall be repaired and assembly retested.
- 15.2.6** Suitable reinforced concrete foundation(s) as per approved for construction drawings shall be constructed on which the valve assembly shall be firmly installed.
- 15.2.7** The Contractor shall carry out necessary excavation; cutting, beveling and welding of the tie-ins required for the installation of such assembly. The final tie-in shall not be made until the

valve is fixed in position.

- 15.2.8** The civil and structural work shall be carried out in accordance with the relevant specifications issued for the purpose and in accordance with the approved drawings, and as directed by Company representative. The work shall as a minimum include clearing, grading, filling, fencing, foundations, supports, etc. as required.

### **15.3 SCRAPER LAUNCHER AND RECEIVER FACILITIES AT STATIONS**

- 15.3.1** Scraper launcher and receiver facilities at stations including the associated piping shall be fabricated and installed as per the approved for construction drawings. The Contractor shall completely assemble, test and make the scraper facilities including connected piping and all related instruments etc. fully functional prior to hook-up with the pipeline.
- 15.3.2** The Contractor shall maintain elevations shown on the approved drawings and carry out any pipe work adjustments, necessary for this purpose. Field cuts shall be square and accurate and field welds shall not be performed under stress of pipe ends.
- 15.3.3** The painting for the scraper stations shall be carried out as per relevant Specifications for Painting. The underground sections shall be coated with 3 Layer Polyethylene coating up to at least 300 mm above grade.
- 15.3.4** Entire scraper facilities including the associated piping, after fabrication, shall be tested hydrostatically to a test pressure equal to 1.5 times the design pressure as applicable. All weld joints and piping components shall be inspected for leakage. Leakages if any shall be repaired and assembly retested. Test pressure shall be maintained for minimum four (4) hours.
- 15.3.5** The Civil and structural works for the scraper stations shall be carried out as per the relevant specifications, in accordance With the approved for construction drawings. The work as a minimum shall include site survey, site preparation, clearing, grading, filling, fencing, foundations, etc. as required.

### **15.4 INSULATING JOINTS (IJS)**

- 15.4.1** Pipeline insulating joints shall be installed in accordance with and at the locations specified in approved for construction drawings.
- 15.4.2** Pipe abutting insulating joints shall be aligned so that the joint is not subject to loads that induce bending or torsional moments in the joint during installation. During welding of in-line insulating joint, propagation of heat shall be avoided. To achieve this, the joint shall be kept cool by means of rags continuously wetted.
- 15.4.3** Insulating joints shall be electrically tested by the contractor prior to welding into the pipeline. The electrical conductance test shall be carried out using a Megger. Measurement of the insulation resistance across the joint shall be approx. one Mega Ohm. The test shall be repeated after installation and welding of the joint into the pipeline to verify that the insulating joint assembly is not damaged.

### **15.5 DIMENSIONAL TOLERANCES**

These tolerances apply to inline items and corrections for other lines. These tolerances can be exceeded on items such as vents, drains, dummy supports, field supports, temperature and



pressure connections, where the deviation will not affect another spool.

- A. General dimensions such as face to face, face or end to end, face or end to center, and center to center:  $\pm 3\text{mm}$ .
- B. Inclination of flange face from true in any direction: 4mm per meter.
- C. Displacement of branch connection from indicated location:  $\pm 1.6\text{mm}$ . When multiple branches are involved, the displacement of the branches shall not exceed 3mm from a common point.

## 15.6 FLANGED CONNECTIONS

Contractor shall ensure that prior to final bolting, all flange faces are parallel and centered, according to standard practice. Contractor shall not use bolting forces as a means for attaining alignment. A gasket of required size and quality shall be installed between the flanges at each joint.

Bolts shall be tightened in diagonal sequence and shall be centered with equal amounts of thread visible on both sides. Bolts shall be uniformly tightened to produce a leak-proof joint. Bolts that yield during-tightening shall be removed and discarded. It is mandatory that a torque wrench is used for bolt tightening.

## 15.7 THREADED CONNECTIONS

Damaged threads shall be cut from the end of a run and the pipe shall be rethreaded. Contractor shall properly align all threaded joints. Pipe entering unions shall be true to centerline so the union will not be forced during make-up. The threaded pipe shall not project through fittings to cause interference with valves or other operating mechanisms.

Except for the threaded connections of instruments, which will require periodic testing and maintenance, all threaded joints shall be seal welded. The latter joints shall be made up without pipe joint compound and with a minimum of oil from the thread cutter. Seal welds should taper into the pipe with as little discontinuity as possible, and should cover all threads. All seal welds shall be tested with DP, MP testing.

## 15.8 WELDED CONNECTIONS

Where the ends of the piping components being welded have an internal surface misalignment exceeding 1.6mm, the wall of the component extending internally shall be trimmed by machining so that the adjoining internal surfaces will be approximately flush. All welding shall be performed in accordance relevant specification.

## 15.9 PAINTING

All exposed surfaces like piping, valves, structures, and miscellaneous appurtenances shall be painted in accordance with the specifications issued for this purpose.

## 15.10 COATING OF BURIED INSTALLATIONS, ETC.

All buried valves, insulating joints, flow tees, bends, other in-line fittings and appurtenances shall be coated with 100% solid high build epoxy (minimum 500 micron THK) or any other equivalent suitable Company approved coating at no extra cost to Company. For buried pipes and LR bends, heat shrink sleeves relevant specification for Field Joint Coating shall be used. Contractor shall submit to Company a report regarding the method of application and the materials used along with all test certificates. Only after obtaining written approval from the

Company, Contractor shall commence the work of coating.

### **15.11 CIVIL WORK**

Civil work shall be performed in accordance with Specifications issued for the purpose.

## **16. THIRD PARTY FACILITIES**

### **16.1 GENERAL**

The proposed pipeline may be required to be constructed in or adjacent to easements established by others to carry services including overhead electric transmission cables, buried fiber optic transmission cables, telephone and power cables gas, water and other pipelines, etc. Though the Company has endeavored to identify and locate such services known to cross or closely run parallel to the pipeline, it is possible that some such services may not have been fully delineated during the surveys and/ or changes to the services identified have occurred since the Company's surveys. The Contractor shall be responsible for delineating and protecting all such services while executing the works.

Where the works covered under the Contract parallels or crosses an existing service, the requirements of the Authorities having jurisdiction over such a service related to protection of the service from damage during the construction activities shall be identified and complied with by the Contractor.

### **16.2 LOCATION AND PROTECTION OF BURIED SERVICES**

The Contractor shall undertake an investigation to confirm the location of services identified by the Company, and to establish the location of any other services that may interfere with the pipeline construction.

Buried services when located shall be identified by hand excavation, and each service identified shall be marked with a stake and red flag. For all such services, location (UTM co-ordinates), angle of intersection, offset distance, size, depth of cover, etc. shall be recorded by the Contractor.

Temporary under-pinning or any other type of supports and other protective measures necessary to keep the interfering structure/ utility intact shall be provided by the Contractor at his own cost and shall be of such design as to ensure stability and safety against their possible failure.

Despite all precautions, should any damage to any structure/ utility occur, the owner/ authority shall be contacted by the Contractor and repair shall forthwith be carried out by the Contractor at his expense under the direction of Company representative and the concerned owner/ authority. If the Contractor fails to repair in reasonable time, Company reserves the right to have the repair executed at the cost of the Contractor.

### **16.3 PROTECTION AGAINST INDUCED VOLTAGE HAZARDS**

Where the work covered under the Contract parallels or is in close proximity to overhead high voltage power transmission lines, potentially dangerous voltages may be induced in the pipeline and in the working environment posing danger to personnel working on the pipeline. NACE Standard RP0177 shall be followed to the extent applicable during construction for safety purposes. The Contractor shall undertake following precautions in this regard.



- i. Personnel performing work within the area influenced by the high voltage system must wear electrically insulated footwear (e.g., rubber knee-boots) and insulating rubber or plastic gloves so that metal parts of the pipeline can be touched.
- ii. During thunderstorms or whenever discharges are observed on insulators, all personnel must leave the area of the high voltage line and pipeline.
- iii. Vehicles and equipment must be earth-connected. This should be affected by connecting an uninsulated cable or chain of adequate length to the underside of the vehicles/equipment.
- iv. To prevent electrical voltage in a non-buried section of the pipeline from rising to dangerous levels, the length of the pipeline sections that have been welded together before lowering must not exceed the length at which the maximum admissible voltage may be induced. This length may be calculated using an appropriate calculation method.
- v. The welded connection between pipeline section yet to be lowered and section already buried must be at least 50 m from the nearest point of pylon base of a high voltage transmission line.

#### 16.4 ADDITIONAL REQUIREMENTS WHEN WORKING AT LESS THAN 50 M FROM THE CENTRE OF THE HIGH VOLTAGE SYSTEM

When working at a distance less than 50 m from the center of a High Voltage system, following requirements shall be complied with.

- i. The work must not be started until agreement has been reached with the authorities, who control the high voltage system, with regard to the safety measures to be adopted.
- ii. Measures must be taken to prevent excavators and hoisting equipment from approaching high voltage lines within the following distances.

| Voltage level  | Radial distance |
|----------------|-----------------|
| 0- 50 kV       | 3 m             |
| > 50 - 200 kV  | 5 m             |
| > 200 - 380 kV | 8 m             |

Measures to be taken in this regard may be as follows:

- Special selection of equipment, or limiting or blocking certain directions of movement, or limiting the operational area, thereby making it definitely impossible for any work to be done at a distance from the high voltage line of less than accepted minimum.
- In case the measures recommended above are not feasible, installation of clearly visible markers with no passage beyond this point' painted bright red and white must be done to prevent any work being done inside the danger area.

In the event that a vehicle, crane etc. should accidentally come into contact with a live line / conductor of a high voltage system or flash-over of electrical charge occurs, the driver must not get down from his vehicle because this will pose a serious threat to his life. The vehicle or crane must break the contact without any help from outside. The driver must not leave his vehicle until he has managed to leave the dangerous area, or alternatively, when the Electricity Authorities have given notice that the cable(s) have been put out of circuit. In case a serious fire starts in the vehicle, he is permitted to jump from the vehicle, clearing it as far

as possible, while the jump should be possible at a dry sport.

## **17. MARKER**

The Contractor shall fabricate and install all types of pipeline markers along pipeline route. Number and type of pipeline markers shall be as per As-built survey/ alignment sheet & reference specification and as directed by the authorities having jurisdiction. The Contractor shall install all types of markers in accordance with Specification for Markers and approved for construction drawings.

## **18. FINAL CLEAN-UP OF THE CONSTRUCTION RIGHT-OF-USE (ROU)**

**18.1** Contractor shall restore the ROU and all sites used. for the construction of pipelines, water crossings and other structures in accordance with Company's instructions, and deliver them to the satisfaction of Company.

### **18.2 SURPLUS MATERIALS**

For Company supplied materials, after completion of work, the Contractor shall return all surplus materials at Company's designated areas.

The reconciliation of surplus free issue line pipes shall be as per the requirement of commercial condition of contract.

### **18.3 DISPOSAL**

**18.3.1** All surplus and defective materials supplied by Contractor and all trash refuse and spoiled materials shall be collected and disposed of by Contractor.

**18.3.2** The ROU shall be cleared of all rubbish, broken skids, empty cans, card board, sacks, stumps, trash, and leftover construction material. All burnable matter shall be burned, but only after obtaining appropriate permits for such burning. If burning is not allowed, Contractor shall haul the clean-up material to an approved dumping area. All scrap metal and unburnable material shall be disposed of, in an appropriate manner, but never be buried in the ROU.

**18.3.3** Surplus soil can only be removed from the Owner's plot after authorization by Company.

**18.3.4** All dumping fees and royalty connected with the disposal of materials shall be to the account of Contractor.

**18.3.5** All loose stones and rock exposed by the construction operations and scattered over the ROU or adjacent grounds shall be removed by Contractor and be transported to a location considered suitable by the land-owner and/ or tenant, or by authorities have jurisdiction, for satisfactory disposal. For stones, gravel or other hard material, which may be buried in the trench the provisions of the specifications shall apply with the understanding that the use of the land by the land-owner and/ or tenant will not be interfered with.

### **18.4 TEMPORARY STRUCTURES**

All auxiliary structures such as bridges, culverts, sheet piling, posts, signs, etc., which were erected or installed by Contractor as temporary measure, shall be removed. However, it may be necessary to remove the fence of ROU during the maintenance period.

### **18.5 REPAIR OF DAMAGES**

- 18.5.1** Damages to roads, bridges, and private property shall be repaired by Contractor. All fences and other structures, which are damaged during construction, shall be restored to original.
- 18.5.2** Slopes, water course sides or banks which have been partially or totally demolished during the execution of the works shall be properly consolidated and restored (without waiting for their natural consolidation and setting) complying to requirement of the concern authorities. The bed of water-courses shall be restored to the original level. The banks and any excavated areas shall be restored to the original levels and contours. The banks shall also be stabilized.
- 18.5.3** All boundary stones, which have been moved or removed during the work, must be reset in their original location to the satisfaction of the landowner concerned.
- 18.5.4** On completion of clean-up, the ROU shall be restored to such stable and usable condition as may be reasonably consistent with the condition of the ROU prior to laying the pipeline. The Company shall be completely indemnified and held harmless by Contractor from any and against all claims, demands, losses, expenses etc. that may arise in this behalf or the Company may anyway suffer or sustain, relative to, arising out of, or in connection with same. The Company require from the Contractor signed releases from landowners regarding satisfactory indemnification and restoration of their lands.
- 18.5.5** Special precautions shall be taken near steep slopes prone to erosions and landslides. All necessary steps shall be taken to ensure the rapid growth of grass by providing wicker barriers and by regulating the drainage of surface waters.
- 18.5.6** All cadastral or geodetic markers, which may have been removed during the execution of the work, shall be restored in their exact position.
- 18.5.7** Ditches for which no instructions for their restoration have been issued, or restoration cannot be done due to absence of banks, shall be restored as instructed by Company. The bed of ditches crossed by the pipeline shall be cleaned over the full width of the ROU, also outside the ROU if necessary. This restoration might contain but is not limited to the supply and installation of proper materials for backfill and protection, the sodding or other precautions to prevent erosion or guarantee the stability. All work has to be done after deliberation and acceptance of the authorities and Company. Other field drains have to be restored over full width of ROU and if necessary, also outside the ROU by hand and/ or special equipment as soon as possible.
- 18.5.8** Any subsidence, cave-ins, wash-outs, which have been caused during the pipeline construction and maintenance, caused by whatever reason within the edge of ditches and open drains, shall be repaired by Contractor immediately or at first notice given by Company.
- 18.5.9** After the clean-up, the ROU of pastures has to remain fenced considered suitable by the tenant and to be removed during the maintenance period. When agricultural and other traffic (requested by tenant) have to cross the ROU the cross-over have to be fenced with the same material as the ROU. If necessary, special materials have to be used to allow traffic on the cross-over. Fencing of the right-of-use as specified shall not be removed until Contractor has obtained written permission by Company. In general, this has to be done during the maintenance period.
- 18.5.10** All openings in or damage to the fences or enclosures shall be repaired by installing new fencing of a quality, which shall be at least equal to the parts damaged or removed. Provisional gates shall be removed and replaced with new fencing. All repairs to fences and

enclosures shall be carried out by Contractor to the complete satisfaction of Company, landowner and/ or tenant.

**18.5.11** If, in the opinion of Company, the sod in pasture land has been damaged by vehicles, and wheel tracks are visible, the ROU shall be tilled with a disc-harrow or rotary cultivator several times. The damaged sod shall be firmly cut up and thoroughly mixed through the top-soil. In general, the ROU has also to be ripped. After this procedure no closed-in layers must be found and sufficiently loose top-soil 25 to 30 cm thick must be present. The whole procedure must be approved by Company. Subsequently, the entire ROU, which is part of pasture land, shall be prepared for seeding and fertilized by Contractor according to the instructions of Company.

**18.5.12** In crop fields the tillage shall consist of passing over the land several times with a disc harrow, cultivating with a spading machine, or plow, to a depth of approx. 20 cm. In general, the ROU has also to be ripped. After this cultivation process no closed-in layers must be found any more in the ROU. The equipment used and methods adopted shall require the approval of Company. Ripping has to be done with rippers with a distance of 50cm between the ripper blades. The type to be used shall be approved by Company.

**18.5.13** Adequate numbers of saplings of any plant/ tree uprooted or cut during construction shall be planted along the route as per the direction of the Company and in accordance with the requirement of Authorities. The cost of sapling and its plantation shall be to Contractor's account.

The ROU and the backfilled trench in particular have to be finished in such a way that after settlement of the soil the fields are at their original level.

If during the maintenance period certain parts of the ROU are lower than the original level, Company can order Contractor to bring these parts to the original level.

In cases where heavy damage has occurred to the structure of the subsoil as a result of adverse circumstances, Company reserves the right to order Contractor to carry out special restoration work. Said special work can include:

- Spading with dragline (depth 30-80cm);
- Spading with dragline (depth 80-100cm);
- Fertilizing;
- Cover with sand.

If during clean-up operations, soil shortages become apparent outside the trench, Contractor shall supplement said soil shortage using suitable materials, approved by Company.

If site and/ or climatic conditions should render this necessary, Company shall have the right to order Contractor to suspend certain parts of the work related to the clean-up and postpone it to a later date.

## **18.6 SOIL SURPLUS**

**18.6.1** If on site, as a result of the work and after careful backfilling and compacting, a sub-soil surplus exists, this shall be worked up by grading and compacting below the sub-soil top layer and as a rule this shall be done in the same plot of land. It shall not be permitted to remove the surplus from the plot concerned, unless it concerns rejected soil, which has to be

removed. Working up surplus soil or removal of rejected soil shall be considered to pertain to the work.

**18.6.2** To work a soil surplus into the ground, Contractor shall remove an additional strip of top soil beside the trench. Next, the upper layer of sub-soil shall also be removed. Both soil types shall be stored separately across the width depending on the size of the soil, surplus. The soil surplus shall then be distributed across the trench thus widened, after which it shall be graded and compacted and subsequently the top layer of sub-soil and the top-soil shall be replaced in the correct order, in accordance with the Specifications.

**18.6.3** In case Company has given prior permission for mixed excavation of the sub-soil as well as in cases where Company deems mixed excavation permissible, the above provision of separate storage of the upper layer of sub- soil shall not apply to the working up to the soil surplus.

**18.6.4** In cases where the soil surplus can be worked up in others plots where soil shortages have arisen due to the work, this shall only be done after prior permission by land-owner, land user and Company.

## **18.7 SOIL SHORTAGES**

**18.7.1** If due to unforeseen circumstances during backfilling and compacting there should not be enough soil to fill the trench properly, or to install the crown height as stipulated, Contractor shall supply the necessary backfill material.

**18.7.2** Soil shortages shall be supplemented and applied before the top-soil is replaced.

**18.7.3** The soil to be supplied shall be worked up in those locations and into those layers where a soil shortage has been established. The quality of the supplemented soil shall be equal to that of the shortage.

## **19. MAINTENANCE DURING DEFECTS LIABILITY PERIOD**

Defects Liability Period as defined as period of liability in the Contract.

Company reserves the right to carry out instrumented pigging survey of the completed pipeline.

Contractor shall be responsible for making good with all possible speed at his expense any defect in or damage to any portion of the work which may appear or occur during the Defects Liability Period and which arises either:

- a) From any defective material (other than supplied by Company), workmanship or design, (other than a design made, furnished or specified by Company and for which Contractor has disclaimed responsibility in writing), or
- b) From any act or omission of Contractor done or omitted during the said period.

If such defect shall appear or damage occur, Company shall forthwith inform Contractor thereof stating in writing the nature of the defect or damage.

If any such defect or damage be not remedied within a reasonable time, Company may proceed to execute the work at Contractor's risk and expense provided that he does so in a reasonable manner. Such defect or damage can be, but is not limited to:

- Clean-up of ROU, including water courses.
- Sagging or sinking of site level or pipe supports.
- Sliding of ditch banks.
- Repair of fencing or removal of construction fencing.
- Repaving of pavements, repair of pavements and repair of Roads.
- Repair of coating, painting.
- Realigning markers, signs.
- Leak/ burst of pipe, leaking of flanges, washouts
- Short-circuit in casings

Construction defects such as dents, ovality, welding offsets/ defects, etc. detected during intelligent pigging survey, etc.

Company reserves the right to have the required Computerized Potential Logging Test executed during the Defects Liability Period and whenever weather conditions are more favorable for this job. The work shall (at or as soon as practicable after the expiration of the Defects Liability Period) be delivered to Company in the conditions required by the contractor, fair wear and tear excepted, to the satisfaction of Company. Contractor shall finish the work, if any outstanding, at the date of completion as soon as possible after such date and shall execute all such work.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR CONSTRUCTION OF PIPELINE, CROSSING ROADS, RAIL ROADS & MINOR WATER CROSSING

VCS – SS – PP - 2002

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
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|         |            |  |  |  |  |
| 03      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 02      | 04.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                                                        |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                         | Revision Description                                                                                                   |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Issued as Standard Specification                                                                                       |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                  | SK                                                                                    | (Document formatting, Cover Page, Doc numbering updated from SS-PL-006 to VPC-SS-PL-0006 keeping Revision Number Same) |
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| 02              | 04.01.2022    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Revised as marked                                                                                                      |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                    |                                                                                                                        |
| 03              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                    |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                    |                                                                                                                        |





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## **ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |
| OISD | Oil Industry Safety Directorate          |



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## 1.0 SCOPE

This specification covers the minimum requirements for the various activities to be carried out by the Contractor for or about installation of pipelines crossing roads, railroads, minor water courses and other services.

The provision of this specification is not applicable for pipelines crossing water courses, which are specifically designated as "Major water Courses" in the CONTRACT.

This provision is formulated to protect the facilities crossed by the pipeline as well as to provide adequate design for installation and operation of pipeline.

Requirements related to installation of pipeline crossing including, but not limited to site preparation, supply of materials, string fabrication, joint coating application, boring / jacking, testing, tie-in, clean-up, restoration and as-built drawing are addressed in this specification.

## 2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition in force at the time of floating the enquiry) of the following codes, standards and specifications.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- |       |   |                                                                        |
|-------|---|------------------------------------------------------------------------|
| B31.4 | : | Pipeline Transportation system for liquid Hydrocarbon & other liquids. |
| B31.8 | : | Gas Transmission and Distribution Piping Systems.                      |

### AMERICAN PETROLEUM INSTITUTE (API)

- |             |   |                                                                                   |
|-------------|---|-----------------------------------------------------------------------------------|
| API RP 1102 | : | Recommended practice for liquid Petroleum Pipeline Crossing Railroads and Highway |
|-------------|---|-----------------------------------------------------------------------------------|

### PNGRB REGULATIONS:

- |                           |   |                                                            |
|---------------------------|---|------------------------------------------------------------|
| G.S.R 808(E) T4S          | : | Regulations for Natural Gas Pipelines                      |
| G.S.R. Infra/ T4S/ P&PPPL | : | Regulations for Petroleum and Petroleum products pipelines |
| G.S.R. 612(E) T4S         | : | Regulations for CGD Network                                |

### SPECIFICATIONS

- |                |   |                                                             |
|----------------|---|-------------------------------------------------------------|
| VPC-SS-PP-2001 | : | Standards Specification for pipeline construction (onshore) |
| VPC-SS-PP-2014 | : | Specification for Hydrostatic Testing of Onshore Pipeline.  |

**2.1** In case of conflict between the requirements of above mentioned codes, standards, regulations, specifications and practices, the most stringent requirement shall govern. For the purpose of this specification the following definitions shall hold:

- Words 'Shall' and 'Must' where used indicate that a provision is mandatory.
- Words 'Should' and 'Will' where used indicate that a provision is not mandatory but is recommended as good practice.

### **3.0 GENERAL**

**3.1** Crossing of roads, railroads, buried services, canals and minor water courses with equipment and/ or personnel is allowed only after acquiring approval from the authorities having jurisdiction and after making arrangements for safeguarding the roads, etc. and the verges and/ or banks thereof and the buried services with appropriate provisions.

The carrier pipe shall be firmly supported on both sides of the crossing. The bottom of trench and pit for at least 12 m length at approaches to crossing shall be graded and filled with soil compacted up to 95% Proctor density to an elevation that will provide sufficient continuous support to the carrier pipe. Earth or sand filled bags may be used to firmly support the carrier pipe adjacent to the crossing. In case of cased crossing, carrier pipe shall be supported in such a manner that it remains correctly aligned at the casing ends during and after backfilling.

Highways, Main-Roads and Railroads and their verges and banks of water crossings are not allowed to be used for loading, unloading or stacking of materials and/ or equipment. For secondary roads, such loading/ unloading is permitted only after prior approval from the concerned authorities. Contractor is not allowed to close or divert roads or watercourses without prior approval from the company and the concerned authorities. Contractor shall never unnecessarily hamper the users of the roads, railroads, buried services and/ or watercourses. The water flow shall not be obstructed in any way.

**3.2** Contractor shall submit the followings before start of any crossing works:

- Approval letter from concerned authorities
- Time Schedule
- Execution methodology with details of equipment
- Test procedure
- Manpower deployment
- Description of temporary works
- Design calculations for crossing (if any)
- Soil investigations etc.
- Construction drawings

Such works shall be without any extra cost to company.

### **3.3 SURVEYS AND INVESTIGATIONS**

The Company may carry out surveys and soil investigations along pipeline route including crossing locations. The details of the surveys, soil investigations and other data collected

by the Company shall be presented in the drawings and documents enclosed with the Contract for the information of the Contractor.

The Contractor shall be deemed to have reviewed and satisfied himself with regard to the details provided in the Contract. It shall be the responsibility of the Contractor to assess requirement of any additional surveys and/ or soil investigations or any other data collection that may be deemed necessary for proper execution of the works in accordance with the drawings, specifications, other requirements of the Contract including requirements of concerned Authorities.

The Contractor shall be responsible for carrying out survey, soil investigation and data collection, as deemed necessary by the Contractor, for proper execution of the works. The Company shall not provide any additional details in this regard.

Whenever specified in the contract, contractor shall carryout all geotechnical investigation and Hydrological, scour calculate in case of water

### **3.4 PROTECTION OF UNDERGROUND UTILITIES**

Contractor shall ensure that the crossing is not interfering with any of the existing underground utilities. Should any damage to any utility/ structure occur, the Owner/ Authority concerned shall be contacted by the Contractor and repair shall be carried out by the Contractor to entire satisfaction of the Owner/ Authority. All costs for reinstatement or incidental to reinstatement shall be settled and paid by the Contractor.

### **3.5 MINIMUM COVER REQUIREMENT**

Within the limits of bored crossings, unless noted otherwise on the Contract drawings, minimum requirements of cover indicated in Table-1 shall be satisfied.

| <b>Table 1 – Minimum Cover Requirements for Crossings</b> |                                             |
|-----------------------------------------------------------|---------------------------------------------|
| <b>Utility Crossed</b>                                    | <b>Minimum Cover</b>                        |
| National Highways and Expressways                         | 1.2 m from top of road to top of pipe       |
| State Highways                                            | 1.2 m from top of road to top of pipe       |
| Railroads                                                 | 1.7 m from base of rail to top of pipe      |
| Canal (Lined / Unlined)                                   | 1.5 m below the canal bed level             |
| River                                                     | 2.5 m (below scour depth/ Lowest bed level) |
|                                                           | 1.5 m in case of rocky strata               |

In case any additional cover over and above the above minimum cover is stipulated by the Authorities, the Contractor shall ensure compliance with the requirements of the Authorities.

### **3.6 HYDROSTATIC TESTING**

Pipeline crossings for road, railroad, canals and rivers etc., shall be hydrostatically pretested ex situ, prior to joint coating, whenever,

- Crossing is executed by boring of carrier pipe
- Casing pipe used in crossing installation

- River Crossing pipes which are to be continuously concrete weight coated (to be tested prior to concrete coating).
- Whenever, in company's opinion, the repair of pipeline at crossing, in case of a leak during final hydrostatic testing, would require inordinate number of efforts and/ or time
- Whenever pretesting is insisted upon by the Authorities having jurisdiction over the utility crossed.

The pipeline shall be hydrostatically tested to a minimum test pressure equal to 1.25 / 1.5 times the design pressure as applicable. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of pipe material. Test pressure shall be retained in the pipeline for minimum period of 2 hours. Test section shall be visually examined for leaks/ defects, etc.

## **4.0 ROAD AND RAILROAD CROSSINGS**

- 4.1** The work under crossings shall include necessary clearing, grading and trenching to required depths and widths, welding of casing and carrier pipes, lowering-in, back filling, clean-up, restoration to the original condition and further strengthening and protective works, testing, installation of assemblies, insulators and seals, and temporary works such as sheet piling, bridges etc.

The work shall be carried out in accordance with the approved drawings and job standards, as directed by Company and to the satisfaction of Company and the authorities having jurisdiction over the facility crossed. The work carried out for road and railroad crossings shall meet the minimum requirements of API RP 1102.

Prior approval from the statutory authorities shall be obtained to lay the pipeline across the highway/ road either by boring or by open-cut- method. Installation of the crossing shall be by the method (i.e., boring/ open-cut) approved by Authorities having jurisdiction. Railroad crossings shall always be bored/ .

Before the installation work of crossings is started, the Contractor shall provide suitable barricades, temporary bridge/ bypass work (especially where roads are open cut) with railing, if required by Company for safety of traffic. Adequate traffic warning signals and/ or traffic lights and suitable diversions shall be provided as directed by Company/ Authority having jurisdiction over these areas. Such diversions shall not cross the pipeline where it has already been installed, unless proper safeguarding at Company opinion is ensured.

- 4.2** Boring/ jacking of carrier pipes for crossings is allowed only if the pipes for boring/ jacking are provided with a suitable corrosion coating and Contractor remains liable for the suitability of the pipe and weld coating of carrier pipes to be bored and type of coating and method of application are anyhow to be authorized by Company without prejudice to Contractor's liability. In all other cases the carrier pipes shall be cased.

Before start of the boring/ jacking, Contractor shall execute a soil investigation and determine the ground water table. Based on these investigations Contractor shall prepare

a construction drawing and submit to Company for approval including time schedule and soil investigation report.

During the execution of the boring, the ground water table over the length of the boring shall be lowered up to at least 0.50 M below bottom of the pipeline. This water table is to be regularly inspected and maintained by Contractor and reported to Company to safeguard the stability of the bore pit. Contractor shall, if necessary, in Company opinion, use a closed sheet piling, which shall extend at least over 50% of the length in undisturbed soil. The length of the boring shall be in accordance with the width of the ROU of the crossing (road, railroad, etc.) with minimum 0.6 M extra on either side.

In approaches to the crossing, Contractor shall eliminate unnecessary bending of pipe by conforming to the contour of the ground by gradually deepening the ditch at such approaches as directed by the Company.

- 4.3** The diameter of the hole for a bored section shall have a hole diameter as close as practicable to the outside diameter of the carrier or casing pipe. If excessive void or too large hole results, or if it is necessary, in the opinion of Company, to abandon the bored hole, prompt remedial measures such as filling the hole with suitable material shall be taken to the entire satisfaction of the Company and Authorities having jurisdiction thereof at no extra cost to Company. Equipment used for installation of casing pipe shall be of the type approved by Company.

An installation consisting of hydraulic jacks shall be provided with easily readable pressure gauge (in bar) and sealable pressure limits. Their proper operation shall be demonstrated before the work is started. Company can request that the maximum pressing force be limited.

At the front of the pipe there may be a cutting ring which may be 12 MM larger than the outside diameter of the pipe or casing. A lubricating pipe can also be used in jacking, the nipples of which shall not protrude from the cutting ring. Said lubricating pipe shall not be fixed to the pipe or casing. When jacking, only biologically degradable lubricants shall be used.

The progress in the work, the readings of the gauge pipes, the jacking pressures observed, etc., shall be recorded in a log book, to be shown to Company upon request. All information shall be supplied to Company on completion of the work.

In case of jacking failure e.g., resulting in pipe buckling or the equipment being unable to push the pipe further, the pipe shall be left in the hole, filled with sand and plugged at both ends. Cost of pipe lost due to such failure shall be borne by the Contractor.

Company reserves the right to inspect certain lengths of pipes to assess damages, if any, to the corrosion coating of the carrier pipe used for boring. Contractor shall weld additional lengths of pipe and pull the required extra lengths for Company's inspection. If during inspection any defects are noticed, Contractor, in consultation with Company, shall carry out the remedial measures required.

- 4.4** After completion of the pipe laying, the trench shall be properly compacted by mechanical compactors to the satisfaction of the Authorities and restored back to the original.

While welding of the casing and vent/ drain pipes, internal high or low is not allowed. Welding of casing and vent/ drain pipes need not be radiographed; however, only normal

visual checks shall be carried out. Before welding, the single length of pipe shall be inspected in order to check that there is no out of roundness and dents. When such defects are noticed, these must be completely removed before joining the pipes. If these defects cannot be repaired, the defective section shall be cut out.

- 4.5** In the case of crossings where excavation has been authorized, the welding for the casing pipe and for a continuous section of the pipeline corresponding to the expected length shall be carried out in the proximity of the crossing. Casing must be laid immediately after the trenching. Casing pipe must be laid with a single gradient in order to allow for an easy insertion.
- 4.6** The assembly of vent pipe units as approved by Company shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe to avoid damage to insulators from welding heat. The operation of assembling and extending the vent pipe shall be carried out in such a way that there is no contact with the carrier pipe. The painting/ coating of the vent pipes shall be applied before backfilling as per relevant specifications.
- 4.7** Before installation of carrier pipe, the casing pipe shall be thoroughly cleaned to remove soil, mud, stones and other foreign material. A nose-piece having a diameter equal to that of the pipe shall be welded to the front end of the carrier pipe to facilitate correct installation of the carrier pipe in the casing. Pushing or pulling force is evenly and constantly applied to avoid damage to the insulators.
- 4.8** Insulators, as per specification as approved by Company, shall be securely fastened to the pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in Standard drawing No VCS-STD-2009 or 2.5 meters center (whichever is more stringent). At the end of both sides of the casing, a double set of insulators shall be installed.
- 4.9** Care must be taken in pushing or pulling carrier pipe into the casing so that the pipe is aligned correctly in the casing and that the pushing or pulling force is evenly and constantly applied to avoid damages to the insulators. A nose piece having a diameter equal to that of the pipe shall be welded on the front and back end of the carrier pipe to facilitate installation of the carrier pipe properly in the casing and to keep it dry and clean.
- 4.10** In the event of failure, the pipe/ section removed from the installed pipeline shall be kept aside and preserved for further investigation of the reasons for failure.

After successful testing the ends of the pipeline section shall be capped and buried unless immediate tie-in is carried out. The location of the ends shall be marked on ground by installing markers.

- 4.11** After installation of the carrier pipe section, the casing and the appurtenances, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the Contractor in the presence of the Company, to determine the resistance between the casing and the carrier pipe or the carrier pipe and the soil. These tests shall show at least a resistance of 100,000 ohm M<sup>2</sup>. After backfilling and compaction, additional tests shall be conducted to determine if the casing is electrically shorted to the pipe. If the installation is found to be shorted, Contractor shall make the necessary corrections and repairs at his cost, unless a test to the satisfaction of the Company is obtained.



In case of failure of test, the Contractor shall assess the reasons for lower resistance and if it is established that casing and carrier pipe are electrically short circuited, the Contractor shall make the necessary repairs and verify that short circuiting has been successfully removed.

## **5.0 MINOR WATER COURSE CROSSINGS**

- 5.1** Minor water crossings are crossings of (future) ditches, canals, water courses, rivers, streams etc. whether the bed(s) contain(s) water or not, and not being specified as "Major Water Crossings" in the CONTRACT.
- 5.2** For minor water crossings a standard drawing or a separate detailed approved drawing for individual crossing shall be applicable, and all further specifications are applicable.
- 5.3** Whenever minor water crossings in the ROU are to be crossed, Contractor shall install bridges and further comply with the provisions as laid down in this specification.
- 5.4** In crossings of water courses with either moderate flow rate or of torrential nature with marked and unpredictable flooding, an adequate survey shall be carried out before starting the work with the object of determining what precautions are necessary and the most favorable period for executing the work.
- 5.5** In case of crossings of water courses for which no special methods of laying are required, a pipe section of a size as per the approved drawings shall be assembled and subsequently laid. Bends shall be of cold field type.

The depth of the existing bottom of a minor water course crossing shall be determined in relation to the adjacent ground level by taking the average of four measurements. Measurements shall be taken with a gauge rod having a flat bottom. The minimum force to be exerted shall be 360N (36kgf).

Contractor shall take special care to check with the responsible authorities for special conditions applying to working on, over, under or thorough minor water crossings and Contractor shall comply with any such conditions. Written arrangements with authorities shall be drawn up in cooperation with Company.

- 5.6** Whenever required by Company, Contractor shall, before start of construction, execute a geo-technical and hydrological investigation. Based on these investigations Contractor shall also calculate scour level and prepare construction drawings, Contractor shall submit all reports, calculations and drawings for approval by Company.
- 5.7** The minimum cover over the pipe shall be as specified in the relevant approved drawings and job standard.
- 5.8** For crossing beneath the bed of water courses, the pipe section shall be made in such a way that it conforms to the existing or future bed as indicated in the approved drawings. In crossings for which an individual drawing has not been prepared, the minimum cover of the pipeline shall not be less than that indicated in- the standard drawings for a similar type. of crossing.
- 5.9** Whenever the crossing requires a straight section of pipe between the lower bends coinciding with the river bed, this section shall be laid at a single horizontal level.

- 5.10** For crossing of ditches, canals, banked channels, etc. by boring, the pipe section shall be prepared, laid and tested in accordance with the applicable clauses of Section 4.0 of this specification.
- 5.11** The Contractor shall arrange temporary installation of diversions as may be necessary, to ensure the effective functioning of these watercourses crossed, to the entire satisfaction of the concerned local Authorities as well as the Company.
- 5.12** Banks and trenches of minor water crossings shall be backfilled with soil which is to be approved by Company and shall be thoroughly compacted to prevent soil and bank erosion as per the drawings and standards to the satisfaction of authorities having jurisdiction thereof and the Company. Whenever boulders, rock, gravel and other hard objects are encountered, they shall not be placed directly on the pipe. Sufficient earth, sand or selected and approved backfill material shall be backfilled initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 30 centimeters around the pipe before backfilling remainder of the trench with excavated or other material as per approved drawings and standards.

After the trench has been backfilled and during the clean up works, the minor water crossing shall be cleaned at least across the whole width of the ROU.

When specified in the CONTRACT, Contractor shall repair the ditch bank with materials to be supplied by himself as follows:

The excavation shall be backfilled with well compacted solid soil, followed by a minimum 0.25 M thick layer of properly shaped boulders (75-150 MM) encased in a net of galvanized iron wire of dia 3 MM spaced at a maximum distance of 50 MM to be laid over the backfilled, compacted and graded banks.

The width of the above protection shall be equal to the bank excavated and damage and extending 3 M on either side. The length of this protection on the slope shall be determined by the following:

- 2 M plus the highest water level.
- Up to the bottom of the crossing or 20 M below the highest water level whichever is smaller.

- 5.13** After completion of crossing, any temporary arrangements made for diversion flowing water shall be restored back to the original.

Where possible a gradual slope to the pipe shall be given on both sides to avoid use of sag bend at the crossing. Otherwise, single pipe sag bend suitable for each nala / stream shall be prepared by field cold bending and installed at the crossing.

- 5.14** The crossing of any embankments shall be carried out strictly in accordance with approved drawings.

No drilling work on embankments shall be permitted without prior written approval from the competent Authorities.

## **6.0 CROSSING OF BURIED SERVICES**

- 6.1** The pipeline under construction may pass above or below the existing buried facilities such as pipelines, cables, etc. Type of crossing shall be such that a minimum depth of cover as required in the drawings and specifications are guaranteed. The minimum clearance required between pipeline and the existing facility shall be 500 MM as per job standard.
- 6.2** Whenever buried services in the ROU are to be crossed by Contractor, Contractor shall safeguard the buried facilities and the required protecting precaution shall be executed as approved by Company of the buried services and by Company.



## VCS QUALITY SERVICES PVT.LTD.

### STANDARD SPECIFICATION FOR PIPELINE BALL VALVES

VCS-SS-PP-2004

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 07.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                                                                      |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                        | Revision Description                                                                                                                 |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Issued as Standard                                                                                                                   |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 01              | 22.05.2019    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Revised based on API 6D 24 <sup>TH</sup> Edition.                                                                                    |
|                 |               | BS                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 02              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Documents Formatting, numbering updated from SS-PL-004 to VPC-SS-PP-2004, vent drain Diagram updated, other Detail updated as marked |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 03              | 07.01.2022    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Revised as Marked                                                                                                                    |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                   |                                                                                                                                      |
| 04              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                                  |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                   |                                                                                                                                      |

**ABBREVIATIONS:**

|        |                                                           |
|--------|-----------------------------------------------------------|
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society for Testing and Materials                |
| API    | American Petroleum Institute                              |
| BHN    | Brinell Hardness Number                                   |
| DN     | Nominal Size                                              |
| HAZ    | Heat Affected Zone                                        |
| LC     | Lock Close (valve locked in full close position)          |
| LO     | Lock Open (valve locked in full open position)            |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| NDT    | Non Destructive Testing                                   |
| NPS    | Nominal Pipe Size                                         |
| RTJ    | Ring Type Joint                                           |
| SSPC   | Steel Structures Painting Council                         |
| MPI    | Magnetic Particle Inspection                              |
| DP     | Dye Penetrant                                             |

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## 1 SCOPE

This specification covers the minimum requirements for design, manufacture, testing and supply of carbon steel ball valves of size DN 50 mm (2") and above and ASME pressure rating Class 150# thru 900# for use in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2 REFERENCE DOCUMENTS

All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, latest edition (edition in force at the time of issue of enquiry), Specification for Pipeline and Piping Valves, with additions and modifications as indicated in the following sections of this specification.

Reference has also been made in this specification to the latest edition (edition in force at the time of issue of enquiry) of the following Codes, Standards and Specifications.

### 2.1 American Society of Mechanical Engineers (ASME)

|              |   |                                                                               |
|--------------|---|-------------------------------------------------------------------------------|
| B31.3        | : | Process Piping.                                                               |
| B31.4        | : | Pipeline Transportation System for Liquid and Slurries.                       |
| B 31.8       | : | Gas Transmission and Distribution Piping Systems.                             |
| B16.5        | : | Pipe Flanges and Flanged Fittings.                                            |
| B16.10       | : | Face to Face and End to End Dimensions of Valves.                             |
| B 16.25      | : | Butt Welding Ends.                                                            |
| B 16.34      | : | Valves-Flanged, Threaded and Welding Ends.                                    |
| B 16.47      | : | Large Diameter Steel Flanges.                                                 |
| Section VIII | : | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels. |
| Section IX   | : | Welding and Brazing Qualifications.                                           |

### 2.2 American Petroleum Institute (API)

|      |   |                                                                |
|------|---|----------------------------------------------------------------|
| 1104 | : | Specification for Welding of Pipelines and Related Facilities. |
|------|---|----------------------------------------------------------------|

### 2.3 American Society for Testing and Materials (ASTM)

|       |   |                                                                                 |
|-------|---|---------------------------------------------------------------------------------|
| A370  | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |
| B 733 | : | Auto catalytic (Electro less) Nickel - Phosphorus Coatings on Metal.            |



## 2.4 Manufacturers Standardization Society (MSS)

- SP-6 : Standard Finishes for contact faces of Pipe Flanges and Connecting – End Flanges of Valves and Fittings.
- SP-44 : Steel Pipeline Flanges.

## 2.5 Steel Structures Painting Council (SSPC)

- SSPC-VIS-I : Steel Structures Painting Council Visual Standard-Guide and Reference Photographs for Steel Surfaces prepared by Dry Abrasive Blast Cleaning.

- 2.6 In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred above, the requirements of this specification shall govern.

## 3 MATERIALS

- 3.1 The material of major components of the ball valves shall be as indicated in Valve Data Sheet. Remaining components shall be as per Manufacturer's standard (suitable for the service indicated in the data Sheet) and shall be subjected to approval by Company. In addition, the material shall also meet the requirement specified hereinafter.

All process-wetted parts, metallic and non-metallic, sealant and lubricants shall be suitable for the service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/ seawater environment, which may be used during field testing.

Non-metallic parts of the valves (including O-rings, soft seals etc.) intended for hydrocarbon gas service shall be resistant to explosive decompression.

- 3.2 Carbon steel used for the manufacture of valves shall be fully killed.
- 3.3 The carbon equivalent ( $CE_{IIV}$ ) of valve end connections which are subject to further field welding by Company shall not exceed 0.43 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE_{IIV} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

## 3.4 Charpy V-Notch Test Requirements

Charpy V-notch test on each heat of base material shall be conducted for all pressure containing parts such as Body, End Flanges, Stem and Welding Ends as well as Bolting materials for pressure containing parts.

Test procedure for Charpy V-Notch Test shall conform to ASTM A370.

For Carbon Steel, alloy steel & Stainless Steel (except Austenitic Grades) Materials, The impact test temperature shall be 0 °C or minimum design temperature indicated in valve

data sheet / MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi)/ 34 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi)/ 26 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi).

For Low Temperature Carbon Steel Materials, the impact test temperature shall be as per requirement of Material Standard or minimum design temperature indicated in valve data sheet/MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi)/ 34 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi)/ 26 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi).

Where the material specification requires impact values to be higher than specified in the above paragraphs, the higher values shall apply.

For duplex & super duplex stainless steel the Charpy V-Notch test values and test temperature shall be as per API 6D.

### 3.5 Hardness Test Requirements

For valves specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross section shall be taken for this purpose and the maximum hardness of the materials of valve components shall not exceed 248 HV<sub>10</sub>.

### 3.6 Electroless Nickel Plating Requirements

For all such valves where Carbon Steel/Low temperature carbon steel is used as ball material, the ball shall have 75 micrometers (0.003 inches) thick Electro less Nickel Plating (ENP) as per ASTM B 733 with following classification:

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

## 4 DESIGN AND CONSTRUCTION REQUIREMENTS

### 4.1 General

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler & Pressure Vessel Code, Section VIII, Div 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of above code. Also, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design; however, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The

manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

## 4.2 Valve Installation

Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet/ Material requisition.

## 4.3 Valve Body

4.3.1 For above ground valve, valve body design shall be either fully welded or bolted type. For buried valves, valve body design shall be fully welded type only. Valve body joints with threads are not permitted.

4.3.2 Ball mounting shall be trunnion or pivot type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable

## 4.4 Ball

Ball shall be of single piece, solid type construction.

## 4.5 Valve Bore Configuration

Valves shall be Full bore (FB) or Reduced bore (RB) as indicated in the Valve Data Sheet.

### Full Opening Valve

Full bore valves shall be suitable for the passage of all types of pipeline pigs including instrumented intelligent pigs and regular cleaning, batching and scraper pigs on regular basis without causing damage to either the valve component or the pig. The full bore, valve shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore of full bore butt-welded & flanged valves shall be in line with Connecting pipe as stated in valve data sheet or Valve MR, however in any case it shall not be less than the minimum required shown in Client Ball Valve specification & API 6D.

### Reduced Opening Valve

The bore size of reduced bore valve shall correspond to that of a full-bore valve of smaller nominal diameter as indicated in Table- 4.5 below. For sizes of a particular rating not covered in API 6D, the bore size of the reduced bore valve shall be as per manufacturer`s Standard.

| TABLE – 4.5        |                                     |                    |                                     |
|--------------------|-------------------------------------|--------------------|-------------------------------------|
| Nominal Valve Size | Nominal Valve Size for Reduced Bore | Nominal Valve Size | Nominal Valve Size for Reduced Bore |
| DN mm (NPS inches) | DN mm (NPS inches)                  | DNmm (NPSinches)   | DNmm (NPS inches)                   |
| 50 (2)             | 40 (1.5)                            | 600 (24)           | 500 (20)                            |

|          |          |           |           |
|----------|----------|-----------|-----------|
| 80 (3)   | 50 (2)   | 650 (26)  | 550 (22)  |
| 100 (4)  | 80 (3)   | 700 (28)  | 600 (24)  |
| 150 (6)  | 100 (4)  | 750 (30)  | 600 (24)  |
| 200 (8)  | 150 (6)  | 800 (32)  | 650 (26)  |
| 250 (10) | 200 (8)  | 850 (34)  | 700 (28)  |
| 300 (12) | 250 (10) | 900 (36)  | 750 (30)  |
| 350 (14) | 250 (10) | 950 (38)  | 800 (32)  |
| 400 (16) | 300 (12) | 1000 (40) | 850 (34)  |
| 450 (18) | 350 (14) | 1050 (42) | 900 (36)  |
| 500 (20) | 400 (16) | 1200 (48) | 1050 (42) |
| 550 (22) | 450 (18) |           |           |

#### 4.6 Seat Design

The valves shall either be a soft seated valve or metal seated valve or with primary metal-to metal contact and secondary soft seats or seat design shall be as indicated in valve data sheet.

For soft seated valves, Metal seat rings may be provided with soft insert. The same shall be positively locked in position in Metal seat rings.

For valves with primary metal to metal contact and secondary soft seats, O-rings or other seals if used for drip tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation of valve at maximum differential pressure corresponding to valve class rating. The seat rings shall be so designed as to ensure sealing at low as well as high differential pressures.

**4.7** Valves shall be designed to withstand a sustained internal vacuum of at least 1 (one) mille-bar in both open and closed positions.

#### 4.8 Double Block & Bleed Design

Valves shall have double block and bleed feature to facilitate complete flush, drain and venting of the valve body cavity. Cavity relief pressure shall be as per API 6D.

#### 4.9 Sealant Injection

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced Bore valves of nominal valve size DN 250 mm (10") & above, shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with block valve and an internal non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Location and arrangement of sealant points shall be as per Fig 4.9.

#### 4.10 Vent & Drain

Valves shall be provided with vent and drain connections. Location and arrangement of

vents and drains shall be as per Fig. 4.9. Body vent and drain shall be provided with valves (Ball or Plug type). Number and size shall be as per Fig. 4.9.

Valve design shall ensure repair of stem seals/ packing under full line pressure.

#### 4.11 Support Foot

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced bore valves of nominal valve size DN 250 mm (10") & above, shall be equipped with support foot and lifting lugs unless specified otherwise. Tapped holes and eyebolts shall not be used for lifting lugs. Height of support foot shall be kept minimum. The location and size of support foot/ lifting lugs shall ensure unrestrictive operation of vent/ drain valves. The design of support foot shall be such that it shall take minimum double the weight of the valve assembly.

**4.12** Valve design shall be such as to avoid bimetallic corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.

**4.13** The valve body cavity over-pressure shall be prevented by self-relieving seat rings/ assemblies. Valve Cavity relief pressure when added to the valve pressure rating shall not exceed 133% of the pressure rating of the valve at its maximum specified design temperature.

#### 4.14 Valve Ends

Valve ends shall be either flanged/ or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/ forged with the body of the valve. Face to face/ end to end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.

Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22"), as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26 inches) and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.

Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

In case of all Butt welded end valves (including soft seated valves or valves with primary metal to metal and secondary soft seats), actual yield strength of valve body shall not be less than 2/3<sup>rd</sup> of the specified minimum yield strength (SMYS) of the connecting pipe material.

For soft seated valves with Butt welded end, valves shall be provided with pup pieces on

either side of length 200 mm each for size up-to 8" & 250 mm for size 10" and above, with material as specified in valve data sheet. Length of pup piece shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. Pup piece thickness shall be calculated for the class rating. Vendor shall provide for each type (considering size, grade and thickness of the pup pieces used for all offered valves) of pup piece, test rings (500 mm long) from pup piece material for field weld procedure qualification. Valves shall be tested along-with pup piece.

**4.15** Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) is not liable to be damaged. The manufacturer shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.

#### **4.16 POSITION INDICATORS**

Valve shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions. For actuated valves, additionally mechanical means of position indicator shall be provided.

#### **4.17 STEM EXTENSIONS**

When stem extension requirement is indicated in Valve Data Sheet, the valves shall have the following provisions.

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. In case of below Ground LTCS valves, Stem extension material shall be equivalent to stem material.
- c. Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160 for carbon steel valves and ASTM A 333 Gr 6, with Sch 160 for Low temperature carbon steel valves or the material shall be as specified in valve data sheet. The material of fittings for Carbon Steel valve shall be ASTM A105/ ASTM A234 Gr. WPB and material for the fittings for low temperature carbon steel valves shall be ASTM A 350 Gr LF2 Cl 1 or the material shall be as specified in valve data sheet. The fittings and valve end shall be Socket welded ANSI class 6000# as per ASME B 16.11 (For piping class up to 600#) and BW end (For Piping Class 900#).
- d. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- e. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
- f. The Stem Extension shall be self-relieving.

#### 4.18 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes,  $DN \leq 100$  mm (4") shall be wrench operated and valve sizes,  $DN \geq 150$  mm (6") shall be gear operated. The length of wrench shall not be longer than twice the face to face or end to end dimension of the valve. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be 1.25 times the break torque required to operate the ball valve under the maximum differential pressure corresponding to the Valve Class Rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N. However, failing to meet above requirement, vendor shall offer gear operated valves. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The numbers of turn shall not exceed 250 for valves sizes up to 24" and 450 for valve size above 24".
- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

**4.19** The tolerance on internal diameter and out of roundness at the ends for welded ends valves shall be as per connected pipe specification as indicated in the Valve Data Sheet.

#### 4.20 LOCKING DEVICES

When indicated in Material Requisition/Data sheet/ Tender, valves shall have locking devices to lock the valve either in full open (LO) or full close (LC) positions. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.

#### 4.21 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

#### 4.22 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However, repair



by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein. Heat treatment and radiography shall be repeated after the weld repair.

- 4.23** No Casting is permitted for stem and stem extended material of all valve. Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division 1. For power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.
- 4.24** Wherever specified for the part of valve in valve data sheet, minimum thickness of stelliting shall be 1.6mm
- 4.25** All Soft seated valves shall be fire safe design and qualified as per API 6FA/ API 607/ ISO 10497.
- 4.26** Soft-seated valves shall have antistatic device.

## 5 INSPECTION & TESTS

- 5.1** The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment, at his works. Such inspection and tests shall be, but not limited to, the following:
- 5.2** All valves shall be visually inspected. The internal and external surfaces of the valves shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.
- 5.3** Dimensional check on all valves shall be carried out as per the Company approved drawings.
- 5.4** Chemical composition and mechanical properties shall be checked as per this specification and relevant material standards, for each heat of steel used.
- 5.5** Non-destructive examination of individual valve material and component consisting of but not limited to castings, forgings, plates and assembly welds shall be carried out by the Manufacturer.
- a. Body castings of all valves shall be radio graphically examined as per ASME B16.34. Procedure and acceptance criteria shall be as per ASME B 16.34. The extent of the radiography shall be as under:

| Pressure Class Rating | Valve Size        | Extent of Radiography |
|-----------------------|-------------------|-----------------------|
| ANSI 150 # Class      | ≤ DN 600 mm (24") | Nil                   |
|                       | ≥ DN 650 mm (26") | 100%                  |



|                            |                   |      |
|----------------------------|-------------------|------|
| ANSI 300 # Class           | ≤ DN 400 mm (16") | Nil  |
|                            | ≥ DN 450 mm (18") | 100% |
| ANSI 600 # Class and above | All sizes         | 100% |

Radiography shall be performed after the final heat treatment also.

All castings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall, comply with ASME B 16.34.

- b. All valves, with body fabricated from plates or made by, forgings, shall be ultrasonically examined in accordance with the procedure and acceptance standard as per ASME B16.34.

All forgings shall be Wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall comply with ASME B16.34.

- c. Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of 5.5 (a) for cast components or 5.5 (b) for forged components and plates.

**5.6** Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8 as applicable and API 1104.

**5.7** Welds, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII , Division 1, Appendix 12 and, Appendix 6 respectively.

**5.8** All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

- a. Weld ends of all cast valves subject to welding in field shall be 100% radio graphically examined and acceptance criteria shall be as per ASME B16.34.

- b. After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

**5.9** All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material: The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes for both Shell & seat Test. No leakage is permissible during hydrostatic testing. The body cavity self-relieving feature meeting the requirements of clause 4.13 of this specification shall also be checked.

**5.10** A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried

out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

**5.11** Valves shall be subjected to Operational Torque Test as per API 6D (Annex I, Para I.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. It shall be established that the force required to operate the valve does not exceed the requirements stated in section 4.18 (C) of this specification.

**5.12** Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

Hand operator provided on the actuator shall also be checked after above testing, for satisfactory manual over-ride performance.

These tests shall be conducted on minimum one valve out of a lot of five (5) valves of the same size, rating and the actuator model/ type. In case, the tests do not meet the requirements, retesting/ rejection of the lot shall be decided by the Company's Inspector.

**5.13** Subsequent to successful testing as specified in clause 5.11 and 5.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Company Representative for cyclic testing as mentioned below:

- a. The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
- b. Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.9 and 5.10.

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of manufacturer.

Previously carried out test of similar nature shall be considered acceptable if the same has been carried out by Manufacturer in last two years. Valves of two sizes below and two sizes above the size of valve previously tested, and rating similar or one rating lower of valve tested previously, shall be qualified.

**5.14** Checks shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of clause 4.12 of this specification.

**5.15** Anti-Static testing for soft seated valves in accordance with L.5 of API 6D.

**5.16** Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's

Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his inspector shall relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

Inspection and tests performed/ witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

## 6 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN 10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection
- e. Test report on operation of valves conforming to clause 5.11, 5.12 and 5.13 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

## 7 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SA-2 ½ / SSPC-SP10. For Coastal area, painting shall be suitable for industrial marine environment. For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating.

## 8 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.

- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** The serial number of each valve indicated on its name plate shall appear on all required documentation in accordance with EN 10204 3.2.
- 8.6** Name Plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25
- 8.7** All valves shall be transported with ball in fully opened condition
- 8.8** On packages, following shall be marked legibly with suitable marking ink:
- a. Order Number
  - b. Manufacturer's Name
  - c. Valve size and rating
  - d. Tag Number
  - e. Serial Number

## **9 SPARES & ACCESSORIES**

- 9.1** Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2** Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

## **10 DOCUMENTATION**

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

- 10.1** At the time of bidding, Manufacturer shall submit the following documents:
- a. Reference list of similar ball valves manufactured and supplied in last seven years indicating all relevant details including project, year, client, location, size, rating, service etc.
  - b. Torque curves for the power actuated valves along with the break torque, running torque for the valve stem and maximum allowable stem torque.
  - c. Copy of valid API 6D Certificate.
  - d. Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.
  - e. Details of support foot including dimensions and distance from valve centreline to bottom of support foot.
  - f. List of recommended spares required during start-up and commissioning & 2 years of normal operation and maintenance.

10.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for Company's approval:

- a. General arrangement & detailed sectional drawings showing all parts with reference numbers and material specifications, overall dimensions and features. Number of turns of hand wheel required for operating the valve from full open to full close position for Gear Operated valves, painting/ coating scheme, Complete dimensional details of support foot (where applicable), shall be indicated in the GA.

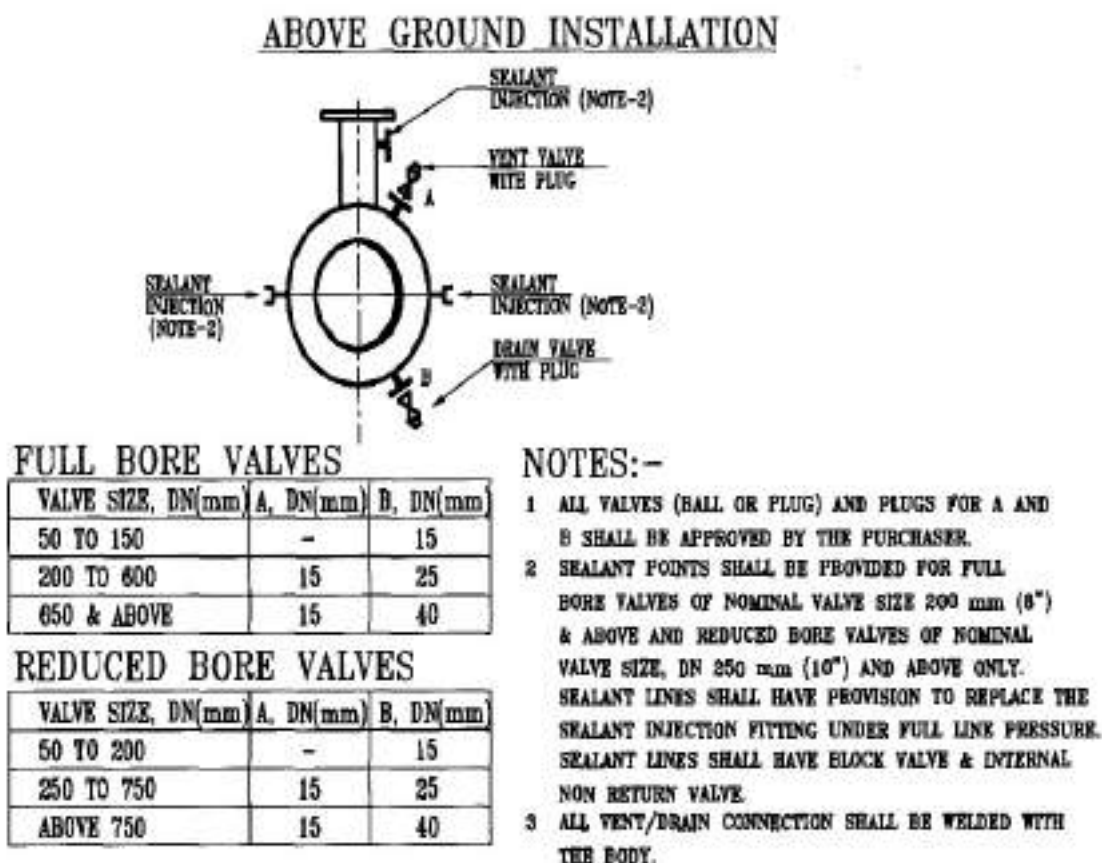
Manufacture of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

10.3 Within 30 days from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in clause 10.2 above.

10.4 Prior to shipment, Manufacturer shall submit to Company following:

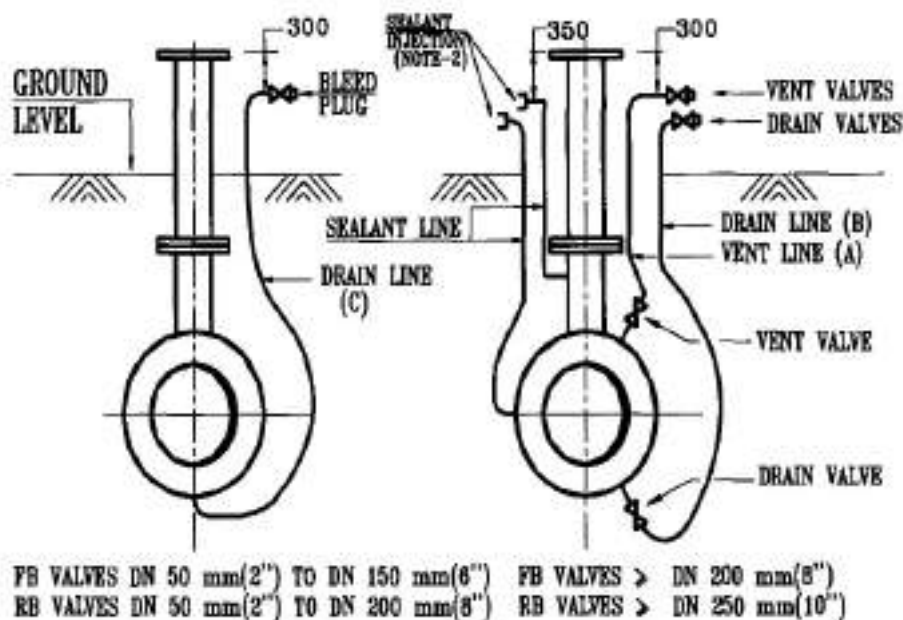
- a. Test certificates as per clause 6.0 of this specification.
- b. Manual for installation, erection, maintenance and operation instructions including a list of recommended spares for the valves.

10.5 All documents shall be in English language only.





## UNDERGROUND INSTALLATION



### FULL BORE (FB) VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) | C, DN(mm) |
|--------------------|-----------|-----------|-----------|
| 50 TO 150          | -         | -         | 15        |
| 200 TO 300         | 25        | 25        | -         |
| 350 TO 600         | 25        | 25        | -         |
| 650 & ABOVE        | 40        | 40        | -         |

### REDUCED BORE (RB) VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) | C, DN(mm) |
|--------------------|-----------|-----------|-----------|
| 50 TO 200          | -         | -         | 15        |
| 250 TO 400         | 25        | 25        | -         |
| 450 TO 750         | 25        | 25        | -         |
| 800 & ABOVE        | 40        | 40        | -         |

### NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
- 3 ALL VENT/DRAIN CONNECTION IN BURIED SECTION SHALL BE OF WELDED CONSTRUCTION. ALL PIPING INCLUDING VALVE ENDS IN BURIED PORTIONS OF VENT & DRAIN SHALL BE WELDED TYPE.

**FIGURE-4.9**



# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION FOR WATER CROSSING (CONVENTIONAL TRENCHING)

VCS – SS – PP - 2005

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 04.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by | Revision Description                                                                                                  |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                     |               | Issued as Standard Specification                                                                                      |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                  | SK            |                                                                                                                       |
| 01              | 19.09.2019    |                                                                                     |                                                                                     |                                                                                     |               | Document formatting, Cover Page, Doc numbering updated from SS-PL-001 to VPC-SS-PL-0001 keeping Revision Number Same) |
|                 |               | SSS                                                                                 | SM                                                                                  | AD                                                                                  | SK            |                                                                                                                       |
| 02              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                     |               | Document numbering updated from VPC-SS-PL-0001 to VPC-SS-PP-2004                                                      |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK            |                                                                                                                       |
| 03              | 04.01.2022    |                                                                                     |                                                                                     |                                                                                     |               | Revised as marked, Doc No Change from 2004 to 2005                                                                    |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK            |                                                                                                                       |
| 04              | 29.04.2022    |  |  |  |               | VCS QMS Integration                                                                                                   |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW            |                                                                                                                       |



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**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |
| OISD | Oil Industry Safety Directorate          |

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## 1.0 SCOPE

This specification covers the minimum requirements for the various activities to be performed by Contractor for the construction of pipeline major water crossings by conventional trenching method. Provisions of this specification are applicable only for " Water Crossing" specifically named as such in the contract.

This specification shall be read in conjunction with the condition of all specifications and documents include in the contract between company and contractor.

## 2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

The latest edition(edition in force at the time of floating the enquiry) of following Codes, Standards and regulations are referenced in this specification and all provisions of these reference codes, standards and regulations shall be applicable.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation system for liquid  
Hydrocarbon & other liquids.
- B 31.8 : Gas Transmission and Distribution Piping  
Systems.

### AMERICAN PETROLEUM INSTITUTE (API)

- RP 1102 : Liquid Petroleum Pipeline Crossing Railroads and  
Highways
- 1109 : Marking Liquid Petroleum Pipeline Facilities
- 1104 : Welding of Pipelines and Related Facilities

### PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products  
pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

### PIPE LINE SAFETY STANDARD

- Part 192, Title 49 : Transportation of Natural and other Gases by

Part 195 : Transportation of Liquid by Pipe Line

### COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

|                |                                                                                  |
|----------------|----------------------------------------------------------------------------------|
| VPC-SS-PP-2001 | Standard Specification for Pipeline Construction                                 |
| VPC-SS-PP-2010 | Standard Specification for Pipeline Concrete Weight Coating of Onshore Pipelines |
| VPC-SS-PP-2014 | Standard Specification for Hydrostatic Testing of Onshore Pipelines              |
| VPC-SS-PP-2015 | Standard Specification for Pipeline Markers                                      |

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Company.

### 3.0 GENERAL REQUIREMENT

- If specified, Contractor shall carry out all geotechnical and hydrological investigation as per relevant specification. Contractor shall also carry out scour calculation based on the above and submit all reports and calculation to company for review and approval.
- Contractor shall comply with all the conditions and requirements issued by Authorities having jurisdiction in the area where the work is to be performed. Contractor shall, at his own responsibility, obtain necessary permits from the Authorities having jurisdiction, for performing its work.
- Contractor shall take full responsibility for the suitability, stability and safety of all operations and methods involved in the work.
- Contractor shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself so far as practicable as to the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, the extent and nature of the work and materials necessary

for the completion of the work, and the means of access to the work area.

- e. Prior to start of any work, Contractor shall carry out a pre-construction survey of the major water crossings and. acquaint himself with site conditions and to collect any data regarding the water velocity and the tidal variation in the flow pattern and shall verify the suitability of his equipment and the method of construction.
- f. Contractor shall, with due care and diligence, execute the work in compliance with all laws, by-laws, ordinances, regulation etc., and provide all services and labor, inclusive of supervision thereof, all materials, excluding the materials indicated as "Company Supplied Materials", equipment appliances or other things of whatsoever nature required in or about the execution of the work, whether of a temporary or permanent nature.
- g. Contractor shall be deemed to have obtained all necessary information as above mentioned as to risks, contingencies and all other circumstances, which may influence the work.
- h. Contractor shall, in connection with the work, provide and maintain at his own-costs all lights, guards, fencing, watching etc., when and where necessary or required by Company or by any duly constituted Authority for the protection of the work and properties or for the safety and the convenience of public and/or others.
- i. If no public roads exist, Contractor shall arrange at his own for access to work areas at no extra time and cost to Company.
- j. Before start of the field construction work, Contractor shall submit the following for approval of each major water crossing
  - Installation method.
  - Proposed time schedule indicating start and finish dates with detailed break-up showing critical activities.
  - Layout, location and other drawings / sketch of work area.
  - Details of equipment (including number and capacity of equipment deployed)
  - Manpower deployment during construction
  - Proposed sub-contractors and / or vendors (if any) along with their scope of work.

The description of the installation method as a minimum shall include the following:

- a. Preparation of fabrication yard and launching area along with proposed Layouts.
- b. Pipeline construction details (including hauling, stringing, welding, NDT, concrete coating, etc.).
- c. Study of water currents in relation to the method of launching (on bottom and on surface)
- d. Preparation of sheet piling/Details of Dams/Coffer dams/diversion of water methodology proposed.
- e. Calculations For stability of pipeline during launching and final test.
- f. Grading of bank area & record of it original level for restoration purpose.
- g. Buoyancy Studies.
- h. Pre-test procedure.
- i. Pulling or other installation method and related calculations / analysis including rope test, checking of winch/crane pulling capacity etc.
- j. Pulling arrangement including launch way and anchoring and braking device.
- k. Trench correction before launching / lowering.
- l. Method of positioning and sinking / lowering of pipeline.
- m. Method of rectification of damages to the pipeline / coating, during launching.
- n. Method of backfilling and bank protection.
- o. Final test procedure after backfilling. .
- p. Safety system adopted
- q. Communication system adopted during construction/testing/survey.
- r. Abandonment and recovery procedures in case of failure.
- s. Procedure for corrosion coating of field joint

Approval by Company of the methods used by Contractor shall in no way relieve Contractor from the sole responsibility for safe and satisfactory installation of the crossing.

## 4.0 TRENCHING

### 4.1 EXCAVATION

Contractor shall dredge or excavate the trench for the water crossing in conformity with the approved drawings. Dredging of the trench shall be executed as accurately as possible.

The trench shall be excavated to such depth as, required to provide the minimum cover and the pipeline configuration as specified. The pipeline profile of the crossing shall be followed as accurately as possible. Before laying, the trench shall be cleaned and leveled. The trench shall be subject to inspection by Company prior to installation of the pipe.

Contractor will not be entitled for any compensation in terms of time and cost, if his work is hampered or delayed due to weather conditions, any obstacles / or any traffic on the spot, where work is executed.

Contractor is fully responsible for the execution of the blasting (wherever permitted), the dredging and excavation work, hopping of the spoil; transportation, dumping on land or in water, all to be executed in agreement with Authorities, land owners and Company.

Contractor may be obliged to dredge or excavate a trench deeper or wider than indicated in the drawings. in order to properly lay the pipeline in unstable (underwater) areas, or near and adjacent to the banks of water-courses. It shall be understood that Contractor is aware of such problems at the time of his Bid and that when such additional excavation is required, it shall be done by Contractor as part of the work and that he will install the necessary provisions and/or temporary works such as sheet-piling, special filling materials, etc. at no extra cost to Company.

Contractor, if so desired by Company, shall make cross profiles at intervals of not more than 10.0 m of the bottom of the watercourse along the surveyed centerline of the water crossing. In such a case, horizontal measurements shall be taken by triangulation or tapping between known points and shall be made with such accuracy that the location of each vertical measurements is known with 1.0 m. Vertical measurements shall be taken with a sonic recording device, or with line and rod, as directed by Company and shall be taken with such an accuracy that

each depth is known within 0.2 m. Vertical measurements shall be taken at points averaging not more than 5.0 m apart and no two measurements shall be more than 7.0 m apart. The cross profiles shall extend at least 10 m on both sides of the top of the trench.

All measurements shall be recorded by Contractor. Company may witness such measurements. The resulting profile, corrected to the elevation of the undisturbed watercourse, shall then be the reference profile. Said profile shall be plotted on a 1:200 vertical and horizontal scale.

Contractor shall keep the trench in good condition until the pipe is laid, and no claim is to be made to the Company by reason of its caving either before or after the pipe is laid. Contractor shall do whatever is required to excavate the trench, install the pipe in it and backfill the trench in accordance with the specifications at no extra cost to Company.

Immediately before installation of the water crossing in the excavated trench, Contractor shall prepare a profile of the trench bottom along the surveyed center line of the water crossing for comparison with the reference profile. Contractor shall also make cross sections of the trench at intervals of not more than 50 m. All profiles and cross section measurements shall be taken as specified and, if required, shall be witnessed by Company. These data shall be submitted to Company for approval.

Contractor shall grade the trench in such a manner as to give the maximum amount of uniform support to the pipeline when it is lowered or pulled into place. The maximum unsupported span shall not exceed 10.0 m.

In submerged sections, where rock or gravel is encountered in the bottom of the trench, padding is required. The thickness of the padding under the concrete coated pipe shall at least be 0.5 m and after installation at least 0.5 m around the pipe.

Blasting, if any, and padding shall be included in the Contractor's work.

In case of major rivers, Navigational traffic shall not be obstructed, unless permission has been given thereto. Contractor shall issue all necessary, publication according to the local requisitions. Instructions given by Authorities shall be followed accurately and immediately, so that traffic encounters no



shall render assistance for this purpose and make available for Company appropriate survey boats, fully manned and equipped, before the trench excavation work of the water crossing can be started-

#### **4.2 PUMPING LINES**

In case Contractor uses pumping lines to discharge the spoil, he shall take care of the necessary permits.

Pumping lines, discharges and siphons shall be installed by Contractor and removed before the completion of the work. At crossing with existing roads, the pumping lines shall be led through a casing pipe bored/jacked under the road or led through a porch over the road. A stress calculation must then be handed over to Company. The necessary provision to embank the dumping area and also the spoil basins shall be made by Contractor. Contractor is responsible for transportation of the spoil and dumping on land and is liable for damage to works of third parties caused by leakage of pumping lines, etc. Contractor shall at all-time prevent overflow of pumping water, spoil or sand over embankments, parcels or roads. Further more, Contractor shall safeguard Company from claims of compensation by third parties due to encountered damage.

#### **4.3 SPOIL**

Spoil which is not dumped on and including spoil acquired after cleaning the water crossing trench, shall be transported and dumped in places, designated thereto by agreement between Contractor and Authorities and approved by Company. Spoil shall be transported in (split), barges; only those barges shall be used that avoid spilling during transportation due to incorrect closing of the flaps, etc. Spoil, which is dumped outside the designated places, shall be removed by Contractor at first notice by Company.

#### **4.4 DIKES, DAMS AND WEIRS**

Contractor shall install temporary provision in the existing dikes, dams, etc. to prevent flooding of low areas.

Therefore, in general, in existing dikes, dams, etc. a double substituting weir must be installed before start of excavation in the existing dike or dam. Such a double substituting weir can be a closed wall of sheet piling, supported by soil. The provisions shall be such that the underwater profile of the dredged trench, the

## **5.0 POLLUTION CONTROL MEASURES**

Contractor shall take all necessary precautions not to pollute river water and banks during entire construction operation. Equipment deployed and, construction methodology adopted shall be such, that minimum damage is caused to the existing environmental conditions. Union and State Government requirements concerning pollution control and environmental protection shall be fully complied with.

## **6.0 CONTINUOUS CONCRETE COATING**

Contractor shall provide concrete coating over the pipeline including the bends in accordance with the specification issued for the purpose and approved procedure. Contractor shall coat the weld joints in order to arrive at the continuously concrete coated pipeline. However, the concrete coating shall be applied after the hydrostatic pretest.

## **7.0 HYDROSTATIC PRE-TESTING**

Contractor shall hydrostatically pre-test the pipe string of each water crossing before installation as per approved procedure.

Joint coating of the welds shall be done after this pre-test.

The section of the pipeline corresponding to the crossing shall, before installation, be subjected to a minimum hydrostatic test pressure equal to 1.25 / 1.5 times design pressure as applicable. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of the pipe material.

After the temperature has been stabilized, the pressure shall be maintained in the pipeline for at least six hours and recorded by manothermograph. During test, the Contractor shall check all welds for leakage. Failure, if any, during the test shall be rectified by the Contractor. If the same is due to failure on account of any cause other than defect in materials supplied by Company, the repairs shall be done free of cost, to the satisfaction of Company.

## 8.0 INSTALLATION

Contractor shall submit a detailed scheme for the method, proposes to adopt for installing the pipeline to Company for approval. Contractor shall calculate all stresses in the pipeline while laying and check whether the stresses remain within permissible limits. A set of all calculations shall be submitted to Company for approval.

Contractor shall perform all work required to install the water crossings, including the possible appurtenances indicated in the drawings. The water crossings shall be installed in such a manner as to comply with the requirements and conditions stated by the Relevant Authorities issuing the permits. Contractor shall pay special attention to minimize any damage to embankments and dikes in the vicinity of water crossings.

The equipment for launching shall be arranged in such a way that the pipeline is laid without impact or jerking and is not subjected to stresses of any type other than those which are allowable. Minimum allowed radius of curvature shall be followed, particularly at the end of the launching way towards the water in the freely suspended section.

During the launching the pipe shall have a submerged weight of 30 kg/meter with a tolerance of  $\pm 10\%$ .

After the water-crossing section has been installed in place, Contractor shall fill this pipeline section including the pertaining land pipeline sections with water for the final testing.

Contractor shall check if the position and depth of the water crossing are in accordance with the approved drawing, by means of a profile of the pipeline, before and after the water crossing section is filled with water. Contractor shall lower each pipeline section, which is not sufficiently deep by dredging or jetting the underlying ground.

The maximum allowed horizontal deviation from the required centre-line shall be limited by the following:

|                                         |   |        |
|-----------------------------------------|---|--------|
| For pipeline dia up to including 500 mm | : | 300 mm |
| For pipeline dia greater than 500 mm    | : | 500 mm |

Prior to backfill the pipeline shall, when laid in the trench, conform to the bottom contour of the trench grade, so that it will be firmly, uniformly and continuously supported within the permissible limits of unsupported spans as specified in Para 4.1.

If the pipe does not properly fit the trench or does not rest at sufficient depth to satisfy the minimum requirements of cover as specified in approved drawings, the

Contractor shall make necessary corrections to trench so that the pipe, when finally in position in the trench, shall fully meet the specification, failing which Contractor may be asked to remove the pipeline. This shall be done at no extra time and cost to the Company.

## 9.0 INSTALLATION OF PARALLEL PIPELINES

When parallel pipelines are required to be installed across major water crossing, Contractor shall further comply with the following requirements.

Depending on the diameter of the parallel pipelines, the characteristics of the crossing and the limitation of Contractor's equipment, Contractor may propose installation of the parallel pipelines either together in a combined operation or separately in a common trench.

If the pipelines are installed together, the minimum clear distance between the parallel pipelines (measured from the outside diameters of the concrete coated pipes) shall be 500 mm. Contractor shall provide spacers (at sufficient intervals along the length of the pipe sections), securely fixed to the pipes, or shall propose other suitable alternative methods, so as to ensure that the stipulated minimum clear distance is maintained. The buoyancy of the combined installation (pipes spacers), shall be checked before installation. The spacers may be removed before the trench is backfilled.

Contractor shall furnish detailed drawings/calculations for the pipe assembly, showing the details of spacers/other arrangements for Company's approval before start of construction.

If the parallel pipelines are installed separately in a common trench, the minimum clear distance between the parallel pipelines in the trench shall be 5000 mm. Contractor shall ensure that this minimum spacing is maintained till the time the trench is backfilled.

## CONSTRUCTION EQUIPMENT

All critical construction equipment deployed shall have a factor of safety of 2 (minimum) over the calculated loads/capacities.

CS Conduit shall be installed by the Contractor as per the requirements stipulated in the Tender at the River/ Major Water Crossings.

## 10.0 BACKFILLING AND BANK PROTECTION

### 10.1 BACKFILLING

Backfilling of the water-crossing section shall be performed as described in the following clauses.

The bottom of the water way shall be reinstated to its original level by backfilling the trench in a manner and with suitable material and as prescribed and approved by the Authorities and Company. In case material other than the original spoil is required, this shall be supplied by Contractor.

Wherever boulders, rock; gravel and other hard objects are encountered, they shall not be placed directly on the pipe.

Sufficient soft earth, sand or selected and approved back fill material shall be backfilled initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 0.5 m around the pipe before backfilling remainder of the trench with excavated or other material.

Wherever required by Company, Contractor shall cover the nearly backfilled trench with a layer of rock boulders to be approved by Company over a width equal to the width of excavated trench with an extra of 5m on either side at no extra cost to Company.

Backfilling progress of the trench shall be checked continuously and a daily progress report shall be made in three-fold and handed over to Company.

All embankments and/or dikes, bed and banks shall be reinstated to their original state and levels, unless otherwise prescribed in the drawings or by the competent Authorities or Company.

All remaining spoil-deposits shall be cleaned by Contractor to the satisfaction of Company.

## 10.2 BANK PROTECTION

- a. Trenches in banks of major water crossing shall be backfilled with soil approved by Company. The fill at the banks shall be compacted firmly and reinforced with sacked earth, rip-rap, or by other means as directed by Company to the satisfaction of Authorities having jurisdiction thereof. In areas where the backfilled soil is expected to be of loose type, which is prone to flow, the trench shall be backfilled with crushed rock of size approved by Company

and pipe shall be provided with adequate padding of soil of a quantity approved by Company. Slope breakers if required shall be provided in both the banks. After the trench has been backfilled and during the cleanup works, the water crossing shall be cleaned across the whole width of RoU.

- b. Unless stipulated otherwise by the Authority or by Company, Contractor shall protect the banks of the major water crossings by using gravel and boulders filled embankment mattresses of galvanized iron wire to be laid over the backfilled, compacted and graded banks. In case slope of the banks is 1:1 or

- c. more, bank protection shall be carried out using gabions. Bank protection works shall be carried out by Contractor in accordance with the relevant drawings. All materials required for such works shall be supplied by Contractor and all works carried out in accordance with specifications, approved drawings, c. instructions of Company and to the complete satisfaction of Authorities having jurisdiction at no extra cost to Company.
- d. The width of the above protection shall be equal to the width of trench excavated and damage and further extending 10 m on either side. The width of the restoration on the slope shall be determined by the levels.
- e. Length of Bank protection shall be as per standard.
- f. Before post installation hydrostatic testing, Contractor shall "prove" the Diameter of the pipeline by passing a gauging pig 95% of ID through the pipeline. The gauging pig shall be capable of locating and detecting defects permitted by governing code. Contractor shall supply and install all temporary test headers and other equipment, piping materials and other consumables for the purpose.

## **11 POST-INSTALLATION HYDROSTATIC TEST**

The test pressure shall be same as adopted during pre-testing. The combined equivalent stress in the pipeline due to bending, static head and test pressure shall not exceed 95% of the SMYS of the pipe material. After temperature stabilization, pressure shall be retained in the pipeline for a minimum 24 hours and recorded by manothermograph. The hydrostatic testing shall be carried out in accordance with approved procedures.

## **12 POST-CONSTRUCTION SURVEY**

After laying of the pipeline, Contractor shall carry out a post-construction survey jointly with Company. Any defects brought to the notice of Contractor shall be promptly corrected by Contractor at his own expense to the complete satisfaction of Company.

## **13 FINAL CLEAN-UP**

After completion of construction, Contractor shall clear the site of all balance material and debris. All balance pipe lengths, in case supplied by company, shall be returned to Company's designated stock yard(s). Site shall be cleared to the

complete satisfaction of Company and Authorities having jurisdiction. All such works shall be done at no extra cost to Company.

## 14 DOCUMENTATION

In addition to the documents specified elsewhere in this specification, Contractor shall submit to the Company six copies of each of the following documents/records.

- i. Pipe book of the crossing.
- ii. Copies of the permits obtained from Authorities having jurisdiction for the various works.
- iii. Clearance certificates from the land owners and Authorities having jurisdiction regarding satisfactory clean-up and restoration of pipeline ROU and work areas.
- iv. Pre and post installation Hydrotest Report.
- v. True profile of the bed and banks of water crossing along the pipeline after backfilling
- vi. True profile of the pipeline as installed and depth of cover at top of pipe at 10 m interval.
- vii. Location and angle of sag bends and over bends.
- viii. Cross section along the pipeline indicating nature and extent of backfill materials, thickness of concrete coating to pipe etc.
- ix. Method and extent of bank protection.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR FLOW TEE

VCS – SS – PP - 2007

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 03.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |



| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                                       |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                                                                  |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Issued as Standard Specification                                                                      |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                       |
| 01              | 24.05.2019    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Re-Issued as Standard Specification                                                                   |
|                 |               | BS                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                       |
| 02              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document formatting, numbering updated from SS-PL-021 to VPC-SS-PP-2007 other detail update as marked |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                       |
| 03              | 03.01.2022    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Revised as marked                                                                                     |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |                                                                                                       |
| 04              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                   |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                                                       |



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**ABBREVIATIONS:**

|        |                                                           |
|--------|-----------------------------------------------------------|
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society for Testing and Materials                |
| API    | American Petroleum Institute                              |
| BHN    | Brinell Hardness Number                                   |
| HAZ    | Heat Affected Zone                                        |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| RTJ    | Ring Type Joint                                           |
| SSPC   | Steel Structures Painting Council                         |

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## 1.0 **SCOPE**

This specification covers the minimum requirements for the design, manufacture and supply of carbon steel flow tees to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2.0 **REFERENCE DOCUMENTS**

The design, fabrication and supply of Flow Tees shall comply with the latest edition(edition in force at the time of floating enquiry) of the applicable following codes, standards and regulations.

### **AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons and Other Liquids.
- B 31.8 : Gas Transmission and Distribution Piping Systems
- B 16.25 : Butt Welding Ends
- B 16.9 : Factory made Wrought Steel Butt Welding Fittings
- BPV Code : Section VIII, Appendices 12 and 6.

### **AMERICAN PETROLEUM INSTITUTE (API)**

- 1104 : Specification for Welding Pipelines and Related Facilities

### **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

- A370 : Standard Test Methods and Definitions for Mechanical Testing of Steel Products

### **MANUFACTURERS STANDARDIZATION SOCIETY (MSS)**

- SP-25 : Standard Marking System for Valves, Fittings, Flanges and Unions
- SP-75 : Specification for High Test Wrought Butt Welding Fittings
- SP-53 : Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method.

### **STEEL STRUCTURES PAINTING COUNCIL (SSPC)**

- VIS-I : Visual Standard

## **PNGRB REGULATIONS:**

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

In case of conflict between various requirements of this specification and reference standards and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

## **3.0 MANUFACTURER'S QUALIFICATION**

Manufacturers who intend bidding for flow tees must possess the records of a successful proof test for tees used in the fabrication of flow tees, in accordance with the provisions of ASME B 16.9/ MSS-SP-75, as applicable. These records shall be submitted at the time of bidding qualifying the entire range of fittings offered.

## **4.0 MATERIALS**

- 4.1 Material for the pressure containing parts of the flow tee shall be as indicated in the Flow Tee Data Sheet. Other parts shall be as per the Manufacturer's standard suitable for the service conditions and shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.
- 4.2 All carbon steel used for fabrication of various components of Flow Tees shall be fully killed.
- 4.3 Each heat of steel used for the manufacture of pressure containing parts of the flow tees shall have Carbon Equivalent (CE) not greater than 0.45 based on check analysis calculated as per the following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

The Vendor shall submit the material test certificates and product analyses for materials used in the manufacture of the Flow Tees.

- 4.4 For flow tees specified to be used for Gas service or LPG service, Charpy V-notch test shall be conducted at 0°C or at temperature as specified on data sheet for each heat of steel used in the manufacture of pressure containing parts of flow tee. The test procedure shall conform to MSS-SP-75 / ASTM A370. The average absorbed impact energy values of three full-sized specimens of base metal, weld metal and HAZ shall be 27 joules, unless otherwise indicated in the Data Sheet. The minimum impact energy value of any one specimen shall not be less than 22J. Results of charpy test shall be recorded.

When Low Temperature Carbon Steel (LTCS) materials are specified in Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

- 4.5 For flow tees specified to be used for Gas service or LPG service, hardness test shall be carried out as per ASTM A370 for each heat of steel used in the manufacture of tees. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, weld metal and HAZ of all the pressure containing parts shall not exceed 248 HV<sub>10</sub>. Hardness shall be recorded.

## **5.0 DESIGN AND MANUFACTURE**

### **5.1 GENERAL**

Flow Tees shall generally conform to the Figure 4.1 and shall meet the following requirements.

- a. Tee used shall comply with ASME B 16.9/MSS-SP-75 and shall be of forged construction. Fabricated Tee (with or without reinforcement pads) shall not be used. Seamless Tee shall be used for run sizes  $\leq 400$  mm (16") NB. Tee shall be either welded or seamless type for run sizes  $\geq 450$  mm (18") NB.
- b. Size & wall thickness of connected pipeline, design factor, material & grade of material, and corrosion allowance to be considered in design of Flow Tees shall be as indicated in data sheets. Allowable stresses shall be as per applicable design code ASME B 31.4/ASME B 31.8.
- c. Inside diameter of internal pipe shall be same as connecting pipeline indicated in data sheet.
- d. The Flow Tee shall allow smooth passage of regular batching and cleaning pigs as well as instrumented pigs in both directions.
- e. Internal sleeve shall be fixed inside the Tee with suitably shaped forged steel end pieces. Machined end pieces shall not be used.
- f. Shape of the holes/slots in the sleeve shall be designed to prevent pig getting stuck or damaged during passage through Flow Tee.
- g. The size and number of holes in the internal sleeve shall be such that resulting area of openings is equal to inside area of branch. In case rectangular holes/slots are made, they shall be oriented at an angle of 45 degrees with respect to run centerline.
- h. No pups shall be provided on the run or branch unless specified in the Flow Tee Data Sheet.

### **5.2 DESIGN**

- 5.2.1 Flow tees shall be designed and manufactured in accordance with the provisions of Codes, Standards and Specifications referred in Section 2.0 of this specification. In addition, design factor and corrosion allowance, as indicated in the Data Sheet, shall also be taken into account for design of Flow tees.
- 5.2.2 Flow tees shall generally conform to the figure shown in the Data Sheet and shall meet the following requirements:

- An internal pipe having the same internal diameter as the connecting pipeline allowing the passage of scraper/instrumented pigs, shall be provided with holes/slots located in the center line of the branch. The holes/slots shall be oriented at 45° angle. The number(s) and size of holes/slots shall be such as to prevent the pig getting stuck or damaged without affecting the flow through the branch line. The area of the holes/slots shall be at least equal to the internal area of branch size. Calculations for the area shall be furnished.
- A seamless/submerged arc welded "tee" as per ASME B 16.9/MSS-SP-75, enclosing the internal pipe and fixed to it by suitably shaped forged steel rings. Machined steel rings shall not be used. The center to end dimension of the outlet shall meet the minimum recommended dimension of the referred standard. Circumferential welding on the branch outlet is not acceptable. Pups shall not be provided either at the run or at the branch.
- Tees used for fabrication of flow tees shall be seamless type for run sizes  $DN \leq 350\text{mm}$  (14") and shall be either welded or seamless type for run sizes  $DN \geq 400\text{ mm}$  (16")

Tees shall conform to ASME B 16.9 for run size up to DN 350 (14"). For run size  $DN \geq 400\text{ mm}$  (16"), the tees shall conform to MSS-SP-75/ASME B 16.9.

- 5.2.3 The flow tees run/branch diameter and wall thickness shall be as indicated in the Data Sheet, matching with the connecting pipeline. Butt weld ends of flow tees shall be bevelled as per MSS-SP-75.
- 5.2.4 All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.
- 5.2.5 Stub-in or pipe-to-pipe connection shall not be used in the manufacture of flow tees. Tees used for manufacturing of flow tees shall be manufactured by forging or extrusion methods only. In case flow tees are manufactured using welded tees, the longitudinal weld seam shall be oriented at least 90° to the branch connection.
- 5.2.6 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall include impact test and hardness test and shall meet the requirements of clause 4.4 and 4.5 of this specification respectively.
- 5.2.7 Repair by welding on parent metal of the flow tee is not permitted. Repair of weld seam by welding shall be carried out only after specific approval by Company's Inspector for each repair. The repair welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests, which are applicable for regular production welding procedure qualification. All heat treatment and radiography shall be repeated after the weld repair.
- 5.2.8 The tolerance on internal diameter and out of roundness at the ends for welded flow tees shall be as per applicable connected pipe specification as indicated in the Data Sheet.

## 6.0 **WELDING**

- 6.1 All welding shall be carried out by welders and welding procedure qualified in

accordance with ASME Section IX. The Procedure qualification shall include impact test and hardness test and shall meet the requirement of clause 4.4 and 4.5 of this specification respectively.

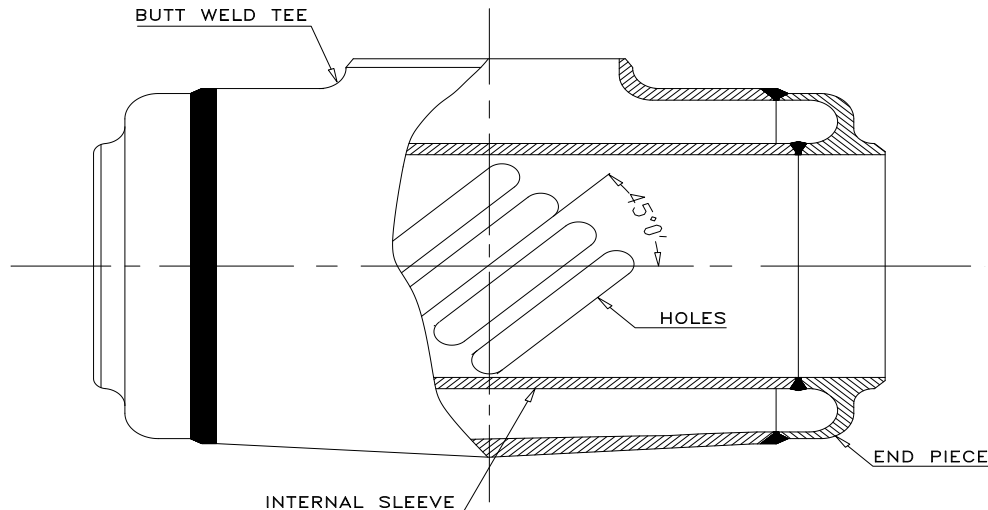


**Figure 4.1**

- 6.2 No repairs by welding shall be carried out on base metal of pressure containing components of Flow Tee. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. Repair welding shall be carried out by welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair WPS and PQR must also be approved before performing repair welding.
- 6.3 All pressure containing welds made for fabrication of Flow Tees shall be butt welds. Other welds shall be full penetration girth or fillet welds.
- 6.4 All weld ends shall be checked for surface defects using dye penetrate prior to welding.
- 6.5 Bevel ends for field welding of Flow Tees shall be in accordance with ASME B31.4 or B31.8, as applicable.
- 6.6 All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.

## **7.0 INSPECTION & TESTS**

- 7.1 The Manufacturer shall perform all inspections and tests as per the requirements of this specification and the relevant codes, standards and specifications, prior to shipment at his works. Such inspections and tests shall be, but not limited to, the following:
- 7.2 All flow tees shall be visually inspected for visible surface defects. The internal and external surfaces of the flow tees shall be free from any strikes, gauges and other detrimental defects. Bevels at butt weld ends shall show a smooth contour.
- 7.3 All dimensions shall be checked for conformance with approved drawings and/or datasheets.



- 7.4 Chemical composition and mechanical properties including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be checked as per MSS-SP-75/relevant material standards, and this specification for each heat of steel used.
- 7.5 Non-destructive examination of individual flow tees shall be performed as given below:
- 100% inspection by radiography shall be carried out on all butt welds of pressure containing parts. Acceptance limits shall be as per API-1104. Radiography shall be performed after the final heat treatment.
  - All finished wrought weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 25 mm from the end. Any lamination larger than 6.35 mm shall not be acceptable.
  - Magnetic particle or liquid penetrant examination shall be performed on cold formed butt-welding tees with extruded outlets. The examination shall be carried out as per the Supplementary Requirement SR 14 of MSS-SP-75.
  - Welds, which, in Company's Inspector's opinion, cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix 6 respectively.
  - All forgings shall be wet magnetic particle examined on 100 % of the forged surfaces. Method and acceptance shall comply with MSS-SP-53.
- 7.6 Company's Inspector reserves the right to perform stage wise inspection and witness tests, as indicated in clause 6.1 of this specification, at Manufacturer's works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection to the Company's Inspector.
- 7.7 Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the manufacturer's obligation to perform the required inspection and tests.
- 7.8 The Manufacturer shall submit an Inspection and Test Plan (ITP) for approval prior to commencement of manufacture.
- 7.9 The Purchaser will advise the Manufacturer, by marking up the Contract Inspection and Test Plan, of the specific inspection review, witness and hold points required. The Manufacturer shall give ten working days prior notice to the Purchaser of such item or hold point being reached.

Following stages will be subject to witness/hold/review by the Purchaser or third party inspector.

- Visual inspection of the Flow Tees.
- Full dimensional checks.
- Material certification checks.
- Inspection of radiographs and other NDT results.
- Pressure testing.

- Surface finish and profile verification at each phase of surface preparation and coating.

Where inspection or testing is to be performed by certified testing laboratories, the Manufacturer shall submit their proposed testing laboratory for approval.

The final inspection, before issue of a release note for the Flow Tees, shall include material certificates, test certificates, surface treatment, dimensional conformity, tagging and packing conformity.

## **8.0 HYDROSTATIC TESTING**

In case factory hydrostatic is specified in the Datasheet, it shall be performed on the completed Flow Tee. Each tee shall be hydrostatically tested at a test pressure as indicated in Data Sheet. The test duration shall be of 15 minutes. No visible leakage or drop in pressure is permitted. After completion of the testing, closure shall be cut off and ends prepared.

## **9.0 TEST CERTIFICATES**

Manufacturer shall submit the following certificates to Company's inspector:

- Test certificates relevant to the chemical analysis and mechanical properties including hardness of the materials used for construction as per this specification and relevant standards.
- Test reports on radiographic, ultrasonic inspection and wet magnetic particle examination.
- Test certificates for each flow tees stating that it is capable of withstanding without leakage a test pressure which results in a hoop stress equivalent to 95% of the specified minimum yield strength for the pipe with which the flow tee is to be attached without impairing its serviceability.
- Test reports on heat treatment carried out as per specification.
- Welding procedures and welder's qualification reports.
- Certified reports of dimensional tolerances.
- Certified report of painting/coating thickness checks.
- Certificates of all other tests specified in this specification.

All pressure retaining part (Tee and End Pieces) material certification shall be traceable to heat numbers. Certificates shall be available at final inspection in the Manufacturer's works.

## **10.0 PAINTING, MARKING & SHIPMENT**

- 10.1 All Flow Tees shall be packed and prepared for shipment/transport in with the procedures included in the Material Requisition (MR)/ Tender.

- 10.2 The Manufacturer shall supply packing and shipping procedure with the tender.
- 10.3 After all inspection and tests required have been carried out/witnessed by Company's Inspector, entire surface of flow tees shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with sufficient coats of standard mill coating/corrosion resistant paint, for protection against corrosion during transit and storage. The surface preparation shall be carried out by shot blasting to SP 10 in accordance with "Steel Structures Painting Council - Visual Standard - SSPC-VIS-I".
- 10.4 All buried flow tees as specified in data sheet shall be coated with 100% solid high build epoxy (minimum 1000-micron thk) or 1.5 mm thick polyurethane coating.
- 10.5 Manufacturer shall indicate the type of mill coating / corrosion resistant paint used in the drawings submitted for approval.
- 10.6 Ends of flow tees shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for weld ends of flow tees.
- 10.7 Flow tees shall be marked with indelible paint with the following data:
- Manufacturer's name
  - Nominal diameter of run and branch
  - Nominal thickness of run and branch ends
  - Material of Construction / Tee and End Piece material and grade
  - Test Pressure.
  - Year of Manufacture.
  - Tag number

## **11.0 DOCUMENTATION**

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

- 11.1 At the time of bidding, Bidder shall submit the following documents:
- Reference list of similar supplies including all relevant details viz. Project, Year of supply, Client, Location, Size, Rating and Service for the last five years.
  - Records of successful proof test for tees used for fabrication of flow tees, qualifying the range of sizes quoted.
- 11.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for company's review and information:
- General arrangement drawings of flow tees with overall dimensions and cross-sectional drawing including relevant calculations for pressure containing parts.
  - Method of manufacturer, welding procedure and heat treatment details.

- Quality Control Manual and Quality controls Plans.
- Type of mill coating/anti-corrosion/anti-fouling paint

Once the approval has been given by the company, any change in design, material and method of manufacturer shall be notified to the company whose approval in writing of all changes shall be obtained before the flow tees are manufactured.

11.3 All documents shall be in English Language.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR FIELD JOINT COATING

VCS – SS – PP - 2012

|            |            |                       |             |               |                |
|------------|------------|-----------------------|-------------|---------------|----------------|
|            |            |                       |             |               |                |
|            |            |                       |             |               |                |
|            |            |                       |             |               |                |
| 02         | 29.04.2022 | VCS QMS Integration   | RP          | MC            | HK             |
| 01         | 06.03.2020 | RE-ISSUED AS STANDARD | MD          | SK            | SK             |
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| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                          |
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| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description                                                                     |
| 00              | 23.06.2017    |                                                                                   |                                                                                   |                                                                                   |                                                                                     | Issued as Standard Specification                                                         |
|                 |               | AS                                                                                | SM                                                                                | AD                                                                                | SK                                                                                  |                                                                                          |
| 01              | 06.03.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     | Document formatting, Cover Page, Doc numbering updated from SS-PL-009 to VPC-SS-PP-2012) |
|                 |               | MB                                                                                | MD                                                                                | AD                                                                                | SK                                                                                  |                                                                                          |
| 02              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                      |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                                                                                          |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                          |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                          |



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**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |
| OISD | Oil Industry Safety Directorate          |

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## 1.0 SCOPE

This specification covers the minimum requirements of materials, equipment, application and inspection/ testing of the field joint anti-corrosion coating. This specification shall be applicable for buried onshore factory coated pipelines with either three layer polyethylene or fusion bonded epoxy coating by heat shrink wraparound sleeves.

The heat shrink wraparound sleeve shall conform to DIN EN 12068 and the requirements of this specification. Unless modified/ replaced by this specification, all requirements of DIN EN 12068 shall remain fully applicable and be complied with.

This specification shall be read in conjunction with the conditions of all specifications and documents included in the Contract between Company and Contractor. Unless specified otherwise, all sections of this specification shall apply to all specifications referred in this specification.

## 2.0 REFERENCE DOCUMENTS

The design, materials, fabrication, inspection, testing and supply of heat shrink sleeve shall comply with the latest edition of the following codes and standards.

### AMERICAN SOCIETY OF TESTING OF MATERIALS (ASTM)

- |         |   |                                                                                                                                                   |
|---------|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| D - 149 | : | Standard Test Methods of Dielectric Breakdown voltage and Dielectric strength of solid electrical insulating materials of commercial frequencies. |
| D - 257 | : | Standard Test Method of D-C Resistance or conductance of insulating material                                                                      |
| D - 570 | : | Standard Method of Test for Water Absorption of Plastics.                                                                                         |

### INTERNATIONAL ORGANISATION FOR STANDARDIZATION (ISO)

- |              |   |                                                                                                                                                                                          |
|--------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 8502 - 3 | : | Preparation of Steel Substrates before Application of Paints and Related Products - Part 3 - Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method) |
| ISO 8503-1   | : | Part 1: Specification and definitions for ISO surface profile comparator for the assessment of abrasive blast clean surfaces.                                                            |
| ISO 8503-4   | : | Part 4: Methods for calibration of ISO surface profile comparator and for the determination of surface profile - Stylus instrument procedure                                             |

### OTHER STANDARDS

- |              |   |                                                                                                                                                                                                |
|--------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DIN EN 12068 | : | Cathodic Protection - External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection-tapes and shrinkable materials |
| SSPC-SP1     | : | Steel Structure Painting Council                                                                                                                                                               |

### COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

VPC-SS-PP-2003      Standard Specification for 3-Layer polyethylene coating of Line Pipes

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

### 3.0 MATERIAL AND EQUIPMENT

#### 3.1 GENERAL REQUIREMENTS

Field joint anti-corrosion coating material shall be a heat shrinkable wraparound sleeve suitable for a maximum operating temperature of (+) 60°C (T<sub>Max.</sub>) and shall conform to designation EN 12068 - C HT 60 UV. In addition, the field joint anti-corrosion coating shall comply the requirements specified in para 3.2 of this specification.

##### 3.1.1 HEAT SHRINKABLE WRAPAROUND SLEEVES

Heat shrinkable wraparound sleeve shall consist of radiation cross-linked, thermally stabilized, ultraviolet resistant semi-rigid polyolefin backing with a uniform thickness of high shear strength thermoplastic/ co-polymer hot melt adhesive. The joint coating system shall consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application.

The total thickness of heat shrinkable wraparound sleeve in the as applied condition shall be as follows:

| Pipe Size<br>(Specified Outside Diameter) | Thickness (mm)      |                     |
|-------------------------------------------|---------------------|---------------------|
|                                           | On Pipe Body (Min.) | On Weld Bead (Min.) |
| < 4"                                      | 2.5                 | 2.0                 |
| 4" – 10"                                  | 2.5                 | 2.0                 |
| 12" – 18"                                 | 2.8                 | 2.2                 |
| 20" – 30"                                 | 3.0                 | 2.4                 |
| ≥ 32"                                     | 3.3                 | 2.6                 |

The heat shrink wraparound sleeve shall have the required adhesive properties when applied on various commercial pipe-coating materials. The pre-heat and application temperatures required for the application of the shrink sleeve shall not cause loss of functional properties of the pipe coating.

The Contractor shall propose the Manufacturer's details, HSS details/ Properties and the specific grade of field joint coating system meeting the requirements of this specification. Contractor shall propose only those coating systems that have been previously used for completed pipeline projects of same or higher size than the size indicated in tender, for a length of 50 km and above in a single project for similar operating conditions.

##### 3.1.2 OTHER REQUIREMENTS

The backing material shall be provided with either dimple or other means to indicate that the desired heat during shrinking in the field is attained.

The heat shrink wraparound sleeve shall be of a size such that a minimum overlap of 50 mm is ensured (after shrinking) on both sides of the yard applied corrosion coating of pipes. The sleeve shall be supplied in pre-cut sizes to suit the pipe diameter and the specified overlap requirement.

In the cases where carrier pipe is installed by direct boring/ jacking, the overlap on the mill, coating for the leading edges of the joints shall be minimum 200 mm. When this extra overlap is achieved by providing an additional patch of heat shrink tape/ wraparound, it shall be applied in such a manner that the square edge of the patch on the joint coating is in the direction opposite to the direction of boring/ jacking.

The pre-heat and application temperatures required for the application of the shrink sleeves shall not result in any damage to the applied mainline coating.

The Contractor shall obtain prior approval from Company regarding the Manufacturer of the field joint coating and the specific grade of the joint coating system proposed. Complete details along with test certificates shall be submitted to Company for this purpose. The said test certificate shall be from an independent DIN recognized/ approved laboratory for all the properties required for the specified EN designation of the field joint coating and the requirements of this specification.

### 3.2 PROPERTIES OF BACKING

Property of PE backing used as a part of heat shrink wraparound sleeve system shall comply the following:

| S No | Property             | Test Condition      | Unit              | Requirement | Test Method  |
|------|----------------------|---------------------|-------------------|-------------|--------------|
| a    | Tensile Strength     | (+)25°C             | N/mm <sup>2</sup> | 12 min.     | DIN EN 12068 |
| b    | Ultimate Elongation  | (+) 25°C            | %                 | 250 min.    | DIN EN 12068 |
| c    | Dielectric withstand | 1000 volts/sec      | KV                | 30 min.     | ASTM D 149   |
| d    | Volume Resistivity   | (+) 25°C            | Ohm-cm            | 1015 min.   | ASTM D 257   |
| e    | Water Absorption     | (+)25°C for 24 hrs. | %                 | 0.05 max.   | ASTM D 570   |

### 3.3 INSTALLED FIELD JOINT COATING PROPERTIES

As applied field joint coating system shall comply the requirements of DIN EN 12068, Table 1 and 2 corresponding to designation DIN EN 12068-C HT 60 UV, except as modified below:

- Cathodic Disbandment Resistance at T<sub>Max</sub> i.e. 60°C shall be 20 mm when tested as per Annexure K of DIN EN 12068. Test shall be carried out at (+) 60° C .
- Peel Strength shall be as follows:

| Peel Strength                    |                     | Units | Required for Mech. Resistance Class C (minimum) | Test Method as per DIN EN 12068 |
|----------------------------------|---------------------|-------|-------------------------------------------------|---------------------------------|
| Inner to Inner<br>Outer to Inner | @ 23 C              | N/mm  | 1.5                                             | Annexure B                      |
|                                  | @T <sub>max</sub>   | N/mm  | 0.3                                             |                                 |
| Outer to Outer                   | 23°C                | N/mm  | 1.5                                             |                                 |
|                                  | @T <sub>max.</sub>  | N/mm  | 0.3                                             |                                 |
| To Pipe Surface                  | @ 23°C              | N/min | 5.0                                             | Annexure C                      |
|                                  | @ T <sub>Max.</sub> | N/mm  | 1.0                                             |                                 |
| To Factory Coating               | @ 23°C              | N/mm  | 5.0                                             |                                 |
|                                  | @T <sub>Max.</sub>  | N/mm  | 1.0                                             |                                 |
| Notes                            |                     |       |                                                 |                                 |
| T max shall be (+) 60 °C.        |                     |       |                                                 |                                 |

### 3.4 TEST CERTIFICATES

The Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch of material and test certificates are provided as per the requirements of this specification. These documents shall be furnished to the Company prior to commencement of field joint coating application. Company reserves the right to have the materials tested by an independent laboratory.

### 3.5 MATERIAL IDENTIFICATION

All materials shall be identified by the batch number. It shall be the responsibility of the Contractor to ensure that the materials supplied are properly packed and marked with the Manufacturer's Name, material designation, batch number, date of manufacture and shelf life.

Random product batch sampling tests shall be performed at site by the Contractor and the results recorded for review by the Company. Tests shall include, but not be limited to, measurement of backing thickness, dimensional compliance and control batch records compliance.

### 3.6 MATERIAL STORAGE

All materials shall be stored as per the Manufacturer's recommendation. Sleeves shall upon receipt be examined to check their integrity and their compliance to the specification. The sleeves shall be stored, covered, sheltered from sunlight, and away from excessive heat. Sleeves, which for any reason have undergone visible distortion or contamination, shall be segregated and removed immediately from the installation site. Liquid materials shall be stored and handled such that their original properties are retained.

The material shall not be older than their period of validity at the time of application by the Contractor.

### 3.7 FACILITIES AND TOOLS FOR FIELD JOINT APPLICATION

The Contractor shall provide and maintain mobile facilities which contain all necessary equipment, tools, tackles, etc. for carrying out the surface preparation and application of field joint coating.

The Contractor shall furnish sufficient number of following equipment and the required spares as a minimum for inspection and testing purposes for each crew:

- Full circle adjustable 25 kV holiday detector with a visible and audible signal system
- Non-destructive type thickness gauge for measuring thickness of as-applied coating
- Contact type temperature recording thermometer
- Roughness profile measuring instrument

#### **4.0 HEAT SHRINK WRAPROUND SLEEVE SYSTEM PRE-QUALIFICATION**

The field joint coating system and its application procedure proposed by the Contractor shall be prequalified during the sleeve installation start-up phase. Five joints shall be coated in compliance with the requirements of this specification and then inspected and tested in respect of the following:

- Surface preparation, including cleanliness, roughness profile and dust contamination
- Pre-heat temperature
- Primer thickness
- Visual appearance and void after sleeve installation on the body, area-adjointing weld seam and adjoining factory applied coating. A strip of 50 mm wide X 200 mm long shall be removed for this purpose.
- Holiday testing
- As-applied coating thickness
- Peel strength test at 23°C and 60°C (between sleeve and pipe surface, between sleeve and factory applied coating & between overlap)

Company Representative shall witness the tests and inspection of coating. Regular application of field joint coating commences only after successful completion of the pre-qualification testing.

After successful completion of the pre-qualification testing, the entire field joint coating shall be removed, the pipe surface re-blasted and field joint coating re-applied as per this specification.

#### **5.0 HEAT SHRINK WRAPROUND SLEEVE APPLICATION**

##### **5.1 GENERAL**

The application procedure shall be in accordance with Manufacturer's instruction and the minimum requirements specified below whichever are most stringent and shall be demonstrated to and approved by Company. Manufacturer's expert shall supervise the application and shall be available at site upon request during qualification of application procedure and during construction at Contractor's Cost.

##### **5.2 OPERATOR QUALIFICATION**

Operators for coating application shall be given necessary instructions and training before start of work, by the Contractor. To verify and qualify the application procedures, all coating applied during the qualification test shall be removed for destructive testing as detailed subsequently in this specification. Contractor shall only utilize those operators who have been approved/ prequalified by the field joint coating manufacturer.

### 5.3 SURFACE PREPARATION

Oil, grease, salt and other contaminants shall be removed from steel surface by wiping with rags soaked with suitable solvents. Solvent cleaning shall be done in accordance with SSPC-SP1.

#### 5.3.1 BLAST CLEANING

Each field joint shall be blast cleaned using a closed cycle blasting unit or open expendable blasting equipment. With the first equipment type, steel or chilled shot and iron grit shall be used and Garnet material with the second one (in case the authority having jurisdiction have no objection, the contractor may adopt sand blasting instead of garnet material). During blast cleaning the pipe surface temperature shall be simultaneously more than 5°C and more than 3°C above ambient dew point, while the ambient relative humidity shall not be greater than 85%. Prior to surface cleaning the surface shall be completely dry. The surface shall be cleaned to a grade Sa2 ½ in accordance with Swedish Standard SIS 055900 with a roughness profile of 50-70 microns. Surface roughness profile shall be measured using an approved profile comparator in accordance with ISO 8503-1 and shall be calibrated prior to start of work in accordance with ISO 8503-3 or ISO 8503-4. The blast cleanliness shall be checked on every joint and the roughness profile shall be checked 1 in every 10 joints.

Dust, grit or foreign matter shall be removed from the cleaned surface by an industrial vacuum cleaner. The contamination allowed shall be of a rating max 2 as per ISO 8502-3. The frequency of checking for dust contamination shall be 1 every 10 joints.

Blast cleaned field joint shall be coated within 2-4 hours according to the conditions below:

- |                                |   |         |
|--------------------------------|---|---------|
| • Relative Humidity (RH) >80%  | - | 2 Hours |
| • Relative Humidity (RH) 70-80 | - | 3 Hours |
| • Relative Humidity (RH) <70%  | - | 4 Hours |

Pipes delayed beyond this point or pipes showing any visible rust stain, shall be blast cleaned again.

#### 5.3.2 SURFACE INSPECTION

The field joint surface shall be inspected immediately after blast cleaning and any feature of the steel surface such as weld spatter, scabs, laminations or other imperfections considered injurious to the coating integrity, made visible during blast cleaning shall be reported to the Company Representative and on permission from Company Representative, such defects shall be removed by filing or grinding. Pipes affected in this manner shall be then re-blast cleaned if the defective area is larger than 50 mm in diameter.

All steel joint surfaces shall be thoroughly examined before the application of the coating in order to ensure the surfaces are free of oil, grease, rust, mud, earth or any other foreign matter. All these substances shall be removed before coating.

#### 5.3.3 PREPARATION OF EDGE OF FACTORY APPLIED COATING

The ends of existing factory applied mainline coating shall be inspected and chamfered. Disbanded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned. The adjacent chamfered areas of the line pipe coating shall also be cleaned and abraded, to expose a clean uniform fresh surface of uncontaminated factory applied coating.

Field joint coating shall be applied on the joints immediately after the completion of cleaning operation.

## 5.4 PREHEATING

Before placing the wraparound sleeve, the bare steel surface shall be preheated either with a torch moved back and forth over the surface or by induction heating. The minimum pre-heat temperature shall be as recommended by manufacturer and shall be checked by means of contact type temperature-recording thermometer at minimum four (4) locations uniformly spaced around the pipe circumference.

Temperature indicating crayons shall not be used.

Pre-heat temperature shall be checked on every joint. Care shall be taken to ensure that the entire circumference of the pipe is heated evenly. Temperature measuring instruments shall be calibrated immediately before the start of the works and thereafter at intervals recommended by the Manufacturer of the instrument.

## 5.5 APPLICATION OF PRIMER

Upon pre-heating, the pipe surface shall be applied with two pack epoxy primer of wet film thickness of 200 microns or as per manufacturer's recommendation whichever is higher, to cover the exposed bare metal of the welded field joint and 10 mm minimum on to the adjacent pipe coating if recommended by the manufacturer. The wet film thickness of the primer shall be checked on every joint with a wet film thickness gauge prior to installation of sleeve. Thickness gauge shall be calibrated once in a shift.

## 5.6 APPLICATION OF HEAT SHRINK SLEEVE

Immediately after application of epoxy primer, the wraparound sleeve shall be entirely wrapped around the pipe within the stipulated time recommended by the Manufacturer. Sleeve shall be positioned such that the closure patch is located on one side of the pipe at 10 or 2 O'clock position, with the edge of the undergoing layer facing upward and an overlap of minimum 50 mm. Gently heat by appropriate torch the backing and the adhesive of the closure and press it firmly into place.

A heat shrinking procedure using heating torch or induction heaters shall be applied to shrink the sleeve in such a manner to start shrinkage of the sleeve beginning from the center of the sleeve and heat circumferentially around the pipe. Continue heating from the center towards one end of the sleeve until recovery is completed. In a similar manner, heat and shrink the remaining side. Shrinking has been completed when the adhesive begins to ooze at the sleeve edges all around the circumference and change in the visual indicator other means provided on the backing material, to signify proper shrinkage, shall be complete and uniform.

The complete shrinking of the entire sleeves shall be obtained without undue heating of existing pipe coating and providing due bonding between pipe, sleeve and pipe coating. The installed sleeve shall not be disturbed until the adhesive has solidified.

## 6.0 INSPECTION AND TESTING

### 6.1 VISUAL INSPECTION

Visual inspection of the as applied coating shall be carried out on every joint, for the following:

- Mastic extrusion on either ends of the sleeve shall be examined



- There shall be no sign of punctures or pinholes or bend failure. The external appearance of the sleeve shall be smooth, free of dimples, air entrapment or void formation. All sleeves shall be tested for the presence of voids by knocking on the sleeves. A hollow sound compared to the remainder of the sleeve may indicate the presence of voids under the sleeve. Such sleeve shall be tested for adhesion at the discretion of the Company Representative.
- Weld bead profile shall be visible through the sleeve
- Visual indicator provided on the backing and the closure patch showing desired heat is achieved.

## 6.2 COATING THICKNESS

Coating thickness shall be checked by non-destructive methods for each field joint. Average thickness of the as-applied coating on pipe body shall be established based on measurements at min. eight locations i.e. four measurements on either side of the girth weld at 3, 6, 9 & 12 O'clock positions. To establish the minimum thickness on the girth weld, four measurements shall be taken on apex on the weld at 3, 6, 9 & 12 O'clock positions. All such measurements shall be recorded. Company representative reserves the right to ask for additional measurements at any location on the field joint coating, whenever doubt arises.

## 6.3 Holiday Detection

The entire surface of each joint shall be inspected by means of a full circle holiday detector approved by Company, set to a DC voltage applicable as per the requirements of factory applied mainline coating specification of Company. Inspection of the sleeves shall be conducted only after the joint has cooled below 50°C. The holiday detector used shall be checked and calibrated daily with an accurate DC voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

No field joint shall be covered or lowered in the trench until it has been approved by the Company.

## 6.4 Peel Strength Testing

**6.4.1** One out of every 50 joint coatings or one joint coating out of every day's production, whichever is stringent, shall be tested to establish the peel strength on steel and factory applied coating. Contractor shall carry out such testing in the presence of Company Representative.

**6.4.2** From each test sleeve selected as above, one or more strips of size 25mm x 200 mm shall be cut perpendicular to the pipe axis and slowly peeled off.

The required peel strength shall meet the requirements of this specification as applicable for (+) 23 °C or (+) 60 °C whichever is feasible. This test shall be conducted between wrapping & metal and mill coating & between layers at Overlap with joint coating (wherever applicable). After removal of strip, the bulk of adhesive shall remain adhered to the pipe showing no bare metal, otherwise, test shall be considered failed. The adhesive layer that remains on the pipe surface shall generally be free of voids resulting from air or gas inclusion. In case the peel strength test at a different temperature than that specified is warranted due to the ambient site conditions, then the peel strength shall comply the recommendation of the manufacturer. Manufacturer shall be asked to furnish peel strength values corresponding to various expected temperatures, prior to start of the works.

**6.4.3** If the sleeve does not meet the requirements of clause 6.4.2 the adjacent two sleeves shall also be tested. If the adjacent two sleeves are acceptable the test rate shall be increased to



one sleeve every twenty five until Company's Representative is satisfied. The test rate can then be reduced as per clause 6.4.1 at discretion of Company's Representative. If either or both of the adjacent two sleeves do not meet the requirements of clause 6.4.2, the field coating shall be stopped.

- 6.4.4** Company Representative reserve the right of 100% removal of sleeves if he is not convinced that the requirements of clause 6.4.2 are achieved.

## **7.0 REPAIRS**

- 7.1** If a field is detected to be unacceptable after testing as per section 6.0 of this specification the Contractor shall, at his own cost:

- Determine the cause of the faulty results of the field coating.
- Mobilize the expert of manufacturer, if required.
- Test to the complete satisfaction of Company, already completed field coatings.
- Stop the field coating works until remedial measures are taken against the causes of such faults, to the entire satisfaction of the Company.

- 7.2** Contractor shall replace all joint coating found or expected to be unacceptable as per section 6.0 of this specification.

- 7.3** Contractor shall, at his own cost repair all areas where the coating has been removed for testing by the Company.

- 7.4** After the coating work on welded joints and repainting to the coating have been completed the coating as a whole shall be tested with a spark-tester before lowering or jacking the pipeline.

- 7.5** Company shall be entitled to check the coating on buried pipelines or parts of pipelines with equipment such as the "Pearson Meter" and the resistance meter or during CP survey. If coating defects are established, the Contractor shall be responsible for excavation at such points, repairing the coating, spark testing and backfilling the excavations without extra cost to Company.

## **8.0 DOCUMENTATION**

### **8.1 PRIOR TO PROCUREMENT**

The Contractor shall furnish the following details for qualification of the heat shrink wraparound sleeve Manufacturer and the material, prior to commencement of procurement, for Company approval:

- Comprehensive information as per Section 5.2, DIN EN 12068 along with descriptive technical catalogues
- Test certificates and results of previously conducted tests, for all properties specified in this specification
- Reference list of previous supplies of similar material in the last five years, indicating the project name, pipeline diameter, operating temperature, year of supply, contact person and performance feedback

### **8.2 PRIOR TO SHIPMENT**

- The Contractor shall furnish the following documents, prior to shipment of the materials:
- Test certificates and results as per Manufacturer's quality control procedure for each batch

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of materials

- Specific application instructions
- Storage and handling instructions
- Recommended peel strength values corresponding to expected site conditions/ ambient temperatures.

**8.3 PRIOR TO FIELD APPLICATION** After successful qualification of field joint coating system and its application procedure, the Contractor shall submit a qualification report before commencement of production of field joint coating.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR HORIZONTAL DIRECTIONAL DRILLED CROSSINGS

VCS – SS – PP – 2013

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | Hk                                                                                   | GW                                                                                    |
| 03      | 04.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                          |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                         | Revision Description                                                                     |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Issued as Standard Specification                                                         |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                  | SK                                                                                    |                                                                                          |
| 01              | 21.02.2018    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Document formatting, Cover Page, Doc numbering updated from SS-PL-011 to VPC-SS-PL-0011) |
|                 |               | SHH                                                                                 | MC                                                                                  | AD                                                                                  | SK                                                                                    |                                                                                          |
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|                 |               | MB                                                                                  | SM                                                                                  | AD                                                                                  | SK                                                                                    |                                                                                          |
| 03              | 04.01.2022    |                                                                                     |                                                                                     |                                                                                     |                                                                                       | Revised as Marked                                                                        |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                    |                                                                                          |
| 04              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                      |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                    |                                                                                          |



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## **ABBREVIATIONS**

|       |                                            |
|-------|--------------------------------------------|
| ASME  | American Society of Mechanical Engineers   |
| API   | American Petroleum Institute               |
| OISD  | Oil Industry Safety Directorate (of India) |
| SMYS  | Specified Minimum Yield Strength           |
| PNGRB | Petroleum and Natural Gas Regulatory Board |
| SMYS  | Specified Minimum Yield Strength           |



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## 1.0 SCOPE

- 1.1. This specification covers minimum technical requirements related to various activities to be performed by an agency/ contractor entrusted with the responsibility to install pipeline at crossings (i.e., Major Rivers, Canals, Highways etc.) using Horizontal Directional Drilling (HDD) technique.
- 1.2. This specification shall be read in conjunction with the requirements of scope of work, all specifications, documents, drawings and other requirements included in the Contract between Company and Contractor.
- 1.3. Contractor shall, execute the work in compliance with laws, by-laws, ordinances and regulations. Contractor shall provide all services, labor, inclusive of supervision thereof, supply of all materials, (excluding "Company supplied Materials") equipment and appliances.
- 1.4. Contractor shall take full responsibility for the suitability and safety of all operations and methods involved in the work.
- 1.5. Contractor shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself as far as practicable with sub-surface conditions, hydrological and climatic conditions, the extent and nature of the work and materials necessary for the completion of the work, and the means of access to the work area.
- 1.6. Contractor shall be deemed to have obtained all necessary information with regard to risks, contingencies and all other circumstances, which may influence the work.
- 1.7. Contractor shall, in connection with the work, provide and maintain at his own costs all lights, guards, fencing, as necessary or directed by Company.
- 1.8. For the purpose of this specification, the following definitions shall hold:
  - The words 'Shall' and 'Must' are mandatory.
  - The words 'Should', 'May' and 'Will' are non- mandatory, advisory, or recommended.

## 2.0 REFERENCE DOCUMENTS

- 2.1 Reference has also been made in this specification to the latest edition (edition in force at the time of issue of enquiry) of the following Codes, Standards, regulations and Specifications.

### **AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons and other Liquids
- B 31.8 : Gas Transmission and Distribution Piping Systems

### **AMERICAN PETROLEUM INSTITUTE (API)**

- RP 1102 : Steel Pipeline Crossing Railroads and Highways

### **PNGRB REGULATIONS:**

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

### **COMPANY STANDARDS**

- VPC-SS-PP-2001 : Specification for Pipeline Construction (Onshore)
- VPC-SS-PP-2003 : Specification for 3 Layer Polyethylene Coating
- VPC-SS-PP-2014: Specification for Hydro Testing of Onshore Pipelines

**2.2** In case of conflict between the requirements of this specification and the above referred documents, the requirements of this specification shall govern.

## **3.0 DESIGN AND ENGINEERING**

- 3.1** The minimum requirements of limits of each river/ major water crossing shall be as defined in the CONTRACT drawings furnished by Company. Contractor may change the limits slightly to suit his equipment and installation technique, with prior written approval from Company.
- 3.2** Within the entire limits of crossing, as defined in the CONTRACT drawings, the cover to top of corrosion coated pipe shall be at least 2.5 meters below the "specified" minimum scour level profile for the river/ major water bodies with normal soil, and at least 1.5 meters below the "specified" minimum scour level profile for the river/ major water bodies with rock sub-strata.



**3.3** The entry and exit points of the pipeline at ground level shall not come within the limits of crossing as defined for individual river/ major water crossings.

**3.4** Wherever the drilled length for a river/ major water crossing includes the crossings of other obstacles such as roads, railroads, canals, streams, etc. Following minimum requirements of cover to the pipe shall be satisfied:

For Road Crossing : 1.2 m from top of road to top of pipe coating

For Railroad Crossing : 7 m from base of rail to top of pipe coating

For Canal/Stream Crossing : 1.5 m from lowest bed level to top of pipe coating

For Drainage Ditches at Road/Railroad : 1.2 m from bottom of ditch to top of pipe coating

**3.5** Contractor shall carry out calculations for determining the maximum permissible overburden on pipe, to check that the empty pipeline is safe from collapse at any point along the drilled crossing section. Drilled hole shall be checked against collapse/caving under overburden and pipe shall be checked against buckling/collapse under axial tension and bending stresses. Contractor shall submit these calculations to Company for approval.

### **3.6 Pipeline Axis**

As shown in the reference drawing at each crossing, the plane containing the pipe axis shall be perpendicular to the horizontal plane. There shall be no bending of longitudinal pipe axis at depths shallower than two meters below ground level.

**3.7 Back-reamed Hole and Pipeline Interface** For each crossing, Contractor shall devise a suitable combination of the following in order to optimize the crossing design in terms of pipeline stresses and pull force requirements.

- Back-reamed hole diameter
- Bentonite density
- Pipeline submerged weight in bentonite (and means to achieve that weight)

Contractor shall indicate the maximum shear stress in the pipeline coating that will result due to the above parameters and other design characteristics described in this section. Contractor shall furnish all calculations for Company's approval. If shear stress on pipe

coatings is, in the opinion of Company, beyond the permissible limits, Contractor shall revise the above parameters to reduce shear stress on pipe coating to permissible limits.

- 3.8** Contractor shall determine the minimum allowable elastic bend radius for the pipe from the following considerations:

**3.8.1 Pipeline Longitudinal Stress during Installation**

Total maximum longitudinal stress in the pipeline due to tension and bending at any location shall not exceed 90 % of the SMYS of the pipe material. Contractor shall, in order to check this requirement, evaluate the maximum tension forces to which the pipeline is subjected at any phase of its installation during the pulling operation.

**3.8.2 Pipeline Equivalent Stress during Final Hydrotest**

After installation, the pipeline shall be hydrostatically tested to a minimum test pressure equal to 1.5 times the design pressure for gas pipeline and 1.25 times the design pressure for liquid pipeline. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 90 % of the SMYS of pipe material.

**3.8.3 Pipeline Maximum Equivalent Stress during Service**

Permissible values of pipeline maximum equivalent stress during service shall be governed by the requirements of ASME B31.8/ B31.4, as applicable.

- 3.8.4** The minimum allowable radius of curvature for the pipeline shall be the highest value of the minimum pipeline elastic bend radius as computed from the considerations outlined as above (Para 3.8.1 thru 3.8.3) after correction for drilling inaccuracies or multiplication by the factor 1.85 whichever result in the highest permissible value of minimum elastic bend radius.

- 3.8.5** Contractor shall submit all calculations for Company's approval.

**3.9 Pipeline Configuration along the Supported String before Entry Point**

For each crossing, Contractor shall determine the required pipeline configuration in order to allow smooth pull in the crossing entry point and admissible stress in the supported pipeline string. Pipeline combined stress shall not exceed 90 % of the SMYS for line pipe material.

Contractor shall furnish all calculations and specify the number of required supports, description of the supports, their coordinates and capacity in metric tons. Contractor shall also furnish a drawing of the launching ramp indicating the pipeline configuration. The

distance between each roller shall also be specified. Calculations for roller in this respect shall be submitted.

- 3.10** Contractor shall, based on results of design and engineering carried out by him, prepare construction drawings for each river/ major water crossing and shall submit the same for Company's approval. Construction drawings shall indicate the pipeline profile with levels furnished at sufficient intervals for proper control during construction. Other relevant details viz. entry and exit angles, radii of bends, etc. shall also be indicated. Contractor shall also calculate the total length of pipeline required as well as the maximum tension required on the pull head of the rig. All construction works shall be carried out in accordance with the construction drawings approved by Company
- 3.11** Before commencement of any field work, Contractor shall furnish for Company approval all design calculations as stipulated in Para 3.5, 3.7 thru 3.10 above and all construction drawings. Company shall inform Contractor within 21 calendar days of receipt of such calculations/drawings/data, of its comments/clarifications, if any on the same. Contractor shall incorporate the comments, if any and resubmit the documents for Company approval.

## **4.0 CONSTRUCTION**

Contractor shall comply with all the conditions and requirements issued by Authorities having jurisdiction in the area where the work is to be performed. If no public road exists to the crossing location, Contractor shall arrange on his own for access to his work area at no extra cost to Company.

### **4.1 Installation Procedure**

Contractor shall, before commencing any work at site, submit for Company's approval a detailed installation procedure for each river/ major water crossing.

- a) Project Organization Chart indicating Contractor's organizational set-up at site and manpower deployment
- b) Preparation of fabrication yard and launching areas
- c) Details of all equipment to be deployed for preparation of pipe string and installation of crossing. Technical characteristics and capacity of each equipment including instrumentation, monitoring and control equipment shall be furnished in details.
- d) Pipeline string preparation details (hauling, stringing, welding, etc.)
- e) Method of installation covering all steps of construction, viz. rig

up, Calculations for maximum pulling force on the rig and recommended maximum pulling speed and rig anchoring.

- f) Hole collapse and pipe buckling calculations
- g) Pre/post-installation hydrostatic test procedure.
- h) Cold field bending and tie-in details.
- i) Time schedule for construction

Company shall inform Contractor within 21 calendar days of receipt of above installation procedure, of its comments/clarifications, if any, on the same. Contractor shall incorporate the comments, if any and resubmit the documents for Company approval.

The time schedule shall be in accordance with overall time schedule for the project.

Approval by Company of the methods used by Contractor shall in no way relieve the Contractor from the sole responsibility for safe and satisfactory installation of the crossing.

## 4.2 ROU Preparation

The Contractor is required to perform his construction activities within the width of ROU set aside for construction of pipeline, unless he has made other arrangements with the land owner and/or tenant for using extra land.

Contractor shall clear and grade the length of ROU required for installation of on land portion and drilled river-crossing portion in his scope. Contractor shall do such grading on ROU to provide access to the pipeline construction and to ensure safe construction of pipeline.

Contractor shall ensure that his construction activities shall neither cause inconvenience to public nor shall there be any undue interference with the normal use of the land and watercourses. Minimum necessary trees on ROU to be cut/ felled shall be identified, permissions obtained, recorded and record shall be handed over to Company. The ROU clearing and grading operations shall in no case involve damages/changes of embankment/structures of any type and class without prior approval of the authorities having jurisdiction over the same.

## 4.3 Taking-over, Handling, Hauling, Storing and Stringing of pipes and other materials

### 4.3.1 Contractor shall receive and take-over against requisition bare/corrosion coated

line pipes from Company's designated place(s) of issue, as defined elsewhere in the CONTRACT. Contractor shall be fully responsible for the pipe and pipe identification marking from the time of taking delivery from the Company, until such time that the pipes are installed in permanent installation.

**4.3.2** Contractor shall perform visual inspection of the bare pipes and coating of the corrosion coated pipes in the presence of Company Representative and all damages shall be recorded. In the case of corrosion coated pipes, Contractor at his option may carry out holiday detection at a prescribed set voltage and record such holidays, in the presence of Company Representative at the time of "taking over". However, if Contractor proposes to perform only visual inspection of coating, then the repair of all the holidays found at the time of installation shall be carried out by the Contractor at no extra cost to Company.

**4.3.3** Contractor shall perform visual inspection of the bare pipes and coating of the corrosion coated pipes in the presence of Company Representative and all damages shall be recorded. In the case of corrosion coated pipes, Contractor at his option may carry out holiday detection at a prescribed set voltage and record such holidays, in the presence of Company Representative at the time of "taking over". However, if Contractor proposes to perform only visual inspection of coating, then the repair of all the holidays found at the time of installation shall be carried out by the Contractor at no extra cost to Company.

The Contractor shall be entitled for extra compensation for repair and rectification of defects recorded at the time of taking delivery as per the rates set forth in the 'Schedule of Rates'. Repair of all damages beyond such record shall be the Contractor's responsibility at his cost. Contractor shall be fully responsible for arranging and paying for all/ any storage areas.

**4.3.4** Materials which are susceptible of deteriorating or suffering from damages especially due to humidity, exposure to high thermal excursions or adverse weather conditions, shall be suitably stored and protected. Deteriorated materials shall not be used and shall be replaced with no extra cost to Company.

#### **4.4 Pipe String**

Complete pipe string shall be prepared as a single string for pulling.

#### **4.5 Repair of Pipe Corrosion Coating**

Repair of pipe corrosion coating shall be carried out by Contractor as per relevant specification included in the CONTRACT

#### 4.6 Lining-Up

Each length of pipe shall be thoroughly examined internally and externally to make sure that it is free from visual defects, damage, severe corrosion, dirt, animals, or any other foreign objects. Each length of the pipe shall be adequately swabbed, either by use of canvas belt disc of proper diameter, compressed air blowing or by other methods approved by the Company. Damaged/corroded pipes shall be kept separate. Each length of pipe shall be examined/ cleaned by pulling through just before being welded.

#### 4.7 Pipe Defects and Repairs

It is Contractor's responsibility to repair all internal and/or external defects. Immediately prior to aligning pipe for welding, the beveled ends of each joint of pipe and the area immediately adjacent thereto (at least 25mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign matter by use of power driven wire buffing wheels, disc sanders, or by other methods approved by Company. This shall be done at no extra cost.

All damaged ends of pipes that are bent, cut or otherwise mutilated such that, in the opinion of the Company, faulty alignment or unacceptable welding would result, shall be repaired or cut-off and relevelled to the correct angle with a beveling machine of a type approved by Company.

Dents in bevels with a depth of less than 1 mm shall be removed by Contractor during cleaning and grinding, ahead of the welding in the field at no extra cost. Contractor shall rebevel dented bevel ends with a depth of dent between 1 mm and 3mm. Dents over 3mm depth shall be repaired by cutting and rebeveling.

#### 4.8 WELDING

Welding of the Pipeline shall be in accordance with Welding Specification and Welding Specification Charts included in the Contract.

#### 4.9 CORROSION COATING OF FIELD WELD JOINTS

The complete field joint shall be blast cleaned to near white metal finish to Swedish standard SIS 055900 Grade SA 2½. The coating edges shall be suitably roughed and chamfered to provide smooth transition. The joint coating material shall be Raychem's "DIRAX" or another Company approved equivalent. The

method of application shall be strictly as per manufacturer's recommendations and will be subject to Company approval prior to use. Coating of field weld joints shall be carried out after pre-installation hydrostatic testing.

#### **4.10 Installation**

- 4.10.1** Installation shall be carried out in accordance with approved installation procedures. The entire drilled crossing shall be accomplished in a single operation.
- 4.10.2** Contractor shall ensure that the type of cutting tools and drilling fluids mobilized at site is suitable for the sub-soil strata at the drilling location.
- 4.10.3** Starting of any drilling activity is subject to approval from Engineer-in-Charge based upon the inspection of the rig capacity, number of drilling pipes and other accessories mobilized at site to ensure that the capacity of equipment is in accordance to the approved design document and/ or profile drawings to execute the work successfully.
- 4.10.4** Tracking and locating equipment shall be calibrated by the Contractor in presence of Engineer-in-Charge before the start work. Contractor shall continuously monitor the drilling path, entry & exit angle including depth of profile to ensure that pilot hole drilling is being carried out as per approved profile drawing. The as-drilled pilot hole profile drawing shall be verified by Engineer-in-Charge.
- 4.10.5** The lateral offset of the actual exit point of the pilot hole from the calculated and theoretical exit point shall not exceed two percent of the length of the crossing; however, the actual exit point shall not come outside the ROU limits of the pipeline. The length tolerance shall not exceed one per cent of the crossing length, subject to the condition that the actual exit point shall not be within the limits of crossing as defined in the Contract drawings/ documents.
- 4.10.6** Back reaming shall be done separately from the pipeline pulling operation. The size of the back-reamed hole shall be adequate (approximately 1.5 times the pipeline diameter) to allow enough clearance for smooth pullback of the pipeline.
- 4.10.7** Contractor shall be responsible for maintaining the drilled hole till such time the pipeline is pulled in.
- 4.10.8** During pulling operation, the buoyancy of the pipeline shall be controlled by suitable approved methods so as to maintain the buoyancy as close as possible to zero during pull-back in order to reduce friction forces of the pipeline in the hole.

Bentonite slurry of specified viscosity shall be pumped into the hole, preventing the wall from collapsing and protecting the pipeline coating.

**4.10.9** Contractor shall provide free of charge reasonable facilities to Company's personnel to witness all stages of construction.

**4.10.10** Contractor shall be responsible for the integrity of the corrosion coating.

**4.10.11** Contractor shall be responsible for the integrity of the common coating and shall apply and necessary approved protective coatings:

Coating inspection of the pipeline after completion of pulling operation shall be made by:

- a. Pulling the pipe to the extent possible with normal rig set up at the exit point.
- b. Excavating the adjacent portion up to and including the first field joint at the exit point.

The pipeline and joint coating shall be examined visually and with holiday detectors for defect. The length to be inspected shall, as a minimum, be one pipe length and one joint coating. In case damages/ holidays are detected in the first pipe length/ joint, the subsequent pipe length/ joint shall be exposed and coating integrity checks shall be made. If found acceptable by Company, the first pipe length/ joint shall be repaired and/ or replaced as directed by Company. If the coating of second pipe length/ joint is also found damaged, Contractor shall propose further course of action and Company's instructions shall be followed. All works shall be done at no extra cost to Company.

**4.10.12** Before final hydrostatic testing, Contractor shall 'prove' the diameter of the pipeline by passing a gauging pig through the pipeline. The gauging pig shall have a diameter equal to 95% of the nominal internal diameter of the pipe. Contractor shall supply and install all temporary headers and other equipment, piping and materials and consumable for the purpose.

#### **4.11 Protection of Underground Utilities and Special Methods**

Contractor shall obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and be responsible for location and protection of the same.



Where the pipeline crosses other underground utilities/structures, Contractor shall first manually excavate to a depth and in such a manner that the utilities/structures are located. Should any damage to any structure/utility etc. occur, the Owner/Authority concerned shall be contacted by the Contractor and repair shall forthwith be carried out by the Contractor at his expense under the direction and to the satisfaction of Company and the concerned Owner/Authority.

Temporary underpinning or any other type of supports and other protective devices necessary to keep the interfering structure intact shall be provided by the Contractor at his own cost and shall be of such design as to ensure against their possible failure.

#### **4.12 Bending**

After pulling the pipeline across the drilled crossing, Contractor shall cut the extended portion of the pipeline at the entry and exit points. Thereafter, the drilled portion of the pipeline shall be cut at suitable location/ depth and extended on either bank by installing a cold field bend and a straight pipe length of 12 meters (one joint), such that the top of the pipeline is minimum 1.0 meter below the natural ground level.

The cold field bend shall be with minimum bend radius of 21 times the pipe diameter for pipe sizes 12" and below, 30 times the pipe outside diameter (OD) for pipe sizes 14" and 16" and 40 times the pipe diameter for pipe sizes 18" and above as applicable, unless specified otherwise.

Contractor shall use a bending machine and mandrel (if required) and employ approved and accepted methods of bending of coated pipe in accordance with good pipeline construction practice. The procedure shall include amongst other steps- lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend.

Cold field bends made from coated pipes shall be inspected visually and by holiday detector to locate damages, which shall be repaired by Contractor as per Company's approved Procedures.

The ends of each bent pipe length shall be straight and not involved anyway in the bending. In no event shall the end of the bend be closer than 1.5 meter from the end of a pipe or within one meter of a girth weld.

The ovality of the bent pipe shall not exceed 2.5% of the nominal diameter at any point. A check shall be performed on all bends in the presence of Company by passing a gauge consisting of two discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly together at a distance equal to 300 mm. Miter bends are not permitted.

## **4.13 Hydrostatic testing**

### **4.13.1 Pre-Installation Hydrostatic Testing**

Contractor shall hydrostatically test the complete pipe string of each river crossing before installation as per approved procedure.

The section of the pipeline corresponding to the crossing shall, before installation, be subjected to a minimum hydrostatic test pressure equal to 1.5 times design pressure for gas pipeline and 1.25 times design pressure for liquid pipeline. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of the pipe material.

After the temperature has been stabilized, the pressure shall be maintained in the pipeline for at least six hours and recorded by manothermograph. During the test, Contractor shall check all welds for leakage. Failure, if any, during the test shall be rectified by the Contractor. If the same is due to failure on account of any cause other than defect in Company supplied material, the repairs shall be done free of cost, to the satisfaction of Company.

### **4.13.2 Final Hydrostatic Test**

The complete water crossing shall be tested after installation. The pressure shall be the same as that specified for pre-installation hydrostatic test at Para 4.13.1 above. The combined equivalent stress in the pipeline due to bending, static head and test pressure shall not exceed 95% of the SMYS of the pipe material. After temperature stabilization, test pressure shall be maintained in the pipeline for a minimum twenty four (24) hours and recorded by manothermograph. The hydrostatic testing shall be carried out in accordance with approved procedures.

### **4.13.3 Test procedure**

Contractor shall prepare for Company's approval a hydrostatic test procedure manual for pre-testing and post-installation testing of pipeline. The test procedure manual shall include, but shall not be limited to, the following items:

- a. For the pipe section to be tested, a diagram indicating all fittings, vents, valves, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.
- b. Estimated amount of test water, water source, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection and control of concentration.
- c. Filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares), their location and set-up.
- d. The type and sequence of pigs and the pig tracking system for cleaning and removal of air pockets, pig inspection procedures, including procedure to be followed in case the gauging pig indicates damage.
- e. Procedures for levelling and stabilization after filling and for pressurization and to allow for temperature stabilization.
- f. Pressure testing procedure including a complete description of all proposed equipment and instruments (including spares), their location and set-up, and proposed system for observation and recording of data during the pressure test.
- g. All calculations including air-volume calculations and pressure change due to temperature change calculations.
- h. Procedure for detection and location of leaks.
- i. Procedure for safe dewatering the pipeline section after testing, including a complete description of all proposed equipment and instruments (including spares), their location and set-up, the type and sequence of pigs and the pig tracking system along with the pig specifications.
- j. Forms for recording the testing data.

**4.13.2** Contractor shall furnish all necessary equipment & instrumentation for performing the work including all temporary piping, hydro test header and pigging headers etc.

**4.13.3** The test medium shall be fresh water to be arranged by the Contractor. The water to be used shall be filtered, shall not be contaminated, and free from sand or silt. Contractor shall submit laboratory test reports of water used for testing. Contractor shall provide Company approved corrosion inhibitors, oxygen scavengers and bactericides to be added to

the test water. Contractor shall furnish and install all temporary piping, which may be necessary to connect from source of water to its pumps and manifolds/tankage.

**4.13.4** Before filling operation, Contractor shall clean the pipeline by air driven pigs provided with spring loaded brushes and cups to remove all mill scale, rust/sand from the internal of pipe sections.

**4.13.5** The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for changes due to temperature effects, and there is no abrupt pressure drop throughout the test duration.

If test section fails to maintain the specified test pressure after isolation, Contractor shall determine by searching the location of leakage or failure. All leaks and failures within the pipe wall or longitudinal seam shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In those cases where leaks occur in circumferential welds the method of repair shall be determined by Company. Contractor shall comply with instructions of the Company whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should, however, meet the requirements of welding specification contained herein. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per the approved procedures.

**4.13.6** All work of reinstating line pipe, to replace failures, shall be done in accordance with the specifications contained herein.

Contractor shall haul and stockpile all damaged and defective pipes to storage locations designated by the Company. All cracks and splits resulting from failures shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joints of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred.

**4.13.7** After completion of successful hydrotest of the above portion, the pipeline shall be capped and buried. Pipeline end position on the banks shall be marked on the ground by installing location markers on both banks approved by Company.

#### **4.14 Permanent Pipeline Markers**

On both banks of each river/ major water crossing, Contractor shall install a Navigable Waterway Pipeline Crossing Warning Sign in accordance. Contractor shall supply all materials and fabricate and install the markers as per reference

drawing. Wherever feasible, the pipeline markers shall be installed on the embankments, however, exact location shall be decided based on site conditions and as directed by company.

#### **4.15 Fencing**

Wherever specified, Contractor shall supply all materials and install G.I. Wire Chain link security fencing of size 10m x 10m x 2.5m high with lockable steel gate around the pipe ends and test stations for temporary C.P. on both sides of each river/ major water crossing.

#### **4.16 IDLE TIME PRESERVATION OF PIPELINE**

When so stated in the Contract, Contractor shall supply all materials and consumable including water and inhibitor and shall install all piping connections, valves, instrumentation, etc., and perform all works for preservation of pipeline by pressurization with inhibited water. Contractor shall use approved inhibitors and shall determine the required dosages of inhibitors and pressure for idle time preservation of the pipeline for a period of maximum six months from the date of completion of construction. Corrosion inhibitors and dosages shall be subject to Company's approval prior to use.

#### **4.17 FINAL CLEAN UP**

After completion of construction, Contractor shall clear the sites of all balance material and debris. All balance pipe lengths supplied by Company shall be returned to Company's designated stock yard(s), as defined elsewhere in the Contract. Site shall be cleared to the complete satisfaction of Company and authorities having jurisdiction. All such works shall be done at no extra cost to Company. On completion of clean-up, the ROU shall be restored to such stable and usable conditions as may be reasonably consistent with conditions of the ROU prior to laying/ installation of the pipeline.

#### **4.18 Disposal of surplus soil & bentonite slurry & corrosion inhibited test water**

Contractor shall arrange for safe disposal of all surplus soil and bentonite slurry & corrosion inhibited test water so as to avoid any harm to the environment/ occupants at locations duly approved by authorities and pollution control boards having jurisdiction and/ or as instructed by Company without any extra cost.

## 5 DOCUMENTATION

In addition to the documents specified elsewhere in this specification, Contractor shall submit the following documents/ records to Company.

Complete record of pipes 'taken-over' from Company, number of pipe lengths used, and record of return of balance pipe lengths to Company's designated stock-yard(s).

During the course of execution of the crossing, Contractor shall generate/compile the following data and furnish the same whenever required to Company in hard copies and electronic files.

- a. Detailed drilling log and downhole data, including, but not limited to, the following:
  - i) Torque and pulling/pushing force
  - ii) Data on drilling fluid.
    - Density
    - Type of mud and additive employed.
    - Mixing, pumping and cleaning.
- b. Wash and drill pipe data, viz.
  - i) Dimension and material properties.
  - ii) Data on API classification.
  - iii) Age of and type of inspection previously carried out on these pipes.
- c. Permits obtained from authorities having jurisdiction for the various works.
- d. Plan & profile of the drilled hole along with the water level variations.
- e. Records of hydrostatic pre-testing and final testing.
- f. Record of Non-Destructive Testing of welds.
- g. Clearance certificates from the landowners and Authorities having jurisdiction regarding satisfactory clean-up and restoration of pipeline Right of Way and work areas

After completion of construction, Contractor shall prepare and furnish As-Built drawings for the crossings. As built drawings shall, as a minimum include the following information:

- True profile of the river bed and banks along the pipeline;

- True profile of the pipeline as installed and the depth of cover to top of pipe at regular intervals;
- Location of entry and exit points and angles of entry and exit, along with lateral offset of exit point from the original pipeline alignment;
- Location and angle of field bends; Location of pipeline markers.

All As-Built drawings shall be prepared using software AutoCAD or above. Manually drafted drawings are not acceptable to Company. In addition, to the hard copies, as built drawings shall also be submitted in electronic media i.e., CD/ DVD.

All documents shall be in English language.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR HYDROSTATIC TESTING OF ONSHORE PIPELINES

VCS- SS – PP -2014

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
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| 03      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 02      | 04.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                                                       |
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| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                         | Revision Description                                                                                                  |
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| 03              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                   |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                    |                                                                                                                       |

## **ABBREVIATIONS**

|      |   |                                            |
|------|---|--------------------------------------------|
| ASME | : | American Society of Mechanical Engineers   |
| API  | : | American Petroleum Institute               |
| OISD | : | Oil Industry Safety Directorate (of India) |
| SMYS | : | Specified Minimum Yield Strength           |

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## 1.0 SCOPE

- 1.1** This specification covers the minimum requirements of supply and various activities to be performed by Contractor for hydrostatic testing of cross-country steel pipelines transporting hydrocarbons in liquid or gaseous phase under high pressure.
- 1.2** This specification shall be read in conjunction with scope of work, specifications, documents, drawings and other requirements indicated in and included in the Contract between the Company and the Contractor. Unless specified otherwise, all sections of this specification shall apply to all specifications referred in this specification

## 2.0 REFERENCE DOCUMENTS

- 2.1** The latest edition of following Codes and Standards are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B 31.4 : Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
- ASME B 31.8 : Gas Transmission and Distribution Piping Systems.
- ASME Sec. VIII Div. 1 : Boiler and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

### AMERICAN PETROLEUM INSTITUTE (API)

- API RP 1110 : Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide.

### PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL: Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

- 2.2** In case of conflict between the various requirements of this specification and reference codes, standards, regulations and specifications mentioned above, more stringent requirement shall govern.

### **3.0 GENERAL REQUIREMENT**

- 3.1** The Contractor shall ensure that the complete pipeline section undergoing hydrostatic test is mechanically complete in all respects, i.e welds have been accepted and the pipeline has been laid and backfilled, all mechanical and civil works completed. This has to be ensured keeping in view that, Once the section has been hydrotested, no one shall be authorized to re-open the pipeline section without prior approval of the company. Hydrostatic test shall include those sections which have been previously tested viz. Rail/ road crossings, major water crossings including test on banks and in place after installation.
- 3.2** Hydrostatic test shall be performed on the entire length of the pipeline in accordance with approved Hydrostatic Test procedure and Diagrams clearly indicating the number of test sections and minimum and maximum test pressures in each test sections. The maximum length of each test section shall not exceed 50 Kms.
- 3.3** For pipeline sections (i.e. River Crossing, Railway Crossing, HDD Crossing, National Highway Crossing, etc.) which in Company's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be conducted. However, after installation, such pre-tested sections shall be tested again along with the entire pipeline.
- 3.4** All works required for hydrostatic testing shall start only after obtaining prior approval from the Company.
- 3.5** The hydrostatic pressure testing operations shall be carried out by an experienced Test Engineer who shall have no other duty during the hydrostatic testing operations. The Test Engineer(s) shall be in full charge of all activities related to hydrostatic testing operations.
- 3.6** All headers, pre-test headers along with fittings, flanges and attachments shall be pre-tested before putting these for testing purpose.

### **4.0 TEST PROCEDURE**

The Contractor shall submit a comprehensive hydrostatic test procedure to the Company for approval. The procedure shall also include all temporary materials and equipment to successfully complete hydro testing, but not be limited to the followings:

- a) A diagram for the system to be tested, indicating all fittings, vents, valves, temporary connection, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.
- b) A diagram indicating the lengths, elevation charts, and locations of the test sections.
- c) Pipeline details of the test section pipe diameter, wall thickness and material

- d) Source of water for testing and test water discharge location for each test section
- e) Estimated quantity of water for filling and pressurizing
- f) Details of chemicals/ inhibitors and the dosage
- g) Cleaning, gauging, flushing, and filling procedures including type and number of pigs, details of gauging pig.
- h) Procedures for Pig Tracking System (which shall be used in case of pig getting stuck inside pipeline).
- i) Procedures for location and rectification of dents/ buckles/ other deformation, etc.
- j) Temperature stabilization procedure.
- k) Pressure testing procedure including all calculations and test section isolation details.
- l) Procedure for detection, location and rectification of leaks.
- m) Safety precautions and procedures.
- n) Repair procedures for coating damage at thermocouple locations.
- o) Formats to be used for recording the test data.
- p) Procedure for dewatering and neutralization of corrosion inhibitor of the pipeline sections(s) after testing.

The Contractor shall not commence hydrostatic testing activities until the testing procedure is approved.

## 5.0 SAFETY PRECAUTIONS DURING THE HYDROTEST

The Contractor shall take all necessary safety precautions during the hydrotest. As a minimum, the following shall be taken during the hydrostatic test:

- a) Provision shall be made for the installation of no-admittance signs to unauthorized personnel from the roads to the R.O.U.
- b) Warning signs stating 'PIPELINE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps/ test headers and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel and no unauthorised personnel shall be closer than 40 m to the testing equipment or pipeline under test. Warning tapes and signboards shall also be placed near the crossings and regular intervals along the route to warn the public around those areas.
- c) The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.

- d) Once dewatering is over the sectionalizing valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications.
- e) All thermocouples installed in the pipeline shall be removed and damage corrosion coating shall be repaired using Company approved materials and procedure.

## 6.0 TEST PRESSURE AND DURATION

### 6.1 TEST PRESSURE

Unless otherwise specified in the Contract, the minimum hydrostatic test pressure for different classes shall be as follows:

For pipeline handling hydrocarbon in gaseous phase:

|                     |   |                                                 |
|---------------------|---|-------------------------------------------------|
| Class 1             | : | 1.25 times the design pressure as per ASME 31.8 |
| Class 2             | : | 1.25 times the design pressure as per ASME 31.8 |
| Class 3 and Class 4 | : | 1.5 times the design pressure as per ASME 31.8  |

For pipeline handling hydrocarbon in liquid phase:

|              |   |                                                                                                             |
|--------------|---|-------------------------------------------------------------------------------------------------------------|
| All Location | : | 1.25 times the design pressure for pipeline<br>Handling liquids including Liquefied<br>Petroleum Gas (LPG). |
|--------------|---|-------------------------------------------------------------------------------------------------------------|

The test pressure shall be generated at the highest point in the section under test. At any point in the test section, hoop-stress due to test pressure and static head shall not exceed 95% of the Specified Minimum Yield Strength (SMYS) of pipe material.

### 6.2 TEST DURATION

The duration of the hydrostatic test shall be 24 hours after thermal stabilization.

## 7.0 EQUIPMENT AND INSTRUMENTATION

The Contractor shall provide all necessary equipment and instrumentation for performing the work as stated in cleaning, flushing, filling, stabilizing, testing, dewatering procedures.

### 7.1 EQUIPMENT

The equipment to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Pigs for cleaning, gauging, flushing and filling.

Cleaning pigs with spring loaded steel wire brushes. For internally coated pipes, the pigs shall be provided with nylon/polyurethane brushes. . The first Cleaning pig shall be equipped with pig tracking device with a minimum battery span of 72 hours.

•

- Four cup batching pigs / Bi Directional Pigs
  - Magnetic Pigs
  - Gauging pigs fitted with gauge plate.
- b) The Contractor shall provide a sufficient number of pigs, including spares Fill pumps:
- The Contractor shall determine the type and number of fill pumps in order to guarantee the following:
- Differential head : 20% greater than the maximum required
  - Flow rate : Minimum ~~400~~ 200 m<sup>3</sup>/hr; Maximum ~~1000~~ 500 m<sup>3</sup>/hr for 24" and above pipeline.
- : Minimum ~~200~~ 100 m<sup>3</sup>/ hr; Maximum 400 m<sup>3</sup>/ hr up to 18" Pipeline
- If a single pump is used, a standby unit must be available.
- c) Pressurizing pump:
- Variable speed positive displacement pumps equipped with a stroke counter to pressurize the pipeline, capable of generating pressure of 20 bar (g) over and above the required test pressure of the section. Contractor shall also ensure availability of standby pressurizing pump.
- d) Two Positive displacement meters/ Turbine meters to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than three months.
- e) Portable tanks/ Break tanks of sufficient size to provide a continuous supply of water to the pump during filling and pressurizing.
- f) Injection facilities to inject chemicals/ inhibitors into the test medium in the required proportions.
- g) The temporary test header shall be installed at both ends of section. Proper piping and valving arrangements shall be available to allow launching and receiving of each pig independently

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2 with particular reference to Appendices 4 and 5.

## 7.2 INSTRUMENTATION

The instrumentation to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Calibrated Bourdon pressure gauges of suitable pressure range and accuracy.
- b) Dead weight testers with an accuracy of 0.01 bar, measuring with least count of 0.05 bar and provided with a calibration certificate not older than three months.



- c) 48 hours recording pressure gauges complete with pressure recording charts duly tested with dead weight tester prior to use. These shall be installed at the test head. The gauge shall having following specification:

Accuracy :  $\pm 0.1\%$  of the full-scale value

Recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

Recording : Range to be such as to record pressure between 50% and 90% of the diagram width

- d) Temperature recorders for fill water.

Accuracy :  $\pm 1\%$  of the scale range

Scale -10 °C to +40 °C

recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

- e) Environmental temperature shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer featuring the following characteristics:

Accuracy :  $\pm 1\%$  of the scale range

Scale - 0 °C to + 60 °C

Recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

- f) Thermocouples for measuring the pipe wall temperatures, with an accuracy of  $\pm 0.1$  °C

- g) Two laboratory thermometers of range 0 °C to 60 °C and with accuracy of  $\pm 0.2$  °C to be used in thermo wells.

- h) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container with scales or graduated cylinder).

- i) Injection facilities to inject additives into the test medium in the required proportions.

- j) Communications equipment stable for a continuous connection between the beginning and the end of test section and with the inspection team along the line, in accordance with the requirements of local authorities.

- k) The temporary scraper traps shall be installed according to the test section fixed in the test procedure manual. Proper piping and valve arrangements shall be available to

allow launching and receiving of each pig independently.

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2.

l) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested at the following locations:

- One (1) thermocouple at about 500 m distance from the pumping head.
- One (1) thermocouple every 2500 m of the pipe. The spacing may be increased to maximum 5000 m depending on the terrain and nature of sub soil along the alignment of test section.
- One (1) thermocouple at about 500 m distance from the terminal head

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected by padding with minimum 500 mm soil. After successful testing, the thermocouples shall be removed and damaged coating shall be repaired as per applicable coating repair procedure, approved by Company. For soil temperature measurements, the thermocouple shall be buried at pipe centerline depth at a distance of 500 mm from the pipe wall.

m) Digital pressure/ temperature monitoring and chart recording systems can be used in lieu of the components listed above provided that the individual pressure/ temperature sensors included in the system have a level of accuracy and can be field calibrated in a manner similar to those instruments listed above. Instruments shall be portable and rugged in construction with minimum weather proof rating of IP-66. They shall display pressure and temperature readings on the screen and shall have adequate memory for recording the same. The instrument shall have computer interface to export the stored data after completion of test.

## 8.0 HYDROSTATIC TESTING

**8.1** Equipment and/ or parts which need not or must not be subjected to the test pressures or which must not be tested with water, must be disconnected or separated from the pipeline to be tested.

**8.2** If the difference of minimum and maximum atmospheric temperature should cause thermal instability on the pipe section directly exposed to atmospheric condition, the test header and above ground pipeline shall be properly protected.

The pipeline test shall exclude long segments of line exposed to atmospheric conditions, viz. aerial lengths on piers, suspension bridges, etc. Such sections shall be tested separately.

## 8.3 TEST MEDIUM

The test medium shall be soft non-aggressive water supplied by the Contractor. The water to be used shall be filtered, shall not be contaminated and free from sand or silt. Contractor shall submit laboratory test reports of water used for testing. The possible use of sea water shall be subjected to its degree of cleanness, the possibility of obtaining a pre-determined salinity neutralization. The

Contractor shall furnish and install all temporary piping, which may be necessary to connect from source of water to its pump and manifolds/ tankages.

#### 8.4 INHIBITORS

Contractor shall provide Company approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water.

Contractor shall note the following:

- All chemicals for hydro testing shall be procured from approved vendors. Chemicals older than three months shall not be used.
- Company representative shall inspect the chemical containers and take random samples prior to its use. Contractor shall get the samples tested in a govt nominated Govt./PSU/other competent laboratories. Contractor shall get the samples tested, testing shall be carried out for accelerated % corrosion inhibition efficiency, % SRB and TBC killing efficiency test. Company reserves the right to witness the testing. The test report shall be submitted to Company for approval prior to undertaking hydro testing works.
- Only those chemicals which have passed the above tests shall be used for hydro testing.
- Chemicals shall be injected by dosing pump only and mixing in open tank shall not be allowed.

Inhibitors shall be uniformly mixed with the test water in the dosage recommended by the Manufacturer depending upon the water used and in sufficient concentration to ensure the inhibitor remains active for the duration of the test, and any possible delays to testing.

The following products are acceptable for corrosion inhibition of the water used for hydro testing:

- REMIDOL 4000 of M/s Chemtreat India Ltd., Navi Mumbai.
- HIBITOL 2000 of M/s Renkal Chemical, Navi Mumbai.
- INDION 175 of M/s Ion Exchange India Ltd., Hyderabad.
- VISCO 3900 of M/s NALCO EXXON

Indicative dosage for inhibitor is as follows:

- |                  |   |          |
|------------------|---|----------|
| • Upto 6 months  | : | 500 mg/l |
| • Above 6 months | : | 750 mg/l |

However, the exact dosage rates shall be as per the hydro test water analysis and manufacturer recommendations.

#### 8.5 CLEANING

Before filling operation, the Contractor shall clean the pipeline by air driven pigs

provided with spring loaded nylon/polyurethane brushes for internal coated Pipes & wire brush cleaning pigs for internal uncoated pipes to remove all mill scale, rust, sand, etc. from the inside of pipe section. For this purpose, temporary headers for air cleaning shall be attached to the pipeline. The number of pig runs depends upon the cleaning results and shall be determined by the Owner/Consultant at site.

Water column of 1- 2% of test section shall be injected in front of the first cleaning Pig for flushing.

## 8.6 Magnetic Pigging

After the successful acceptance of cleaning, Magnetic pig run shall be used to clean "constructional metallic debris" of the pipeline.

For internally coated pipes, adequate care shall be taken by using soft cups so that no damage takes place to the internal coating of the pipe.

Contractor shall decide the number of magnet cleaning pig runs and the choice of the magnet cleaning pig for each cleaning run as suitable for the purpose to obtain internal condition adequately clean.

However, the ferrous debris permitted with magnetic cleaning pig shall not exceed 5 Kg/100KM. In case debris received is more than this amount, the Contractor shall be required to make subsequent run(s) until at least the above limit is achieved.

The cleaning pigs for successive cleaning pig runs shall be selected by the Contractor in such a manner that effective cleaning i.e. 3kg/100km ferrous debris is achieved.

The best accuracy offered and guaranteed by the Contractor shall be clearly spelt out. However, the tool should have minimum capabilities as under.

**Type of pig:** Uni-directional

**Magnet power:** Min 800 gauss

**Nos. of magnets:** 8/6 nos.

**Min. bend radius pig can negotiate:** 6D

**Min dia pig can negotiate:** 90% standard wall thickness ID

## 8.7 GAUGING

After cleaning the pipeline by using air and acceptance by Company, gauging shall be carried out by using gauging pig. The gauge plate diameter shall be equal to 95% of inside diameter of the heaviest wall pipe in the test section. While computing the Inside Diameter (ID) of heaviest wall pipe, pipe manufacturing tolerances shall not be considered. A 10 mm thick aluminum plate shall be used for making gauge plate. The gauging plates shall have 8 radial incisions at 45

degree interval. Compressed air shall be used to run Gauging pig.

After receipt of gauging pig at the other end, the gauge plate shall be inspected in the presence of Company representative. A deformed, bent or severally nicked plate or damaged pig shall be evidence of gauging pig run failure and the same shall not be acceptable to COMPANY. In such cases, the Contractor shall locate any obstruction and/ or faults such as dents, buckles, flat spots, etc. and rectify the same to the satisfaction of the Company. A written approval shall be obtained from Company regarding successful completion of gauging pig run. Photographs of the Gauge Plate before and after the gauging run shall be taken and included in the inspection report.

After acceptance of gauging operation, air header shall be cut and removed. Pre-tested test headers loaded with three numbers of four cup batching pigs shall be welded to test section.

The drawing of the test headers shall be submitted along with hydrotest procedure for approval. All fittings and flanges to be used in the test header fabrication shall be at least one ANSI rating higher than the line rating. The headers shall be pretested at line hydrotest pressure for duration of minimum 24 hours. The record shall be kept and shall be part of the final hydro test report.

## 8.8 WATER FILLING

After acceptance of gauging run, water filling of the testing section shall commence. For this purpose, pretested test headers loaded with three numbers of four cup batching / Bi -Directional pigs shall be welded to the test section. Weld joints between test header and pipeline shall be radiographed and accepted before filling operation starts.

Un-inhibited water equal to 10% of the volume of test section shall be filled ahead of the first pig. The first batching pig shall be launched using minimum un-inhibited water equivalent to 1.5 Km of test section for longer sections and 0.5 Km for short sections below 10 Km. Then the second pig shall be launched using inhibited water till the second pig is received at the other end. The Contractor shall continuously monitor the volume and pressure, the temperature of the fill water during the filling operation. When it has been confirmed that the filling pigs have arrived in the receiving test header, the thermal stabilization and pressurization operations can commence subsequently.

The temperature of the fill water should be recorded as it is introduced into the pipeline. This will aid in the determination of line temperature stability. Additionally, the flow rates and pressures should also be recorded or monitored to protect the pipeline from an over pressure situation.

## 8.9 THERMAL STABILIZATION

After a check has been made to confirm if the pressure has attained minimum 1 bar (g) on the highest section, the thermal stabilization can be started.

Thermal equilibrium between the pipeline and environment shall be checked through the Thermocouples installed on the pipeline and in the soil.

Temperature readings shall be made at 2 hours-intervals. Thermal stabilization shall be considered to have been achieved when a difference not higher than 1 °C is attained between the average values of the last two readings.

Thermal stabilization completion shall be approved by Company.

## 8.10 PRESSURIZATION

**8.10.1** The pressurization shall be performed in the presence of Company at a moderate and constant rate not exceeding 2 bars/ min. One pressure recording gauge shall be installed in parallel with the dead weight tester. Volume required to reach the test pressure shall be recorded periodically throughout the pressurization as follows:

- Each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester
- Each 2 bar increments between 80% to 100% of test pressure as recorded by the dead weight tester
- It is preferable for a pressure-volume plot to be initiated at the start of the pressurization process and continued until the test pressure is reached. The lower end of the pressure-volume plot can be used to determine the total amount of residual air in the test section. The upper end of the pressure volume plot can be used to determine if any pipe in the test segment may have reached its elastic limit.

**8.10.2** The pressurization shall be cycled according to the following sequence:

- Pressurize to 50% of test pressure, hold pressure for 1 hour,
- Drop pressure to 10% of test pressure of test section at test head,
- Pressurize to 75% of test pressure, hold pressure for 1 hour
- Drop pressure to 10% of test pressure of test section at the test head
- Pressurize to test pressure.

During the pressurization to each test pressure (50% & 75%), two tests shall be carried out for the calculation of air volume in the pipeline under test.

In case, during the hold pressure periods indicated above, a decrease in pressure is observed, the above operations shall not be repeated more than twice, after which the line shall not be considered capable of test, until the Contractor has isolated and eliminated the cause for the lack of water tightness.

## 8.11 AIR VOLUME CALCULATION.

Two separate consecutive pressures lowering of 0.5 bar shall be carried out after pressurizing to test pressure in order to check the presence of air in the pipeline.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured ( $V_1$ ). This amount measured shall be compared to the theoretical amount ( $V_p$ ) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in clause 9.1 of this specification.

If no air is present in the length under test, then  $\frac{V_I}{V_D} = 1$

In order that the above ratio is acceptable, it shall not differ by more than 6% (i.e. 1.06). If the air found in the pipeline is within the above established tolerance, then the pressurizing can continue. If the ratio  $V_I / V_D$  exceeds 1.06, the hydrostatic testing cannot go on and additional pig passages shall be performed to remove the air pockets.

The test shall be repeated as per the above procedure until above estimated tolerances are satisfied. The pressurizing can then continue, to reach the value of the test pressure.

## 8.12 TESTING

The section shall be pressurized to the test pressure after the air volume test has given acceptable results. When temperature and pressure has stabilized, the injection pump, pressuring pump shall be disconnected and all connections at the test heads shall be checked for leakage. The test pressure shall be held for a minimum of 24 hours after stabilization. The pressure recorders shall then be started with the charts in a real time orientation for continuous recording throughout the test.

During the testing period the following measurements shall be recorded

- Pressure measurements from dead weight tester: Every hour
- Soil temperature and the pipe temperature at the thermocouples: Every two hours

All data shall be recorded on appropriate forms attached to the hydrostatic test procedure manual. Care shall be taken that the maximum test pressures are not exceeded. Bleed-off water shall be accurately measured and recorded.

## 8.13 MEASUREMENTS

### 8.13.1 WATER AMOUNT MEASUREMENT

The quantity of water added to the test section shall be measured during the filling stage through a positive displacement meter (a turbine meter may also be used).

The quantity of water added during pressurization shall be measured during the pressurization stages.

### 8.13.2 PRESSURE MEASUREMENT

Pressure shall be measured with a dead weight tester that shall permit readings with least count of 0.05 bar. The pressure shall also be recorded by means of a recording pressure gauge. The recording pressure gauge shall be checked by means of a dead weight tester at the beginning, during and at the end of the hydrostatic test.

Accuracy :  $\pm 0.1\%$  of the full-scale value

Recording : Continuous on tape or disk, graph width 100mm



Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams

Recording range : To be such as to record pressure between 50% and 90% of the diagram width.

### 8.13.3 TEMPERATURE MEASUREMENT

- Water temperature shall be taken at every 2 hours through the thermocouples that have been installed on the pipe wall along the section.

In addition, the temperature measurement shall be taken during filling operation, thermal stabilization stage and during the pressure hold period.

The thermocouples' sensitivity shall enable temperature readings with the accuracy of  $\pm 0.1^\circ\text{C}$ .

- Water temperature shall also be measured at the pump delivery through a recording thermometer throughout the filling stage.

The recording thermometer shall feature the following characteristics:

Accuracy :  $\pm 1\%$  of the scale range

Scale :  $-10^\circ$  to  $+40^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagram

- Ground temperature shall be taken by measuring soil temperature at the thermocouples prior to starting the filling operation.
- Ambient temperatures shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer.

Accuracy :  $\pm 1\%$  of the scale range

Scale :  $0^\circ$  to  $+60^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams.

## 9.0 CALCULATIONS

- 9.1** The theoretical water amount that is necessary for filling the section to be tested shall be obtained from the geometrical volume of the section considering the pipe tolerances.

The theoretical water amount that is necessary for pressurizing the section shall be calculated by means of the following formula:

$$V_p = \left( 0.884 \frac{\pi}{t} + A \right) \times 10^{-6} \times (V_t) \times (\Delta P) \times K$$

Where:

$V_p$  = computed water amount required to raise by P the pressure in the section to be tested ( $\text{m}^3$ )



- $V_t$  = geometrical volume of the section ( $m^3$ )
- $\Delta P$  = pressure rise (bar)
- $r_i$  = nominal inner radius of the pipe (mm)
- $t$  = nominal pipe thickness (mm)
- $A$  = Isothermal compressibility value for water at the pressurization temperature in the P range ( $bar^{-1}$ )  $\times 10^6$  (Refer water compressibility factor v/s pressure and temperature charts. For temperature above 30°C the values may be extrapolated.)
- $K$  = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.

**9.2** The pressure change due to a water temperature change shall be calculated through the following formula:

$$\Delta P = \frac{B}{0.884 \frac{\pi}{t} + A} \Delta T$$

Where:

- $\Delta P$  = Pressure change resulting from a temperature change (bar)
- $\Delta T$  = Algebraic difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (°C).
- $B$  = Value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of steel ( $^{\circ}C^{-1} \times 10^6$ ) (Refer Table1)
- $A$  = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (Refer Figure 1)
- $K$  = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.
- $r_i$  = nominal inner radius of the pipe (mm)  
(In case of the test section having multiple wall thicknesses, "ri" shall correspond to the wall thicknesses, having the maximum total length in the given test section.)
- $t$  = nominal pipe thickness (mm)

## 10.0 ACCEPTANCE

**10.1** The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such changes shall be evaluated as described under clause 9.2 of this

specification.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The pressure value thus adjusted shall be compared with the initial value and the test shall be considered as acceptable if the difference is less than or equal to 0.3 bar. In case of doubt the testing, period shall be extended by 24 hours.

- 10.2** If test section fails to maintain the specified test pressure after isolation, Contractor shall determine the location of leakage or failure by suitable means. All leaks and failures within the pipe wall or weld seams shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In those cases where leaks occur in circumferential welds, the method of repair shall be determined by the Company. Contractor shall comply with instructions of the Company whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should, however, meet the requirements of applicable welding specification enclosed with the Contract. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.
- 10.3** The cost of repairs or replacements, followed by refilling and depressurizing the line, due to poor workmanship, shall be borne by the Contractor. In the event of leaks or failures resulting from faulty Company furnished materials, Contractor shall be reimbursed as per the provisions of Contract. All work of reinstalling line pipe, to replace failures, shall be done in accordance with the relevant specifications included in the CONTRACT.
- 10.4** Contractor shall haul and stockpile all damaged and defective pipes to storage location designated by the Company. All cracks and splits resulting from failure shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred. Failed pipes shall have pipe number and heat number clearly marked on the outside surface along with warning sign to prevent re-usage.

## **11.0 TERMINATION**

After the positive result of testing and all the data have been gathered, the test shall be terminated upon written approval given by the Company. The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by Company. Subsequent operations such as installation of sectionalizing valves, caliper pigging, swabbing, pre-commissioning checks, purging/ inertising and commissioning shall be carried out as per the relevant specifications.

- 11.1** All thermocouples installed in the pipeline shall be removed and damaged coating shall be repaired using Company approved materials and procedure.
- 11.2** Contractor shall dewater the tested line as per the following requirement after test acceptance.

The dewatering shall be carried out by using four cup pigs and foam pigs driven by compressed air. The detailed dewatering procedure shall be deployed by the Contractor in such a way as to provide adequate control of pigs during dewatering. Pigs and equipment required for dewatering the line shall be furnished by Contractor and shall be approved in advance by the Company. Four cup pigs run shall be made through the line to displace the water. Foam pigs shall then be passed in order to complete the line dewatering. Contractor shall use a number of foam pigs each in different colors/ numbered for this purpose. The line shall be considered dewatered when a negligible amount of water is flushed out by the last foam pig and approval is given by the Company.

**11.3** During dewatering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and/ or existing structures and interference with the traffic. Before the start of dewatering and disposal of hydro test water, a procedure for treatment of inhibited water to prevent pollution shall be submitted by Contractor to Company for review and approval.

**11.4** Upon completion of the testing and dewatering operation, any provisional traps/ headers for pigs and all other temporary installation relating to the test shall be removed. Subsequently, the individual sections of the line already tested shall be joined in accordance with the requirements of relevant specifications issued for the purpose.

## **12.0 TEST REPORT**

A complete report signed by Contractor and the Company shall be submitted upon completion of the hydrostatic test for each test section.

This report shall contain as a minimum:

- Pressure at high and low elevations;
- Elevation & Pressure at test point;
- Water test certificate;
- Inhibitor test certificate;
- The cleaning, gauging, flushing, filling and testing procedures used;
- Schematic layout of cleaning, filling and testing facilities;
- Section Elevation Plot;
- Equipment's and Instruments calibration certificate;
- A profile of the pipeline that shows the test sites, all instrument and injection connections;
- Pipe filling logs and records;
- Additive specification, required concentration and additive injection records;
- Pig specifications;
- Pig inspection records including photographs of the damages; records of gauging pig survey and photographs;
- Pressurization and stabilization records;
- Pressure and temperature recording charts with appropriate information

inscribed thereon;

- Temperature data along the pipeline;
- Dead weight tester logs and recordings;
- Air volume calculations;
- Pressure Vs Volume plot
- Pressure changes due to temperature change calculations;
- Environmental data;
- Depressurization logs and records;
- Dewatering procedure and schematic layout of relevant facilities; dewatering logs and records;
- Records and photographs of all leaks, if applicable.

### 13.0 PRESERVATION OF PIPELINE

When so stated in the CONTRACT, to preserve/ conserve the pipeline for a specified duration, Contractor shall completely fill the pipeline with water, with sufficient quantity of corrosion inhibitors depending upon quality of water and the period of conservation, at a pressure as per relevant specification/ Contract. Contractor shall obtain necessary approval from the Company of the procedure, type and quality and quantity of inhibitors used before commencement of the works.

### 14.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out the tests, the following additional requirements shall be complied with:

1. Provision shall be made for the installation of no-admittance signs to unauthorised personnel from the roads to the R.O.U.
2. Signs stating 'PIPE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel. No unauthorised personnel shall be closer than 40M to the pipeline or equipment under test.
3. Provisional scraper traps shall be installed in compliance with methods and suitable location so that their rupture cannot cause any injuries to the personnel or third parties
4. The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.
5. Once dewatering is over the sectionalising valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications. All thermocouples installed in the pipeline shall be removed and damaged corrosion coating shall be repaired using Company approved materials and procedure.

## 15.0 DOCUMENTATION

### PRIOR TO COMMENCEMENT OF HYDROSTATIC TEST

The Contractor shall furnish the Hydrostatic Test Procedure at least six weeks prior to commencement of hydrostatic test operations for the approval of the Company Representative. Hydrostatic test operations shall commence only after obtaining written approval from Company.

Prior to commencement of the testing, copies of certifications, calibrations, etc of any equipment/ instrumentation to be incorporated in the test set-up shall be submitted to the Company Representative.

### ON COMPLETION OF HYDROSTATIC TEST

The Contractor shall furnish the Test Report duly signed by both the Contractor and the Company Representative, immediately upon completion of successful hydrostatic test.

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND  
THE STEEL THERMAL EXPANSION**

**FACTOR ( $^{\circ}\text{C}^{-1} \times 10^6$ )**

| $^{\circ}\text{C}$<br>bar | 1      | 2      | 3      | 4      | 5      | 6      | 7     | 8     |
|---------------------------|--------|--------|--------|--------|--------|--------|-------|-------|
| 0.981                     | -98.62 | -79.89 | -61.81 | -44.34 | -27.47 | -11.14 | 4.66  | 19.98 |
| 10                        | -95.55 | -76.94 | -58.99 | -41.65 | -24.89 | -8.67  | 7.02  | 22.23 |
| 20                        | -92.15 | -73.68 | -55.86 | -38.64 | -22.01 | -5.92  | 9.65  | 24.74 |
| 30                        | -88.74 | -70.4  | -52.72 | -35.63 | -19.14 | -3.16  | 12.29 | 27.26 |
| 40                        | -85.32 | -67.12 | -49.58 | -32.62 | -16.24 | -0.41  | 14.93 | 29.78 |
| 50                        | -81.9  | -63.84 | -46.43 | -29.6  | -13.36 | 2.36   | 17.57 | 32.31 |
| 60                        | -78.47 | -60.55 | -43.27 | -26.58 | -10.46 | 5.15   | 20.23 | 34.85 |
| 70                        | -75.03 | -57.25 | -40.1  | -23.54 | -7.56  | 7.92   | 22.89 | 37.89 |
| 80                        | -71.6  | -53.96 | -36.94 | -20.51 | -4.65  | 10.7   | 25.55 | 39.94 |
| 90                        | -68.16 | -50.66 | -33.77 | -17.47 | -1.73  | 13.5   | 28.23 | 42.5  |
| 100                       | -64.72 | -47.35 | -30.6  | -14.43 | 1.18   | 16.29  | 30.9  | 45.05 |
| 110                       | -61.28 | -44.05 | -27.43 | -11.38 | 4.1    | 19.08  | 33.58 | 47.67 |
| 120                       | -57.84 | -40.74 | -24.26 | -8.34  | 7.02   | 21.88  | 36.26 | 50.18 |
| 130                       | -54.4  | -37.44 | -21.08 | -5.29  | 9.95   | 24.68  | 38.94 | 52.75 |
| 140                       | -50.96 | -34.13 | -17.9  | -2.25  | 12.87  | 27.49  | 41.63 | 55.32 |
| 150                       | -47.53 | -30.83 | -14.73 | 0.8    | 15.79  | 30.29  | 44.31 | 57.89 |
| 160                       | -44.1  | -27.53 | -11.56 | 3.85   | 18.72  | 33.1   | 47    | 60.46 |
| 170                       | -40.67 | -24.23 | -8.4   | 6.89   | 21.64  | 35.9   | 49.69 | 63.04 |
| 180                       | -37.24 | -20.94 | -5.23  | 9.94   | 24.56  | 38.7   | 52.37 | 65.62 |
| 190                       | -33.83 | -17.65 | -2.06  | 12.98  | 27.48  | 41.51  | 55.06 | 68.19 |
| 200                       | -30.42 | -14.37 | 1.09   | 16.01  | 30.4   | 44.3   | 57.75 | 70.77 |
| 210                       | -27.02 | -11.09 | 4.25   | 19.04  | 33.31  | 47.1   | 60.43 | 73.34 |
| 220                       | -23.63 | -7.82  | 7.4    | 22.06  | 36.22  | 49.9   | 63.12 | 75.9  |
| 230                       | -20.24 | -4.56  | 10.54  | 25.08  | 39.13  | 52.69  | 65.8  | 78.48 |
| 240                       | -16.87 | -1.3   | 13.67  | 28.1   | 42.03  | 55.48  | 68.48 | 81.05 |
| 250                       | -13.5  | 1.94   | 16.79  | 31.11  | 44.92  | 58.26  | 71.15 | 83.61 |
| 260                       | -10.14 | 5.17   | 19.9   | 34.12  | 47.81  | 61.04  | 73.81 | 86.81 |
| 270                       | -6.8   | 8.39   | 23     | 37.11  | 50.69  | 63.8   | 76.48 | 88.73 |
| 280                       | -3.48  | 11.6   | 26.11  | 40.09  | 53.56  | 66.57  | 79.14 | 91.29 |
| 290                       | -0.17  | 14.8   | 29.19  | 43.07  | 56.43  | 69.33  | 81.78 | 93.83 |
| 300                       | 3.13   | 17.98  | 32.27  | 46.03  | 59.29  | 72.08  | 84.83 | 96.38 |

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND  
THE STEEL THERMAL EXPANSION**

**FACTOR ( $^{\circ}\text{C}^{-1} \times 10^6$ )**

| $^{\circ}\text{C}$<br>bar | 9      | 10     | 11     | 12     | 13     | 14     | 15     |  |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--|
| 0.981                     | 34.82  | 49.22  | 63.2   | 76.78  | 89.99  | 102.83 | 115.34 |  |
| 10                        | 36.97  | 51.26  | 65.15  | 78.64  | 91.75  | 104.51 | 116.93 |  |
| 20                        | 39.36  | 53.55  | 67.33  | 80.71  | 93.72  | 106.39 | 118.71 |  |
| 30                        | 41.76  | 55.84  | 69.51  | 82.79  | 95.7   | 108.26 | 120.49 |  |
| 40                        | 44.18  | 58.14  | 71.7   | 84.87  | 97.68  | 110.14 | 122.28 |  |
| 50                        | 46.6   | 60.45  | 73.9   | 86.96  | 99.68  | 112.04 | 124.07 |  |
| 60                        | 49.02  | 62.76  | 76.1   | 89.07  | 102.67 | 113.93 | 125.88 |  |
| 70                        | 51.44  | 65.08  | 78.32  | 91.17  | 103.68 | 115.84 | 127.69 |  |
| 80                        | 53.88  | 67.4   | 80.53  | 93.29  | 105.69 | 117.76 | 129.5  |  |
| 90                        | 56.32  | 69.73  | 82.75  | 95.41  | 107.7  | 119.67 | 131.32 |  |
| 100                       | 58.77  | 72.07  | 84.98  | 97.53  | 109.73 | 121.59 | 133.15 |  |
| 110                       | 61.21  | 74.41  | 87.22  | 99.66  | 111.75 | 123.52 | 134.98 |  |
| 120                       | 63.67  | 76.74  | 89.45  | 101.79 | 113.79 | 125.46 | 136.82 |  |
| 130                       | 66.12  | 79.09  | 91.69  | 103.93 | 115.83 | 127.39 | 138.67 |  |
| 140                       | 68.58  | 81.45  | 93.93  | 106.07 | 117.87 | 129.34 | 140.51 |  |
| 150                       | 71.05  | 83.8   | 96.18  | 108.21 | 119.9  | 131.2  | 142.37 |  |
| 160                       | 73.51  | 86.15  | 98.43  | 110.36 | 121.96 | 133.74 | 144.22 |  |
| 170                       | 75.97  | 88.51  | 100.68 | 112.51 | 124.01 | 135.19 | 146.08 |  |
| 180                       | 78.44  | 90.87  | 102.94 | 114.66 | 126.06 | 137.15 | 147.94 |  |
| 190                       | 80.91  | 93.23  | 105.19 | 116.82 | 128.12 | 139.11 | 149.81 |  |
| 200                       | 83.37  | 95.59  | 107.45 | 118.97 | 130.17 | 141.07 | 151.68 |  |
| 210                       | 85.84  | 97.95  | 109.71 | 121.13 | 132.24 | 143.03 | 153.55 |  |
| 220                       | 88.3   | 100.31 | 111.97 | 123.29 | 134.29 | 144.99 | 155.42 |  |
| 230                       | 90.67  | 102.67 | 114.23 | 125.45 | 136.36 | 146.96 | 157.3  |  |
| 240                       | 93.22  | 105.03 | 116.48 | 127.6  | 138.42 | 148.93 | 159.18 |  |
| 250                       | 95.69  | 107.39 | 118.74 | 129.76 | 140.48 | 150.9  | 167.05 |  |
| 260                       | 98.14  | 109.74 | 121    | 131.92 | 142.54 | 152.87 | 162.93 |  |
| 270                       | 100.6  | 112.1  | 123.25 | 134.08 | 144.61 | 154.84 | 164.81 |  |
| 280                       | 103.05 | 114.44 | 125.5  | 136.24 | 146.67 | 156.84 | 166.69 |  |
| 290                       | 105.5  | 116.79 | 127.75 | 138.39 | 148.73 | 158.78 | 168.57 |  |
| 300                       | 107.94 | 119.13 | 130    | 140.54 | 150.79 | 160.75 | 170.45 |  |

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND  
THE STEEL THERMAL EXPANSION**

**FACTOR ( $^{\circ}\text{C}^{-1} \times 10^6$ )**

| $^{\circ}\text{C}$<br>bar | 16     | 17     | 18     | 19    | 20     | 21     | 22     | 23     |
|---------------------------|--------|--------|--------|-------|--------|--------|--------|--------|
| 0.981                     | 127.52 | 139.41 | 151    | 162.3 | 173.37 | 184.18 | 194.75 | 205.08 |
| 10                        | 129.02 | 140.83 | 152.36 | 163.6 | 174.56 | 185.3  | 195.79 | 206.07 |
| 20                        | 130.71 | 142.42 | 153.85 | 165   | 175.9  | 186.55 | 196.96 | 207.16 |
| 30                        | 132.4  | 144.02 | 155.35 | 166.4 | 177.23 | 187.8  | 198.14 | 208.26 |
| 40                        | 134.1  | 145.62 | 156.87 | 167.9 | 178.58 | 189.07 | 199.33 | 209.37 |
| 50                        | 135.8  | 147.24 | 158.39 | 169.3 | 179.93 | 190.34 | 200.52 | 210.49 |
| 60                        | 137.51 | 148.86 | 159.92 | 170.7 | 181.29 | 191.62 | 201.72 | 211.61 |
| 70                        | 139.22 | 150.49 | 161.46 | 172.2 | 182.66 | 192.91 | 202.93 | 212.74 |
| 80                        | 140.95 | 152.11 | 163    | 173.6 | 184.03 | 194.2  | 204.14 | 213.88 |
| 90                        | 142.67 | 153.75 | 164.56 | 175.1 | 185.41 | 195.5  | 205.36 | 215.03 |
| 100                       | 144.42 | 155.4  | 166.11 | 176.6 | 186.8  | 196.8  | 206.59 | 216.17 |
| 110                       | 146.15 | 157.04 | 167.66 | 178.1 | 188.2  | 198.12 | 207.82 | 217.33 |
| 120                       | 147.9  | 158.7  | 169.24 | 179.5 | 189.59 | 199.44 | 209.06 | 218.49 |
| 130                       | 149.65 | 160.36 | 170.81 | 181   | 191    | 200.75 | 210.31 | 219.66 |
| 140                       | 151.4  | 162.03 | 172.39 | 182.5 | 192.41 | 202.09 | 211.56 | 220.84 |
| 150                       | 153.16 | 163.7  | 173.98 | 184   | 193.82 | 203.42 | 212.81 | 222.02 |
| 160                       | 154.93 | 165.37 | 175.56 | 185.5 | 195.24 | 204.76 | 214.08 | 223.2  |
| 170                       | 156.69 | 167.05 | 177.15 | 187   | 196.66 | 206.1  | 215.34 | 224.39 |
| 180                       | 158.47 | 168.73 | 178.75 | 188.5 | 198.09 | 207.45 | 216.61 | 225.58 |
| 190                       | 160.24 | 170.42 | 180.35 | 191.1 | 199.52 | 208.8  | 217.89 | 226.79 |
| 200                       | 162.01 | 172.1  | 181.95 | 191.6 | 200.97 | 210.16 | 219.17 | 227.99 |
| 210                       | 163.8  | 173.8  | 183.55 | 193.1 | 202.4  | 211.53 | 220.46 | 229.2  |
| 220                       | 165.58 | 175.49 | 185.16 | 194.6 | 203.85 | 212.89 | 221.74 | 230.41 |
| 230                       | 167.36 | 177.19 | 186.78 | 196.1 | 205.3  | 214.26 | 223.04 | 231.63 |
| 240                       | 169.16 | 178.89 | 188.39 | 197.7 | 206.75 | 215.63 | 224.32 | 232.85 |
| 250                       | 170.94 | 180.59 | 190.01 | 199.2 | 208.2  | 217    | 225.63 | 234.08 |
| 260                       | 172.73 | 182.3  | 191.63 | 200.8 | 209.66 | 218.4  | 226.93 | 235.31 |
| 270                       | 174.53 | 184    | 193.25 | 202.3 | 211.12 | 219.77 | 228.24 | 236.54 |
| 280                       | 176.32 | 185.7  | 194.88 | 203.8 | 212.59 | 221.16 | 229.55 | 237.77 |
| 290                       | 178.11 | 187.42 | 196.5  | 205.4 | 214.05 | 222.54 | 230.86 | 239.01 |
| 300                       | 179.9  | 189.13 | 198.13 | 206.9 | 215.51 | 223.93 | 232.18 | 240.26 |



**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND  
THE STEEL THERMAL EXPANSION**

**FACTOR ( $^{\circ}\text{C}^{-1} \times 10^6$ )**

| $^{\circ}\text{C}$<br>bar | 24    | 25     | 26     | 27     | 28     | 29     | 30     |  |
|---------------------------|-------|--------|--------|--------|--------|--------|--------|--|
| 0.981                     | 215.2 | 215.14 | 234.88 | 244.41 | 253.79 | 263    | 272.03 |  |
| 10                        | 216.1 | 225.99 | 235.66 | 245.13 | 254.44 | 263.59 | 272.57 |  |
| 20                        | 217.2 | 226.94 | 236.53 | 245.94 | 255.18 | 264.27 | 273.18 |  |
| 30                        | 218.2 | 227.88 | 237.41 | 246.75 | 255.93 | 264.95 | 273.8  |  |
| 40                        | 219.2 | 228.85 | 238.3  | 247.58 | 256.69 | 265.64 | 274.42 |  |
| 50                        | 220.3 | 229.82 | 239.2  | 248.4  | 257.45 | 266.33 | 275.07 |  |
| 60                        | 221.3 | 230.79 | 240.11 | 249.24 | 258.22 | 267.04 | 275.7  |  |
| 70                        | 222.4 | 231.78 | 241.02 | 250.08 | 258.99 | 267.75 | 276.35 |  |
| 80                        | 223.4 | 232.77 | 241.94 | 250.93 | 259.78 | 268.47 | 277.01 |  |
| 90                        | 224.5 | 233.76 | 242.87 | 251.79 | 260.57 | 269.19 | 277.66 |  |
| 100                       | 225.6 | 234.76 | 243.79 | 252.66 | 261.36 | 269.92 | 278.33 |  |
| 110                       | 226.6 | 235.78 | 244.73 | 253.53 | 262.17 | 270.77 | 279.01 |  |
| 120                       | 227.7 | 236.79 | 245.68 | 254.4  | 262.98 | 271.41 | 279.69 |  |
| 130                       | 228.8 | 237.81 | 246.63 | 255.28 | 263.69 | 272.16 | 280.38 |  |
| 140                       | 229.9 | 238.84 | 247.59 | 256.18 | 264.62 | 272.92 | 281.08 |  |
| 150                       | 231   | 239.87 | 248.55 | 257.07 | 265.44 | 273.69 | 281.78 |  |
| 160                       | 232.1 | 240.91 | 249.52 | 257.97 | 266.28 | 274.46 | 282.49 |  |
| 170                       | 233.3 | 241.96 | 250.49 | 258.88 | 267.12 | 275.23 | 283.2  |  |
| 180                       | 234.4 | 243.01 | 251.47 | 259.79 | 267.97 | 276.01 | 283.92 |  |
| 190                       | 235.5 | 244.06 | 252.46 | 260.71 | 268.82 | 276.8  | 284.64 |  |
| 200                       | 236.6 | 245.12 | 253.45 | 261.63 | 269.67 | 277.59 | 285.37 |  |
| 210                       | 237.8 | 246.18 | 254.45 | 262.5  | 270.54 | 278.39 | 286.11 |  |
| 220                       | 238.9 | 247.26 | 255.45 | 263.49 | 271.4  | 279.19 | 286.85 |  |
| 230                       | 240.1 | 248.33 | 256.46 | 264.43 | 272.28 | 280    | 287.59 |  |
| 240                       | 241.2 | 249.41 | 257.46 | 265.37 | 273.16 | 280.82 | 288.35 |  |
| 250                       | 242.4 | 250.49 | 258.48 | 266.31 | 274.04 | 281.63 | 289.11 |  |
| 260                       | 243.5 | 251.58 | 259.49 | 267.27 | 274.92 | 282.46 | 289.86 |  |
| 270                       | 244.7 | 252.66 | 260.52 | 268.23 | 275.82 | 283.29 | 290.64 |  |
| 280                       | 245.8 | 253.76 | 261.54 | 269.18 | 276.71 | 284.12 | 291.4  |  |
| 290                       | 247   | 254.86 | 262.57 | 270.15 | 277.61 | 284.95 | 292.18 |  |
| 300                       | 248.2 | 255.96 | 263.6  | 271.11 | 278.51 | 285.79 | 292.95 |  |

FIGURE – 1

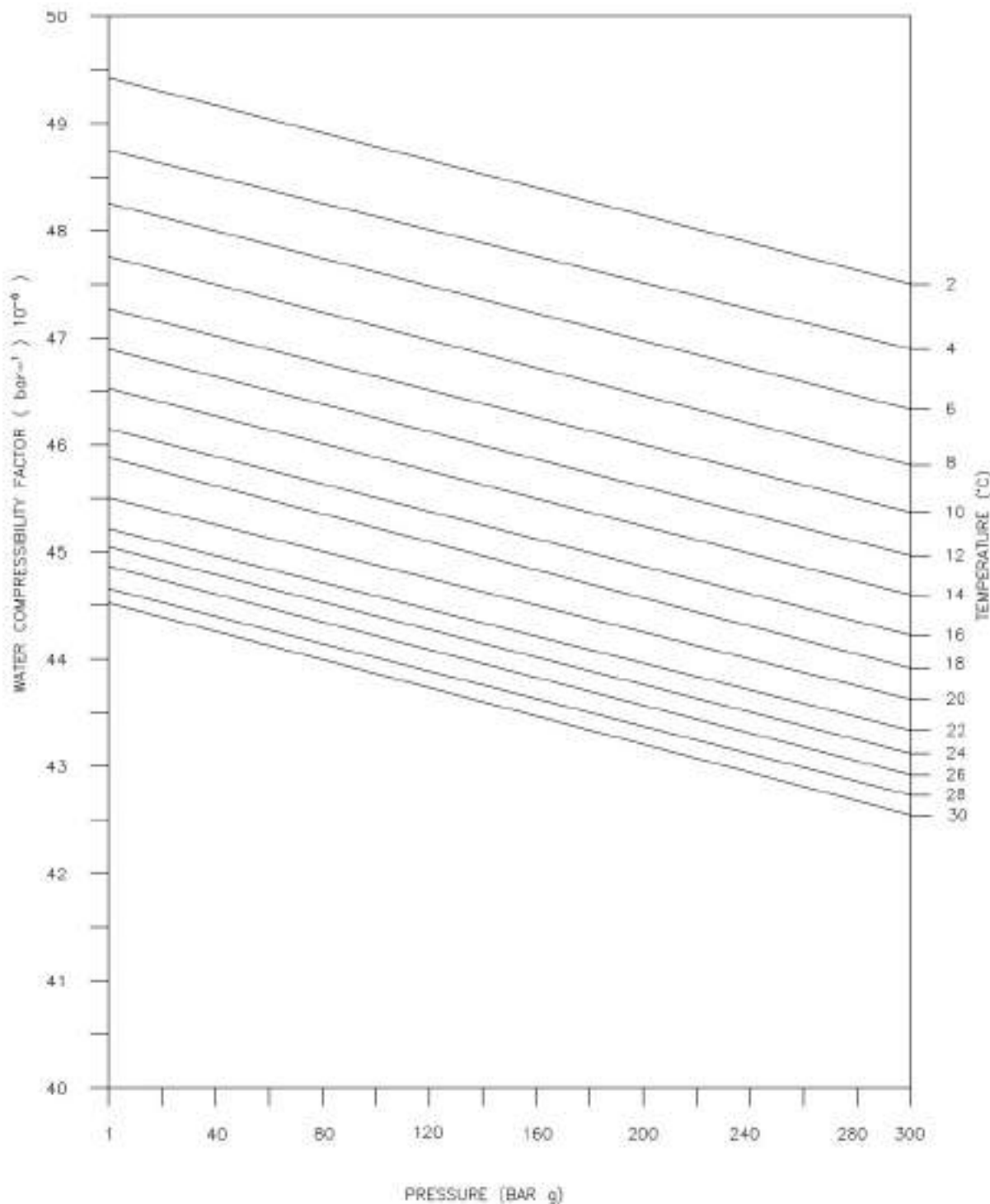


FIG. 1- WATER COMPRESSIBILITY FACTOR v/s PRESSURE AND  
TEMPERATURE



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR PIPELINE MARKERS

VCS – SS – PP - 2015

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 02      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 01      | 28.11.2019 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| 00      | 12.10.2017 | CM                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

|                   |                         |
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| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                        |
|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                        | Authorized by                                                                       | Revision Description   |
| 00              | 12.10.2017    |                                                                                   |                                                                                   |                                                                                    |                                                                                     | Revised as<br>Marked   |
|                 |               | CM                                                                                | SM                                                                                | AD                                                                                 | SK                                                                                  |                        |
| 01              | 28.11.2019    |                                                                                   |                                                                                   |                                                                                    |                                                                                     | Revised as<br>Marked   |
|                 |               | MB                                                                                | MC                                                                                | AD                                                                                 | SK                                                                                  |                        |
| 02              | 29.04.2022    |  |  |  |  | VCS QMS<br>Integration |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                 | GW                                                                                  |                        |
|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                        |
|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                        |

---

**ABBREVIATIONS:**

|      |                                           |
|------|-------------------------------------------|
| API  | American Petroleum Institute.             |
| ASME | American Society of Mechanical Engineers. |

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## 1.0 SCOPE

- 1.1** This specification covers the minimum requirements of supply, fabrication and erection of pipeline markers to be installed by contractor at various locations along the proposed pipeline route of onshore pipelines carrying gas or liquid. The markers and signs may contain information to be used by the public when reporting emergencies and seeking assistance in determining precise location of a buried pipeline.

## 2.0 REFERENCE

The latest edition (edition in force at the time of issue of enquiry) of following additional references are included in this specification.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B31.4 : Pipeline Transportation Systems for Liquids and Slurries.
- B 31.8 : Gas Transmission and Distribution Piping Systems.

### AMERICAN PETROLEUM INSTITUTE (API)

- RP 1109 : Recommended practice for Marking Liquid petroleum pipeline facilities.

## 3.0 GENERAL

- 3.1** Contractor shall supply, fabricate, install and paint the Pipeline Markers along the pipeline route. The location of markers as indicated in the approved drawings shall be treated for guidance purpose only and the exact location of the markers shall be as per requirement stipulated in this specification and as directed by the company. All the markers shall be painted in accordance with the requirement of relevant standard specification for shop and field painting.
- 3.2** The pipeline markers shall be fabricated and installed in accordance with VCS standard drawings included herein. Before start of fabrication of markers, the Contractor shall prepare and submit for company's approval, the detailed scheme for the marker plates as applicable for the project.
- 3.3** The pipeline markers shall be installed, as far as possible, to minimize hindrance to the regular use of land traffic.
- 3.4** The line marker's message should be presented on strong, durable material, finished to resist the effects of exposure and vandalism.

## 4.0 KILOMETER MARKERS

Kilometer Markers shall be installed along the pipeline at every one-kilometer interval. Markers shall indicate cumulative chainage in kilometers from the reference station, in the direction of flow. A kilometer marker is not required in the following locations:

1. If the relative length between the location and any pipeline warning sign is less than 200 meters.
2. Every five Kilometers where Areal Markers are installed.  
For Kilometer Marker details refer VCS Standard Drawing

## 5.0 AERIAL MARKER

Aerial Marker shall in general be installed along the pipeline at every five (5) kilometers intervals and at places specified by the company. For Aerial Marker details refer VCS Standard Drawing.

## 6.0 PIPELINE WARNING SIGN

The pipeline crossing & pipeline facilities such as stations, terminals, valves, metering or pipeline junction manifolds should be marked with appropriate signs. Pipeline Warning Signs shall in general be installed at the following locations. Caution should be used when installing a marker anywhere other than directly over or in proximity to the buried pipeline to avoid any possible misinterpretation as to where the actual pipeline is located.

|                                                                                      |             |
|--------------------------------------------------------------------------------------|-------------|
| National and State Highway Crossings (at both ends)                                  | 2 Nos. min. |
| Other Road Crossings                                                                 | 1 No. min.  |
| Railway Crossings (at both ends)                                                     | 2 Nos. min. |
| Minor Water Crossings(less than 15 meter width)                                      | 1 No. min.  |
| Minor Water Crossings (above 15 meter width)                                         | 2 Nos. min. |
| Major Water Crossings (at both ends)                                                 | 2 Nos. min. |
| Valve Station / TOP / HOV's                                                          | 1 No. min.  |
| Any other location as shown in the approved drawings and as directed by the company. |             |

Pipeline warning sign shall indicate the pressure & pipeline facility and display the name of the Company with an emergency telephone number. For Pipeline Warning Sign details refer VCS Standard Drawing..

## 7.0 ROU BOUNDARY MARKER

Right of Use Boundary Markers shall be fabricated as per the drawings and shall be installed at every 250 meters interval along the entire pipeline route. These shall be installed on either side of the pipeline alignment to define the ROU boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROU limits. Due care shall be taken while installing ROU boundary marker. Boundary marker shall be preferably installed at the boundary of farmer plot as applicable, so that it does not get displaced during course of time. For ROU Marker details refer VCS Standard Drawing..



## 8.0 DIRECTION MARKERS

Direction Markers shall be installed to identify the significant Turning Points of the pipeline during aerial traverse, where there is change of pipeline direction. One direction marker shall be installed at such Turning Point; two more direction markers shall be installed along the pipeline alignment, one on either side of the Turning Point at 200 m from the Turning Point. For Direction Marker fabrication details refer VCS Standard Drawing.

## 9.0 NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN

The Navigable Waterway Pipeline Crossing Warning Sign shall be fabricated and installed one on each bank of navigable water courses at the pipeline crossing location, in lieu of the Pipeline Warning Sign should contain the words "Do not Anchor or Dredge". For Warning Sign fabrication details refer VCS Standard Drawing..

## 10.0 SPECIAL MARKERS

As directed by Company, Special Markers shall be installed at location where following changes take place:

- a) Change in pipeline diameter and wall thickness.
- b) Change in type of pipe.
- c) Change in class locations for pipelines ( in case of gas pipelines )

The above data may be provided on other types of marker (except ROU boundary marker), if the relative distance between the two does not exceed 100 m.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR CASING INSULATORS AND END SEALS

VCS – SS – PP - 2016

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 03      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 02      | 03.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                                                       |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                                                                                  |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document formatting, Cover Page, Doc numbering updated from SS-PL-019 to VPC-SS-PL-0019 keeping revision number same. |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                                       |
| 01              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document numbering updated from VPC-SS-PL-0019 to VPC-SS-PP-2016                                                      |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                                       |
| 02              | 03.01.2022    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Revised as Marked                                                                                                     |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |                                                                                                                       |
| 03              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                   |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                                                                       |

---

**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |

## CONTENTS

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## 1.0 SCOPE

This specification covers the minimum requirements of design, material, manufacture and supply of casing insulators and end seals intended to be used for cased pipeline crossings forming part of buried onshore pipeline.

This specification shall be read in conjunction with the condition of all specifications and documents include in the contract between company and contractor.

## 2.0 REFERENCE DOCUMENTS

The design, materials, fabrication, inspection, testing and supply of casing insulators and end seals shall comply with the latest edition of the following codes and standards.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B31.4 : Pipeline Transportation System for Liquids and Slurries
- B 31.8 : Gas Transmission and Distribution Piping Systems.

### AMERICAN PETROLEUM INSTITUTE (API)

- 1102 : Steel Pipeline Crossing Railroads and Highways

### PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

### COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

VPC-SS-PP-2001: Standard Specification for Pipeline Construction (Onshore)

VPC-SS-PP-2002: Specification for Construction of Pipelines Crossing Roads, Railroad and Minor Water Crossing

In case of conflict between various requirements of this specification and reference standards and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

### 3.0 FUNCTIONAL REQUIREMENTS

#### 3.1 CASING INSULATORS

Pipeline insulators shall be capable to support the carrier pipe inside the casing pipe and shall electrically isolate the carrier pipe from the casing pipe at the cased crossings.

The casing insulators shall be made of injection molded high density polyethylene or other equivalent or superior material and shall meet the following properties:

- Resist mechanical damage while being pulled into the casing.
- Have high compressive strength in order to ensure a permanent support to the carrier pipe.
- Have high electrical insulating value and low water absorption, thus preventing leakage and maintain-electrical isolation between carrier and casing pipes.
- Resist cold flow and do not soften at design temperature.
- Resist corrosion.
- Have low friction, to offer less resistance to carrier pipe movement.

#### PROPERTIES OF CASING INSULATORS

The material shall meet the following specifications:

| Property             | Value                    | ASTM Test Method |
|----------------------|--------------------------|------------------|
| Dielectric strength  | 450-500 Volts/Mil        | D-149            |
| Compressive strength | 3200 psi                 | D-695            |
| Tensile strength     | 3100-5000 psi            | D-638, D-651     |
| Impact strength      | 4.0 ft.lb./inch of notch | D-256            |
| Water Absorption     | 0.01%                    | D-570            |

#### 3.2 CASING END SEALS

Casing end seals are intended to be used for sealing the annular space between casing pipe and carrier pipe at casing ends so as to prevent ingress of moisture and water.

The casing end seals shall be made of heat shrink high density radiation cross linked polyethylene with an adhesive having a melt point suitable for the pipeline service temperature and ambient temperature likely to be encountered during construction. End seals material shall be resistant to heat, cold, vibration, impact, abrasion, corrosive fluids, disbandment, organic and bio-deterioration. Manufacturer shall confirm compatibility of end seals with carrier pipe coating.

### 4.0 DESIGN AND MANUFACTURE

#### 4.1 CASING INSULATOR

The arrangement of insulator shall be generally in accordance with Fig. 1.0. It shall be made in segments duly held together with cadmium plated bolts and nuts, to be supplied

with casing insulators.

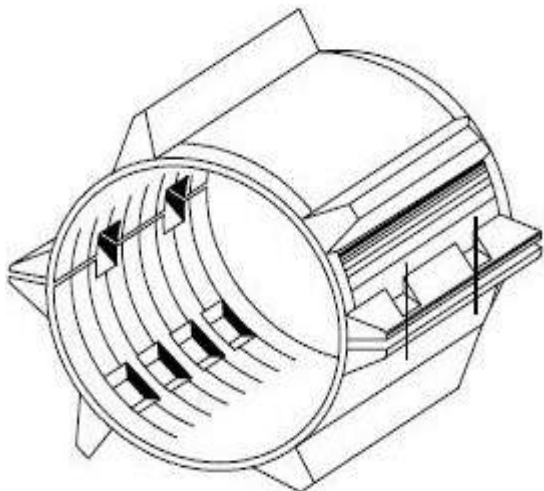
The number of segments shall be two for pipe diameters up to DN 300 mm (12"). For larger diameter, the number of segments may be more than two, but their number shall be kept minimum.

As an alternate design in accordance with the casing insulator element shall be a flexible section containing a toothed male butt strap at one end and an appropriately toothed female slot on the other end. The same shall be wrapped over the outer surface of the carrier pipe and locked positively. The insulator rings should be fastened onto the carrier pipe with the appropriate tool to be provided by the casing insulator manufacturer. No metallic parts or attachments should be considered in the casing insulator element assembly. The design of casing insulator should allow for onsite adjustments for any variances within the allowable O.D. range of pipeline and should grip the pipe firmly without any chances of horizontal movement or breakage of the insulator rings during installation.

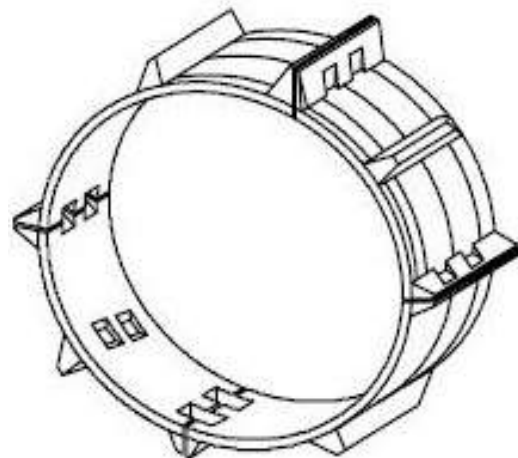
The skid height shall be such that it is slightly less than the value obtained by following formula:

$$\frac{\text{Casing Internal Dia} - \text{Carrier Outer Dia}}{2}$$

Manufacturer shall obtain prior approval from OWNER on casing insulators drawings/design.



TWO PIECE CONSTRUCTION



FOUR PIECE CONSTRUCTION

**Fig 1.0 TYPICAL DETAILS OF CASING INSULATORS**



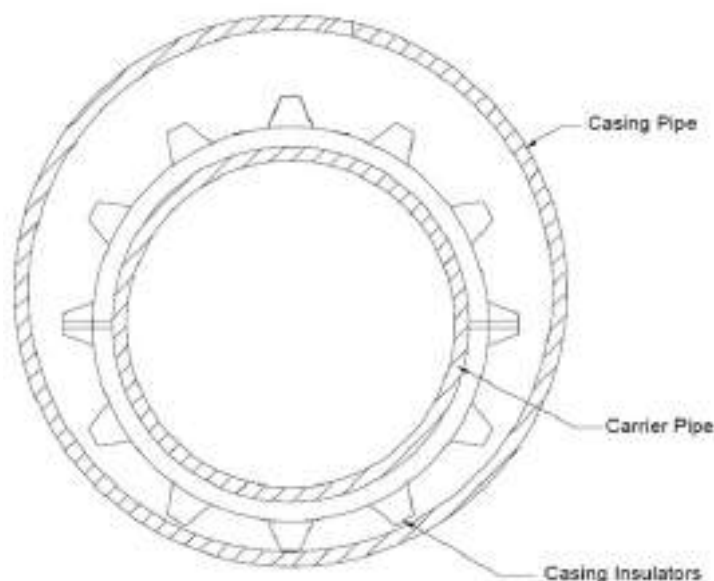


**Fig 2.0 TYPICAL SKETCH OF CASING INSULATOR AND CASING PIPE**

## 4.2 CASING END SEALS

The seals shall be suitable for the casing and carrier pipe diameters as applicable for each case. The casing end seal shall be flexible to cater for the expansion and contraction of carrier and casing pipes and shall be able to tolerate both angular and concentric misalignment of casing pipe without loss of sealing efficiency.

When HDPE ducts for OFC are also to be installed in the same casing pipe, the contractor shall install casing end seal in such a manner as to completely seal off the void between carrier pipe and HDPE ducts for OFC. Care shall be taken during installation of casing end seals so that after installation of casing end seals, neither HDPE ducts nor casing end seals are distorted or damaged.

The design of the casing end seals shall permit easy installation of the seal to the cased pipeline crossing.

It shall provide moisture proof seals when installed for the entire anticipated life of the burned pipeline.

Manufacturer shall obtain prior approval from OWNER on casing end seals design/drawings.

## 5.0 MATERIAL PROPERTIES OF CASING END SEALS

Casing end seals shall meet following minimum property requirements:

- a. BACKING (SLEEVE AND CLOSURE PATCH)

| Property         | Minimum Value | ASTM Test Method |
|------------------|---------------|------------------|
| Tensile strength | 2200 psi      | D 638            |

|                     |                                                         |        |
|---------------------|---------------------------------------------------------|--------|
| Ultimate Elongation | 400 %                                                   | D 638  |
| Heat Shock          | No Visual Cracks,<br>Flow or Drips at 250°C, 4<br>hours | D 2671 |

**b. ADHESIVE**

| Property                      | Minimum Value                                 | ASTM Test Method |
|-------------------------------|-----------------------------------------------|------------------|
| Ring and Ball Softening Point | 90°C                                          | E 28             |
| Lap Shear                     | 60°C - 25 psi<br>23°C - 250 psi (2 inch/min.) | D 1002           |

**c. SYSTEM (AS APPLIED)**

| Property                                                           | Minimum Value        | ASTM Test Method |
|--------------------------------------------------------------------|----------------------|------------------|
| Peel strength<br>(To casing and carrier pipe<br>and closure patch) | 5 pli (10 inch/min.) | D 1000           |

## 6.0 INSPECTION AND TESTING

Manufacturer/contractor shall furnish material test certificates of the components used in the assembly of casing insulators and end seal as per the requirements of clause 4.0 of this specification.

The manufacturer/contractor shall replace, at no extra cost, any material not conforming to the material and performance requirements of this specification.

Manufacturer/contractor shall submit detailed specification of the materials used in the assemblies, along with instructions for handling, use and installation of the material for OWNER approval prior to procurement.

## 7.0 INSTALLATION

Casing insulators shall be installed on carrier pipe at spacing as recommended by manufacturer but in no case greater than. At both ends of cased crossing a set of two insulators shall be installed with outermost insulator at a maximum distance of mm from end. Figure 3.0 shows arrangement of casing insulators inside the casing pipe. All other requirements of installation shall be as per standard.

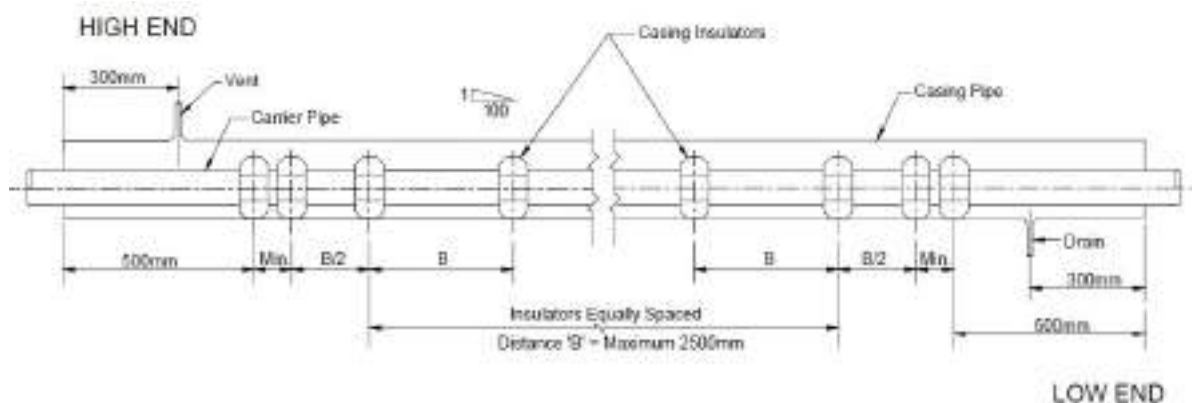


**Fig 3.0 ARRANGEMENT OF CASING INSULATORS ON CARRIER PIPE**



ENERGISING QUALITY

## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR DETAILED PIPELINE ROUTE SURVEY

**VPC – SS – PP - 2017**

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 02      | 28.01.2020 | MB          | MC         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |   |                       |
|-------------------|---|-----------------------|
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STANDARD SPECIFICATION  
FOR DETAILED PIPELINE ROUTE  
SURVEY

DOCNO: VPC-SS-PL-2017  
Rev No : 02

ENERGISING QUALITY

| REVISION RECORD |               |             |            |             |               |                                                                                                      |
|-----------------|---------------|-------------|------------|-------------|---------------|------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description                                                                                 |
| 00              | 23.06.2017    |             |            |             |               | Issued as Standard specification                                                                     |
|                 |               | AS          | SM         | AD          | SK            |                                                                                                      |
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|                 |               | MB          | MC         | AD          | SK            |                                                                                                      |
|                 |               |             |            |             |               |                                                                                                      |
|                 |               |             |            |             |               |                                                                                                      |



**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |
| OISD | Oil Industry Safety Directorate          |



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## 1.0 SCOPE

This specification covers the minimum requirements for various type of surveys required to be carried out for an onshore pipeline. The requirements for surveys and investigations related to locating pipeline route centerline, dumpsites and intermediate station/ terminal facilities on ground, obtaining topographic features, ground profile and soil data along the pipeline route; collection of revenue maps/ data and preparation of cadastral maps for ROU/ Land acquisition purposes; collection of population density data along the pipeline route are specified in this specification.

The specification also covers requirements related to construction of survey monuments, field measurements and presentation of survey data including preparation of maps, drawings, documents and reports.

## 2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition enforce at the time of floating the enquiry) of the following codes.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

|          |   |                                                                              |
|----------|---|------------------------------------------------------------------------------|
| B31.4    | : | Pipeline Transportation system for liquid Hydrocarbon & other liquids.       |
| B31.8    | : | Gas Transmission and Distribution Piping Systems.                            |
| OISD 226 | : | Natural gas Transmission Pipelines and city gas distribution network.        |
| OISD 141 | : | Design and Construction requirements for cross country hydrocarbon pipelines |

## 3.0 REQUIREMENTS

- 3.1 All survey works shall be performed by and/ or under the direct supervision of a qualified land Surveyor.

All survey work shall be carried out using modern and well-maintained survey equipments/ instruments such as DGPS, GPS, EDM, Total Station, Theodolite, Inclometers and any other equipments/ instruments deemed necessary for completion of works as per this specification.

- 3.2 Following type of surveys are covered under this specification:

- i) Pipeline route centerline survey as per Appendix-A
- ii) Detailed pipeline route survey as per Appendix-B
- iii) Soil investigation surveys as per Appendix-C
- iv) Population density survey as per Appendix-D
- v) Cadastral survey as per Appendix-E





Specific requirements of surveys for a particular Project shall be as indicated in Contract.

- 3.3** Normally detailed route survey shall be carried out after centerline survey has been completed and the pipeline route established on ground has been accepted by the Company. In case the pipeline route has already been identified by the Company and/ or the centerline survey is not required to be carried out by the survey contractor, the Surveyor shall make himself fully aware of the general conditions of the terrain along the pipeline route prior to start of survey work.
- 3.4** In case, the pipeline for which the route survey is proposed to be carried out is to be used for transportation of hydrocarbons in gaseous phase, the population density survey shall be carried out as per Appendix-D of this specification.
- 3.5** All major crossings and routing in critical areas shall be finalized by Surveyor in consultation with Company Representative. Company may depute its representative during the survey work to assist the contractor in finalizing such location at its sole discretion.
- 3.6** The Surveyor shall avoid major deviations from identified/ established route during detailed survey. Any such major deviation must be approved by Company representative.

Surveyor shall clearly specify reasons for such deviations while submitting his proposal for change in route.

- 3.7** When so specified in contract document the Surveyor shall locate dump site(s), for storage of line pipe and other pipeline materials, along pipeline route.

Unless specified otherwise in data sheet/ contract document the dumpsite(s) shall be located at 75-100 km interval and shall have an area of 5 - 10 hectares.

Following aspects shall be taken into account while selecting dumpsite location(s):

- a. Dumpsite should preferably be a barren land free from water logging/ low lying areas.
- b. The site shall be located in close proximity of identified/ established route.
- c. It should be in the vicinity of National/ State Highway.
- d. The site should be nearly flat with minimum undulation that might require earth work (fill-up and earth-cutting).
- e. Site should not be under overhead power lines.
- f. Site should preferably be on government land.

#### **4.0 SURVEY NOTES, OBSERVATIONS AND COMPUTATIONS**

- 4.1** The procedures followed both for field and office calculations shall be such that the results obtained shall be maintained by surveyor.
- 4.2** All up-to-date notes and observations related to the basis for determination of boundary lines and corners shall be maintained by surveyors.
- 4.3** Survey records must contain schematic diagrams of all horizontal controls pertinent to the project showing all existing and established control points, bench marks, any triangulation station and boundary lines.



- 4.4 Geo-graphical and UTM co-ordinates of all Turning Points and starting/ end points of the pipeline shall be computed and furnished to the Company Representative.

## 5.0 DOCUMENTATION

### 5.1 MAPS & DRAWINGS

All maps and drawings shall be made using standard formats enclosed with this specification. The Surveyor shall perform all mapping and drawing work so as to contain all relevant data consistent with the survey notes and observations according to Cl. No. 3.0. The drawings shall also contain details of roads, streets, highways, structures, all types of crossings, terrain, surface vegetation and all other details which will be required for the purpose of engineering design. The type of drawings and maps to be prepared shall be as per requirements specified under Appendix-A to Appendix-E.

### 5.2 REPORTS

The reports to be prepared by Surveyor shall be exhaustive and shall contain all relevant information. The report shall describe in brief the survey methodology adopted, equipment used and tests (if required) conducted for obtaining the details/ data presented in the report. The final results/ conclusion shall be based on sound practices and detailed analysis of the data collected. The report must include recommendations as applicable for the Company's consideration.

### 5.3 DRAWING/ DOCUMENT SUBMISSION

All drawings and document shall be prepared using computers. Hard copies and soft copies of all required drawings and documents shall be submitted to Company for review/ approval. The Company shall review and comment, if any, shall be passed on to the Surveyor. The Surveyor shall incorporate all comments, including carrying out fresh field works/ laboratory testing (when required) and revise the drawing/ document to entire satisfaction of Company. Number/ sets of hard copies and soft copies of each drawing and document (submitted for review/ comments by Company) shall be as indicated in Contract.

Once the drawings/ documents have been reviewed by the Company and updated by surveyor to entire satisfaction of Company, the Surveyor shall submit entire documentation (drawings, maps, reports etc.) both in hard copy as well as soft copies for Company's records (number of copies as specified in Contract). All hard copies shall be signed and stamped by Surveyor. All drawings/ reports/ formats etc. submitted to the Company shall be prepared on electronic media. All drawings/ sketches shall be prepared using Auto CAD release 2006 or above. All reports and write-ups shall be in Microsoft Office software. All photographs shall be in JPG/ TIF format. Whenever data base is used for presentation of data (population density, ground profile etc.), the same shall be prepared in Access Data Base Software using Microsoft Office release 2006 or above. Final approved survey data/ documents shall be submitted to Company on CD ROMs.



## **APPENDIX-A**

### **PIPELINE ROUTE CENTRELINE SURVEY**

#### **1.0 OBJECTIVE**

The objective of the centerline survey work is

- i) Physical verification of the identified route and confirm its suitability for pipeline construction.
- ii) Identify restrictive areas and suggest modifications/ detours to the identified route.
- iii) Establish the route on ground.
- iv) Collection of development plans along the proposed pipeline route from various agencies having jurisdiction thereof.
- v) Collecting information required for obtaining clearances from various authorities including environmental clearances.

#### **2.0 REQUIREMENTS**

##### **2.1 GENERAL**

**2.1.1** The Company shall provide the Surveyor identified pipeline route details.

**2.1.2** The Surveyor shall transfer the Company identified route onto Survey of India (SOI) topographic maps (in scale 1:250,000, 1:50,000 or less in case identified route passes through hilly areas) for use during field verification and preparation of route maps. The maps for this purpose shall be arranged by Surveyor unless specified otherwise in contract. For section of the identified pipeline route covered in maps identified/ declared by SOI as "Restricted" maps, Company may arrange such maps and make them available to the Surveyor during field verification. Surveyor may also use satellite imagery for updating of SOI maps, if required, as per provisions of Contract document.

**2.1.3** Surveyor shall carryout reconnaissance survey as necessary to orient the most practical alignment along identified route using best judgment and experience of the Surveyor to interpret the needs of pipeline construction. The Surveyor shall use Global Positioning System (GPS) and other survey equipment such as magnetic compass, inclinometer, theodolite etc. as required during the reconnaissance survey.

**2.1.4** The Surveyor shall locate and identify all existing features and obstructions along the route, identified by Company, and within a corridor of 5 km on either side of centerline that are not shown in the available maps and update the SOI maps to reflect such changes. Surveyor shall collect all development plans from the concerned authorities.

**2.1.5** Surveyor shall establish stakes/ mark flag control points on ground along the centerline of route. Flag control points shall be clearly identified on the route maps. The flag control points shall also be established at all major road, rail, canal, pipeline, river crossings and terminal locations.



## 2.2 PIPELINE ROUTE DEVIATION

- 2.2.1** Surveyor in general shall avoid any major deviation from the route identified by Company. Deviation from route, if considered essential by the Contractor, shall be brought to the notice of the Company representative for Company's approval.
- 2.2.2** Contractor shall avoid obvious man made or natural obstructions such as culverts, bridges, utility poles, buildings/ structures, gorges, plantations, archaeological sites, reserve forest, environmental sensitive areas, mining sites, future built-up areas etc.
- 2.2.3** Surveyor shall take into account following criteria while selecting pipeline route alignment in hilly areas/ ghat regions etc.
- A longitudinal slope along pipeline route shall not exceed 1:5
  - A transverse slope across pipeline route shall not exceed 1:1
  - As far as possible ridges/ spurs should be used to climb up/ come down from hill. Side slopes of hills requiring excessive side hilling should be avoided.

Hand held inclinometer shall be used for estimation of slopes

- 2.2.4** Centerline alignment thus established shall be shown prominently on the route maps. In addition chainage in km, major turning points, intermediate facilities, planned developments, existing features/ obstructions, flag control points etc. shall also be marked on route maps.

## 2.3 FIELD MARKING

- 2.3.1** The entire length of the surveyed route shall be staked on ground along the proposed centerline. Stakes shall be 8 mm dia. painted twisted rods. Sketches/ photographs to facilitate location of stakes in field shall be furnished giving reference of existing features wherever. major directional change takes place.
- 2.3.2** Stakes shall be installed at flag control points, major crossings, major turning points and at an approximate 1.5 to 2.0 km interval as dictated by field conditions.
- 2.3.3** Consideration shall be given to land use in placing the stakes e.g. stakes placed and left in cultivated land may not be acceptable to the land owner. Stakes in such areas shall be placed at boundaries between cultivated areas where necessary.

## 3.0 PRESENTATION OF SURVEY DATA

Centerline survey data shall be presented in the form of following drawings/ documents:.

- Pipeline route map showing route on SOI Topo sheets of scale 1:50,000 or 1:25,000 for unrestricted areas. (SOI topo sheets shall be updated for distance of 5 km on either side of pipeline centerline).
- Pipeline route maps showing route on maps developed from SOI topo sheets or satellite imageries of 1:50,000 or 1:25,000 scale for areas covered in "Restricted" SOI maps.
- Overall pipeline route map in 1:500,000 scale.
- Ground profile drawing and ground elevation v/s pipeline chainages in Microsoft Access software (ground elevations to be furnished on an average at every km interval or at



locations where major change in ground elevation occurs).

- e. Route report consisting of but not limited to following:
- i) Route Description
  - ii) Topographic features
  - iii) Major Crossing details
  - iv) Extent of reserve forest
  - v) Land use pattern and soil strata along route.
  - vi) Developments plans
  - vii) Estimates for land cost for ROU acquisition.
  - viii) General metrological details
  - ix) Site photographs. (Photographs shall be sufficient in numbers to represent the entire terrain features).
  - x) Dump site locations suitable for pipe storage (when specified)
  - xi) Ground Profile along the route
  - xii) Comparison of alternative routes considered



## **APPENDIX-B**

### **DETAILED ROUTE SURVEY**

#### **1.0 OBJECTIVE**

Objectives of detailed pipeline route survey are as follows:

- a. To fix the pipeline alignment on ground.
- b. To determine exact pipeline route length.
- c. Finalize crossing locations and crossing angles.
- d. Establish survey monuments on ground along pipeline route.
- e. To obtain detailed topographic features within 30 m on either side of centreline.
- f. To obtain ground levels and/ or contours.
- g. To obtain cross-section details and topographic features at all crossings.
- h. To gather details of land use pattern and soil characteristics

#### **2.0 REQUIREMENT**

**2.1** Pipeline route and turning points (TPs) along the pipeline route shall be located by the Surveyor in consultation with Company Representative considering the following:

- a. To avoid obstructions along the line, by ranging on ground and shifting the Turning Points if need be.
- b. Terrain gradient to be checked by using hand held inclinometer.
- c. Ensure proper angle of crossing by keeping as nearly right angle (to road/ canals/ rail/ rivers/ streams, etc.) as possible. The right angle may be laid on ground by using a chain or string lengths in ratio of 3, 4 and 5.
- d. To check from construction point of view and avoid objects like power, telephone and telegraph poles, walls, tube wells or such other structures falling in the strip of land, 30m on either side of pipeline alignment.
- e. To maintain minimum distance of 100m between two consecutive turning points.
- f. "R.C.C. Pillars shall be provided with reinforcement of 4 nos. - 6mm dia bars with 4 equally spaced rings of 6mm dia. All pre-cast R.C.C. pillars should also be engraved with Company name on one shorter vertical face."
- g. Surveyor shall locate and identify the existing features or obstructions along the route that are not shown in available maps or drawings.
- h. Archeological sites, reserved forests, environmentally sensitive areas, mining sites and built-up areas shall be avoided.
- i. Where it becomes apparent that a better route could be followed, the Surveyor shall consult the Company Representative for authorization to make a change.



## 2.2 STAKING OF PIPELINE ROUTE

**2.2.1** The pipeline defining trench centre line shall be staked by placing suitably painted marker stakes at Turning Points (TPs) and at Intermediate Points (IPs) between consecutive TPs. All Turning Points (TPs) and Intermediate Points (IPs) are referred as Intersection Points.

The pipeline centre line shall be staked on the ground as follows:

First, the Turning Points (TPs) shall be staked on the ground. After locating and marking the TPs, the intermediate points shall be staked while measuring slack distance. The staking shall normally be done at intervals of 500 m along the centre line of the pipeline.

**2.2.2** The Intersection Points shall be serially numbered from the starting point. The serial number of each Intersection Point shall be boldly inscribed on the marker stake. In addition, the Turning Point (TP) marker stake shall identify the Turning Point reference number from the starting point.

**2.2.3** For Intermediate Points (IPs) letter "P" shall precede the serial number of the intersection point marker. For Turning Points, the letters "TP" shall precede the Turning Point reference number, and the letter "P" shall precede the serial number of the Intersection Point.

**2.2.4** The marker stakes at Turning Points (TPs) shall be referred with three reference stakes around the TP. The reference stakes shall carry the Turning Point reference number and their respective distance from the TP marker stake.

**2.2.5** Change in direction of line shall be marked on the TP marker stakes. In addition, direction markers near TPs and other locations shall be placed wherever necessary.

## 2.3 STAKES AND MARKERS

**2.3.1** All marker stakes shall be pre-cast reinforced concrete blocks having dimensions 150 x 200 x 800 mm, and shall be buried to a depth of 500 mm. Stone pillars of similar dimensions can be used in place of concrete blocks.

The exposed surface of the blocks shall have a smooth finish and shall be painted with 'Post Office' red paint. All letters and figures shall be paint marked on the surface of the blocks in white.

**2.3.2** On the top surface of the marker stake, a cross inside a circle shall be engraved at the centre or a nail shall be put centrally inside an engraved circle, to indicate the exact position of the Intersection Point. The circle shall be of approximately 50 mm diameter.

**2.3.3** Surveyor can, however, propose to the Company Representative other types of stakes/markers which are better suited to site conditions.

## 2.4 BENCH MARKS

**2.4.1** Permanent Bench Marks (BM) approx. every 5 km or permanent structures on or off the Right-of-Use (ROU) shall be established and described. Bench marks shall be located in such a manner that they will not be destroyed when the ROU is cleared for construction.

**2.4.2** Additional permanent bench marks shall be established near the major pipeline crossing sites.

**2.4.3** Location of Bench Marks shall be established in the field by using reinforced concrete/ stone blocks similar to pipeline marker stakes described in clause 2.3.1 of this specification. Exact position of BM shall be marked by a cross inside a circle or a nail put centrally inside an





engraved circle on the top surface of the concrete block. The reduced level of the BM shall be paint marked on the concrete block. Letters "BM" shall precede the reduced level of bench mark recorded to the second place of decimal.

- 2.4.4** Accuracy of the reduced levels of the Bench Marks shall be verified wherever possible by checking levels with the nearest permanent Bench Mark established by Survey of India.

## **2.5 CROSSINGS**

### **2.5.1 GENERAL**

As far as possible, crossings shall be made at right angles. The Surveyor shall record the angles of crossing for all fences, property lines, utilities, roads, railways, canals, streams, etc. that are crossed. In addition, the true bearings of the centerline of the road, railway, canal, as well as that of the pipe centre-line shall be recorded. Turning Points (TPs) provided on either side of crossings shall be located, minimum 50m from the crossing's boundaries, in stable and firm ground.

### **2.5.2 RAILWAY CROSSINGS**

The angles for all railway crossings shall be as close to 90 degrees as possible, but in no case be less than 85 degrees to the centre-line of the railway.

### **2.5.3 PRIMARY ROAD CROSSINGS**

Primary roads are the National & State Highways, all-weather roads (paved/ unpaved) and roads providing access to major installations. The angle of crossings shall be as close to 90 degrees as possible, but in no case be less than 80 degrees to the centre line of the road.

### **2.5.4 SECONDARY ROAD CROSSINGS**

The angles of crossing for secondary roads shall be as close to 90 degrees as possible, but in no case less than 45 degrees to the centre-line of the roads. All seasonal roads, unpaved village roads, cart-tracks, etc. come under this category.

### **2.5.5 RIVER CROSSINGS**

These crossings shall be established as close as possible to the locations shown on the route map. Crossings shall be located in a comparatively straight reach of the river where the banks are stable and there is sufficient area for construction. Angle of crossing shall be as close to 90 degrees as possible.

### **2.5.6 CANALS/ DRAINAGE/ STREAM/ NALA/ DITCH CROSSINGS**

The angle of crossing shall be as close to 90 degrees as possible but in no case be less than 60 degrees to the centre-line of the canal/ drainage/ stream/ nala/ ditch. Crossings shall be located where there is no evidence of slumping or erosion of banks, or bed.

### **2.5.7 UTILITY CROSSINGS**

Utilities crossed shall be located at their centerlines with stakes containing station numbers in the survey. The angle of crossings shall be measured and locations established relative to their above ground facilities. The names and sizes of all utility lines shall be included in the survey notes. In cases of overhead power and telephone lines, the distance to the poles and





towers on each side of the survey line shall be measured, and the numbers of poles or towers noted. Line voltage shall also be recorded. Where possible, the survey shall be established so that there is a minimum distance of 50 meters from the survey line to the nearest High Tension (11KV and above) pole or tower.

Underground utilities shall be located as far as possible and staked for a minimum distance of 30 meters on each side of the survey line.

## **2.6 BUILT-UP AREAS**

### **2.6.1 MONUMENTS AND PROPERTIES**

The pipeline alignment shall run clear of the existing monuments, properties and structures etc., as indicated in Pipeline Route Survey Data Sheet (Refer Annexure-I for sample).

For congested areas, closer distance may be adopted; however, location shall be approved by Company Representative.

### **2.6.2 PARALLEL ALIGNMENT**

The pipeline alignment wherever runs parallel to an existing or planned under/ over ground facility will be treated as parallel alignment. For underground facilities Surveyor shall identify and locate them with suitable pipe locator/ cable locator. The following clearances shall be observed in case of parallel alignment defined above unless specified otherwise:

- a. Between existing/ planned electrical power cables/ lines and the proposed pipeline - 50.0 meters
- b. Between existing/ planned communication cables/ lines and the proposed pipeline - 25.0 meters
- c. Between existing/ planned pipeline and the proposed pipeline - 50.0 meters

### **2.6.3 PARALLEL ENCROACHMENT**

Unless otherwise stated, when the pipeline alignment runs generally parallel to a road or railway it shall be kept sufficiently clear of the Right of Way limits of the facility.

## **2.7 ACCURACIES IN MEASUREMENT**

**2.7.1** Surveyor shall incorporate corrections to the linear ground measurement due to standard errors (and variations from standard temperature and/ or pull in case of chain survey, wherever specifically approved by Company).

**2.7.2** The error for angular closure for the work shall not exceed one minute per station and for linear measurements it shall be read to the nearest 0.001 m.

**2.7.3** The error on closure for measurements on vertical distance to establish bench marks shall not be more than  $24\sqrt{K}$  millimeters (where 'K' is the linear distance in km). The observations for measurement of vertical distances on bench marks shall be read to accuracy to the nearest 5 mm and for Intersection Points and other points along the pipeline route and at crossings to the nearest 10 mm. The error of misclosure in vertical distance shall be distributed linearly.



- 2.7.4** Azimuth control shall be maintained by observations of the Sun or Polaris at intervals of 15-20 km by closing the traverse on existing control points. These observations of bearings together with deflection angles shall be recorded in survey notes.

Azimuth misclosure based on bearings with observed angles at Turning Points shall be equally distributed over the number of stations observed in between. Accuracy of azimuth observations shall be acceptable if the three deductions agree within one minute when Sun is used for Azimuth observation. In case of stars/ polaris observation, computed values should agree within 10 to 15 secs.

This check is not mandatory when using DGPS system for establishing location/ co-ordinates.

## **2.8 CHAINAGE**

- 2.8.1** Distance measurement shall be made by Electronic Distance Measurement (EDM) equipment (or by using 50 m steel tape or 30 m chain if specifically approved by the Company). However, in case of abrupt slope change the tape/ chain shall be used and it shall be straightened parallel to the probable grading.
- 2.8.2** Distance between Intersection Points staked along the pipeline route should be measured and recorded. In addition, distance between level points shall also be measured and recorded.
- 2.8.3** Chaining, wherever permitted, shall be continuous in the direction of survey.
- 2.8.4** The true bearing of all straights shall be observed and recorded.
- 2.8.5** Data on nature of terrain, viz. sandy, stony, vegetation, etc. and type of ground will also be recorded along with chainages of change points.
- 2.8.6** Check on distance measurements shall be by Stadia method at the time of leveling.
- 2.8.7** Standard survey formats shall be used for record keeping.

## **2.9 MEASUREMENT OF HORIZONTAL ANGLES**

- 2.9.1** Horizontal angles are measured to indicate the change in direction of alignment and specify the horizontal bend at the Turning Points.
- 2.9.2** Theodolite, reading directs to 10 seconds or better, shall preferably be used. Angles shall be measured clockwise from back station to fore-station. Mean of two readings-one on face left and other on face right shall be taken as the horizontal angle.
- 2.9.3** The line at both ends shall be tied to the grid control system being used for end facilities. True bearing at the beginning, end and at every 15-20 km shall be observed to keep a check on errors in angular measurements.

## **2.10 PROFILE**

- 2.10.1** Continuous profile of the proposed pipeline route shall be established from the reduced levels taken.

i) at the starting point,



- ii) at all Turning Points (TPs),
- iii) at all Intermediate Points staked on the ground,
- iv) at all points on the pipeline route where there is a change in slope.

**2.10.2** When the terrain is flat, reduced level shall be additionally recorded along the pipeline route at 100 m interval.

**2.10.3** When the terrain is undulating, observation of reduced level shall be made at a sufficient number of points so as to give an accurate plotting of the ground profile along the route.

**2.10.4** For road and railway crossings, the reduced levels shall be recorded at interval of 5 m along the pipeline alignment and at closure intervals wherever there is a change in slope within the entire width of the Right-of-Use of the road/ railway.

**2.10.5** For river/ stream/ nala/ canal crossings, levels shall be taken at intervals of 5 m up to 30 m beyond the highest banks on both sides. Levels shall be taken at closer intervals, if there is a change in slope.

**2.10.6** In right-of-use having slope across the pipeline alignment, as encountered in hilly areas, Ghat regions, ravines and other similar areas as directed by Company, cross-sections at 50 m interval and for a length of 30 m on either side of the pipeline alignment shall be observed and recorded.

**2.10.7** For major water crossing sites, cross section as above shall be observed at both banks.

**2.10.8** Method of RISE and FALL shall be used to compute reduced levels of various points. Check on computation shall be made by using the following formula:

$$\text{Back site} - \text{Fore Site} = \sum \text{Rise} - \sum \text{Fall} = \text{First R.L.} - \text{Last R.L.}$$

**2.10.9** Maximum misclosure shall not exceed  $24\sqrt{K}$  mm where 'K' is the distance in km. Maximum length of line of sight shall not exceed 100 m.

**2.10.10** All levels shall be with respect to Mean Sea Level (MSL).

## **2.11 CO-ORDINATES AND GRID**

**2.11.1** Differential Global Positioning System (DGPS) shall be used to determine co-ordinates of all intersection points and facilities along pipeline route. Accuracy of co-ordinates shall be within 0.5 meter. Non-differential or autonomous GPS are not acceptable.

The following information shall be submitted for DGPS proposed by Surveyor for Company approval:

- GPS Receiver Model used:
- Differential Receiver Type:
- Guaranteed accuracy in meters:

Surveyor shall submit a procedure for setting up & use of DGPS. All co-ordinates shall be indicated in UTM grid as well as geographic grid. In case more than one survey party is deployed, each party shall use same reference grid and DGPS system.

## **2.12 LEVELS AND CONTOURS**



**2.12.1** In addition to the elevation along centre line of route, the Surveyor shall obtain, using Total Station, levels within 30 m wide corridor on either side of route alignment. Co-ordinates (in UTM grid) of each level point shall also be recorded.

**2.12.2** All such level points shall be plotted in the planimetry portion of the alignment sheets. The levels shall be taken in such a manner that contour can be drawn with a contour interval of 5 in. Surveyor shall draw the contours from the data collected.

**2.12.3** Electronic data shall be made available in a format compatible with commercially available Digital Terrain Modeling (DTM) software

### 3.0 PRESENTATION OF SURVEY DATA

The data collected during survey shall be presented in the form of drawing and document listed below:

#### 3.1 DRAWINGS

**3.1.1** As a minimum following drawings shall be prepared and submitted:

| S. No. | Description                                                                                                                                                         | Scale                                                                    |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| a.     | Detailed Route Map                                                                                                                                                  | 1:50,000 on SOI<br>Topographical Maps                                    |
| b.     | Additional Route Map                                                                                                                                                | 1:15,000                                                                 |
| c.     | Alignment sheets covering <ul style="list-style-type: none"><li>•Right-of-Use Planimetry in UTM grid</li><li>•Ground Profile</li></ul>                              | 1:2500 along the line<br>1:2500 across the line<br>1:2500 Horizontal     |
| d.     | Crossing Details<br>(Road/ Railway/ Stream/ Nala/ Canal/ Crossings)                                                                                                 | 1:100 Horizontal<br>1:100 Vertical                                       |
| e.     | Crossing details (River Crossings) <ul style="list-style-type: none"><li>•Up to 250 m width</li><li>•250 to 500 m width</li><li>•Greater than 500 m width</li></ul> | 1:200 Horizontal<br>1:200 Vertical<br>1:500 Horizontal<br>1:500 Vertical |
| f.     | Cross Section for sloping Right-of-Use                                                                                                                              | 1:100 Horizontal                                                         |

Note: Crossing drawings shall be prepared using same horizontal and vertical scales as indicated above. In case one crossing cannot be accommodated in single sheet additional sheets may be used. Not to scale (NTS) drawings shall be rejected.

**3.1.2** Pipeline route map shall show all features including, but not limited to roads and railroads, canals, streams, lakes, rivers, villages, towns, and cities that are located within a distance of 5 km from the pipeline centre-line on either side of it. For the entire region, contours shall be plotted on the route map at 20 m contour interval. Additional information like cultivated areas,



barren land, areas prone to flooding, rocky areas and forests including access paths/ roads to Right-of-Use shall also be shown on the route maps.

Additionally for areas which are undulating such as hilly areas, Ghat regions, ravines, and other areas as directed by Company, Pipeline route map to a scale 1:15,000 shall be drawn over a distance of 1.0 km from the pipeline centre-line on either side of it. For such areas, contours shall be plotted at 10 m contour interval.

- 3.1.3** Right-of-Use Planimetry drawings shall show all objects within 30 meters on either side of the Pipeline in Plan and shall show spot level & contours at 5m interval.
- 3.1.4** For all rail, road, river, stream, canal and utility crossings, the angle of crossing shall be mentioned.
- 3.1.5** For rail, road, river, stream and canal crossings wider than 10 m, the distances at the start and at the end of the crossing from the nearest IP shall also be mentioned. For crossings less than 10 m, the distance of the centre line of crossing from the nearest IP shall be given.
- 3.1.6** For all river, stream and nala crossings, the level of water at the time of survey, High flood level recorded in last 100 years and the approximate surface velocity of the flowing stream (observed & recorded during survey) shall be reported in the survey drawings. Also, the general nature of the surface soil (soft/ hard, normal soil or rock/ boulders) at the bed and banks of the river/ stream/ nala shall be observed and mentioned in the drawings.

Ground profile (chainage v/s ground elevation) for the entire pipeline route shall be prepared and presented in a tabular format using Microsoft Access Database format.

## 3.2 DOCUMENTS

In addition to the drawings listed above, the Surveyor shall submit a report giving,

- Details of survey methodology followed
- Details of equipments used
- Brief Route Description
- Salient features of the route such as
  - Total length of pipeline
  - State wise distribution of pipeline route
  - Terrain details and land use pattern summary
  - No. of crossings (state wise & chainage wise)
  - Details of River crossings
  - State wise extent of forest/ reserve forest/ environmentally sensitive area
  - Significant elevation changes along the pipeline route with chainages
  - Nature of soil (sandy, clay, rocky, marshy, etc.)
- Print out of information required to be submitted as data base including
  - Level & contour information for DTM
  - Pipeline Profile data
  - TP detail



## **APPENDIX-C**

### **SOIL INVESTIGATION SURVEY ALONG PIPELINE**

#### **1.0 Objective**

The objective of soil investigation survey is to obtain visual engineering classification of soil and geotechnical properties of soil for design & engineering of various facilities required along the pipeline route.

#### **2.0 Requirements**

##### **2.1 General**

**2.1.1** The soil investigation includes boring, collection of disturbed samples from bore holes and visual engineering classification of soil along the pipeline route, carrying out Standard Penetration Test (SPT) at specified locations and getting the soil sample collected, from such bore holes, tested at laboratory for specified engineering properties and submission of detailed report to Company.

**2.1.2** Visual classification of soil shall be in accordance with IS-1498; "IS Classification and Identification of Soils for General Engineering Purposes". Geotechnical investigation of soil shall be carried out as per relevant clauses of IS 1892 and other applicable IS standards.

##### **2.2 Location of Bore Holes**

**2.2.1** Boreholes shall be made at an interval of 250 m along the pipeline route, at all intermediate points where there is apparently a change in the type of soil and at other places as given below by Company/Engineer-in-charge.

**2.2.2** For canal, stream and river crossings, boreholes shall be made one on either bank and one on the bed of water crossing. For railroads, state highways and national highways, at least one bore hole shall be made at each crossing location.

**2.2.3** Boring shall be carried out in accordance with the provision of IS : 1892. Minimum diameter of boring shall be 150mm. Auger boring shall be resorted to above water table, whereas below water table the boreholes shall be advanced by rotary drilling with mud circulation through all kinds of soil other than rock. While boring above water table, no water shall be introduced in boreholes. Casing shall be used to support the sides of boreholes in soft to firm soil.

**2.2.4** Except for crossing location as defined under clause 2.2.5, the boring shall be either terminated at a depth of 3 m below NGL or on top of bed rock if rock is encountered at a depth of less than 3 m.

**2.2.5** In case of boring at Highways (National/ State), River and Railways crossings, the boring shall either be terminated at a depth of 5 m below NGL or on top of bed rock, if rock is encountered at a depth less than 5 m.

**2.2.6** Additionally, bore holes shall be made at all SV stations, IP stations and at all terminal locations.



### 3.0 Presentation of Survey Data

**3.1** Results of soil investigation survey and laboratory test carried out shall be submitted in the form of report covering as a minimum the following.

- a. Visual engineering classification of soils encountered along the pipeline route in bore log form. Depth of Ground Water Table (GWT) below NGL shall also be mentioned if encountered.
- b. Soil profiles along the pipeline route shall also be prepared and attached with the report.
- c. Regions along the pipeline route where hard rock is present and special excavation techniques like blasting, etc. needs to be adopted for excavation of pipeline trench shall be clearly indicated in the report.
- d. Summary of results obtained from various laboratory tests and their interpretation to evaluate various soil parameters.

**3.2** Visual engineering classification of soils obtained from bore holes shall be shown in Alignment sheets also, whenever preparations of alignment sheets are included in SURVEYOR's scope of work.



## **APPENDIX-D**

### **POPULATION DENSITY SURVEY**

#### **1.0 OBJECTIVE**

The objective of population density survey is to obtain details of population density (dwelling units, type of buildings, public places of gatherings etc.) along pipeline route in case of Gas pipelines and/ or high vapor pressure liquid pipeline

#### **2.0 REQUIREMENTS**

**2.1** When survey is performed for gas pipelines, the class locations based on population density index as per code ANSI B 31.8 "Gas Transmission and Distribution Piping Systems" shall be recorded along with chainages at change points of each class location.

**2.2** Population density index along the pipeline route shall be determined as follows:

A zone, 400m wide (one quarter mile), shall be considered along the pipeline route with the pipeline in the centre-line of this zone. Then the entire route of the pipeline shall be divided into lengths of 1600m (one mile) such that the individual lengths will include the maximum number of dwellings intended for human occupancy. The number of such dwellings which are intended of human occupancy within each 1600m (one mile) zone shall be counted and reported along with other survey data.

**2.3** Areas shall be classified based on guidelines as given below:

a. Class 1 Location

A Class 1 Location is any 1600m (one mile) section that has 10 or fewer dwellings intended for human occupancy.

b. Class 2 Location

A Class 2 Location is any 1600m (one mile) section that has more than 10 but less than 46 dwellings intended for human occupancy.

c. Class 3 Location

A Class 3 Location is any 1600m (one mile) section that has 46 or more dwellings intended for human occupancy except when a Class 4 Location prevails.

d. Class 4 Location

A Class 4 Location includes areas where multi-storey buildings are prevalent, and where traffic is heavy or dense and where there may be numerous other utilities underground.

**2.3.1** In addition to the criteria contained in Clause 3.1, while classifying areas, additional consideration must be give to possibilities of increase in concentration of population along the pipeline route such as may be caused by the presence of schools, hospitals, recreational areas of an organized character, places of assembly, places of worship etc. If one or more of these facilities are present, the area shall be classified as a Class 3 Location.





**2.3.2** Notwithstanding the provisions of Clause 3.1 and 3.2 above, while determining class location of an area, due consideration shall be given to the possibility of future development of the area during the design life of the pipeline. If it appears likely that future development may cause a change in the location class, this shall be taken into consideration while determining its class location.

### **3.0 PRESENTATION OF SURVEY DATA**

**3.1** The population density data shall be presented to company in company supplied data base in electronic form.

**3.2** Hard copies print out of electronic data shall also be furnished.

**3.3** The drawings (alignment sheets) showing population density data. In case alignment sheets are not prepared by surveyor, the same shall be made available by company for marking of population density data.



## **APPENDIX-E**

### **CADASTRAL SURVEY**

#### **1.0 OBJECTIVE**

The objective of cadastral survey is to identify the ownership & land use details and collect data/ all other details sufficient for acquisition of ROU, under the Petroleum and Mineral Pipelines (Acquisition of Right of User in land) Act 1962 of Government of India, along the pipeline route identified by Company and duly surveyed and established on ground.

#### **2.0 REQUIREMENTS**

**2.1.** The Surveyor shall be responsible for collecting all revenue and other maps as well as arranging all necessary forms required for carrying out cadastral survey at his own cost. Company will assist the Surveyor by way of issue authorization letter only. Alignment of established pipeline route will also be made available to Surveyor.

**2.2.** Preparation of Cadastral Maps in 1:2500 scale as per the format approved by the Company showing the pipeline route and areas 30 m on either side of pipeline route to show the following details in cadastral maps.

- a. Pipeline alignment as per details made available
- b. ROU limit on either side of centerline as per details given in Data Sheet. ROU limit at turning points shall be marked in a curve having turning radius of 50 times pipe line outside diameter for pipeline size 18" & above. The pipeline diameter shall be indicated in data sheet. In case of multiple lines in same ROU, the largest pipe size shall be considered for this requirement.
- c. Property identification/ survey number, Part "Hissas" on survey numbers as per the latest official revenue records.
- d. Identification of ROU of existing pipelines/ utilities/ rail, roads, canal, river and other pipeline crossings on the Cadastral maps.
- e. Number and type of trees within ROU limits.
- f. Other major features such as given below:
  - All built up areas.
  - Religious places, schools, dharamshala, hospitals etc.
  - Railway lines, National/ State Highways and district/ village and Panchayat roads.
  - Creeks, rivers, canals, drains etc.
  - Forest land (Reserved/ Protected/ Social).
  - Industrial Land.
  - Quarry/ mining and other prohibited areas.
  - Over-head/ underground utility crossings

The above information shall be adequate in all respect for ROU acquisition and obtaining forest clearance (if any).

**2.3.** Arrange for and furnish VII and XII extracts in duplicate of all land areas covered/ shown in cadastral map as per clause 2.2 above. The extracts are required to be duly certified by the local concerned authorities. Expenses in obtaining these extracts shall be borne by the Surveyor.



- 2.4.** In respect of the map at 2.2 above, marking of part "Hissas" as per the latest revenue records shall be checked/ verified by the local concerned authorities. Surveyor shall ensure that the land records are submitted to Company for checking and verifications as work proceeds.
- 2.5.** Surveyor shall also prepare a schedule, as per format to be approved by Company Representative, showing information on part "Hissas" and details of ownership (to be extracted from map at para 2.2 above for obtaining pipeline Right of Use (ROU)).
- 2.6.** Surveyor shall prepare a summary of ownership details of land covered within 30 m on either side from the centerline of pipeline giving all relevant details village wise including land cost and crop cost supported by the relevant documents from respective Tehsil/ District head quarters.
- 2.7.** Surveyor shall furnish requisite Performa (number of copies as specified in the Contract) duly completed on proper schedule form, including of procurement of all revenue maps and forms required from revenue department, submitting all proposal. village wise and Tehsil wise.

### **3.0 Presentation of Survey Data**

The Surveyor shall submit all survey data in the form of following drawings/ documents:

- 3.1** Cadastral maps in scale 1:2500 as per clause 2.2 above.
- 3.2** Cadastral Survey Report including summary of ownership details, land and crop cost detail and other documents as per clause 2.5 & 2.6 as above.
- 3.3** All revenue maps collected by the Surveyor from various authorities
- 3.4** All forms/ performas necessary for estimation of land cost.
- 3.5** Any other detail as specified by Company.



## **APPENDIX-F**

### **PIPELINE RECONNAISSANCE SURVEY**

#### **1.0 SCOPE**

The scope of work includes study of Survey Of India (SOI) topographic maps, route alternatives, development of project cost estimates, identification of major/minor crossings (like river, streams, nallahs, canals, railway, NH ,SH etc ) including approximate width, visual identification of type of soil, congestion of underground facilities limited up to visual inspection and local enquiry, collection of Land use pattern(cultivated, barren, protected/reserved/social forest), identification of areas which may pose problem during construction and acquisition, suggesting alternative routes for detailed survey estimation of pipeline length, approx. cost estimates for acquiring R.O.U. along pipeline route, determination of broad population density index, tentative location/ area for locating permanent facilities such as sectionalizing valves, terminals, Tap-Offs and other facilities including booster stations, if any. Providing details for existing hydrocarbon and other mineral pipelines.

The reconnaissance survey shall be carried out proposing minimum three or more feasible alternative routes and giving details of likely crossings and other constraints that is likely to be encountered during pipeline construction on each route, future development plans of land owning authorities like local Municipal authorities, Gram Panchayat, PWD, Railway, NHA/SH , etc, availability of land including ownership details for setting up of CNG stations, DRS stations, PCP (permanent cathodic protection) stations, potential Industrial consumers for PNG usage and recommending the best feasible route .

#### **2.0 REQUIREMENT**

- 2.1.** All survey works shall be performed by or under the supervision of a qualified surveyor.
- 2.2.** All measurement shall be in metric units.
- 2.3.** The readings and noting shall be neat, legible and the Surveyor shall duly initial scorings and over-writing.
- 2.4.** The length of all alternatives shall be clearly mentioned and shown separately in drawing.
- 2.5.** Also routes should be suggested based on considerations regarding execution feasibility, minimum length, permission feasibility and minimum obstructions.
- 2.6.** The side of road or structure along which the proposed pipeline will pass should also be mentioned with proper reasoning for the same.

#### **3.0 RESPONSIBILITY OF COMPANY:**

- 3.1.** The Company will Provide Brief Feasibility Report (Refer Attachment) which includes give only location of the two points i.e. the start and end points of the pipeline route. All the other responsibility will be tenderer's.

**4.0 CROSSING:****4.1. General**

- 4.2.** As far as possible, crossings shall be made at right angles. The Surveyor shall record the crossing number, approximate width and chainages at all crossings for all fences, property lines utilities, roads, railways, canals, stream etc., that are crossed shall be mentioned in the report. Crossing shall be located where there is no evidence of slumping or erosion.

**4.3. Utility Crossings**

The underground facilities such as drainage lines, telephone lines, electrical cables etc. which may cause problem during execution of pipeline shall be located using pipe/cable locator/ground positioning radar system and shall be shown in drawings. Accordingly suggestion shall be given on the side of road (or any structure) the pipeline should pass.

**5.0 PROFILES:**

The general ground profile shall be mentioned in the report. Also any major change in the profile shall be mentioned in the report. At all crossings the ground profile shall be specifically mentioned.

**6.0 REPORT AND DRAWINGS:**

- 6.1.** The drawing shall be prepared in the standard format and inclusive of all the details mentioned above. Also draft report of the same shall be submitted. The report and drawings shall be approved by GGPL before final submission of drawing and report

**ANNEXURE-I****PIPELINE ROUTE SURVEY DATASHEET**

|                                       |   |                                                                                                                                           |
|---------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------|
| Gradient (ROU)                        | : | 1:5 (max.) Along pipeline alignment<br>(See note-5)<br>1:10 (max.) Across pipeline alignment                                              |
| Bend Radius                           | : | 30 D for pipeline size up to 16"<br>40 D for pipeline size greater than 16"<br>(D= Outside diameter of pipeline)                          |
| Minimum Distance between TP's         | : | 100 m                                                                                                                                     |
| Maximum Deflection Angle at TP        | : | 90°                                                                                                                                       |
| ROU width                             | : | 20 m (5 m in left and 15 m in right side of<br>pipeline centerline while viewing in the direction<br>of flow) unless specified otherwise. |
| Minimum distance                      |   |                                                                                                                                           |
| from existing Habited dwellings       | : | 15 m                                                                                                                                      |
| from Buildings/ structures/ monuments | : | 50 m                                                                                                                                      |
| Co-ordinates of starting point        | : | To be filled by Survey Contractor                                                                                                         |

**Notes:**

1. Number of TP's along the pipeline route shall be kept to a minimum. Additional traversing required for TP optimization shall be carried out by the Contractor prior to finalization of TPS.
2. Chainages for pipeline shall start with 0.0 chainage in the direction of flow for each part. In case of spur lines the branch off location from trunk line shall be chainage 0.0 km.
3. At road/ rail/ canal crossing locations, nearest TP on either side shall be located at a distance not less than 50 m from the ROU of the facility being crossed, unless instructed otherwise by Company Representative.
4. In case of major river crossings, no TP shall be located within 150 m from the defined bank on either side, unless instructed otherwise by Company Representative.
5. Slope up to 1:5 can also be acceptable for hill section.

**ANNEXURE-II****SAMPLE FORMATS**

Surveyor shall prepare all drawings as per the enclosed formats. Soft copies of formats will be provided at appropriate time.

1. Alignment Sheets
2. Pipeline Route Maps
3. River Crossings
4. Nala/ Canal Crossings
5. Rail Crossings
6. Road Crossings.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR GEOTEXTILE BAGS

VCS – SS – PP - 2018

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 02      | 29.04.2022 | RP          | MC         | HK          | GW            |
| 01      | 28.01.2020 | MB          | MC         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                                                      |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                                                                                 |
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|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                                      |
| 01              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document numbering updated from VPC-SS-PL-0031 to VPC-SS-PP-2018                                                     |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                                                                      |
| 02              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                  |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                                                                      |
|                 |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                                                      |
|                 |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                                                      |

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## 1.0 SCOPE

- 1.1** This specification covers the minimum requirements for design, manufacture and supply of non-biodegradable geo-textile bags (made from polypropylene fabric) intended to be used for providing anti-buoyancy measures when filled with dredged materials.

## 2.0 DESIGN

- 2.1** The geo-textile bags shall be suitable for pipeline diameter and wall thickness indicated in the Material Requisition.
- 2.2** The factor of safety to be used for anti-buoyancy calculations shall be as specified in the Material Requisition.
- 2.3** Geo-textile bags shall be suitable for filling with dredged materials. Composition and other details of dredged materials shall be as specified in material requisition.
- 2.4** The geo-textile bags shall meet the following requirements:
- Body fabric material must be rated for geo-textile use and as such must be woven with minimum permeability rating to suit specified dredged materials.
  - Geo-textile bags shall be of top loading fabric-type made from woven polypropylene.
  - The centre-to-centre spacing between a set of geo-textile bags shall be kept minimum possible but in no case shall it exceed 6.0 meters.
- 2.5** Buoyancy force (upward force due to submerged 16" NB outside diameter, 3 layer PE coated pipe) of 200 kg/m shall be considered in design calculations for installation of geo-textile bags.
- 2.6** Manufacturer shall take prior approval from Owner on details of geo-textile bags and design calculations.
- 2.7** The fabric weights to be used in the pipeline should be from a manufacturer with a minimum of 5 years continuous, successful experience in production of geo-textile fabric weights for pipeline buoyancy control application. Manufacturing plants must be an ISO 9002 certified facility to ensure consistency in quality.
- 2.8** The proposed bags and associated straps etc. shall not be detrimental to the pipeline coating in any manner.
- 2.9** Repair of bags, in any manner is not permitted.

## 3.0 MATERIAL

- 3.1** The body fabric must be treated for UV protection and longevity. The weight of the body fabric must be a minimum of 400 gms/m<sup>2</sup>.
- 3.2** All material used in the fabrication of geo-textile bags such as webbing, lifting loops, threads etc. shall be polypropylene material.
- 3.3** All webbing must have a minimum individual tensile rating of at least 2268 kg. With a combined safety rating of 4 times the capacity.
- 3.4** Body fabric must have a maximum elongation rating of 15% and be stable within a pH range between 2 to 12.
- 3.5** All testing should be as per ASTM or equivalent standards

## **4.0 DELIVERY, STORAGE AND HANDLING**

- 4.1** Geo-textile bags shall be delivered on pallets with a black protective cover for easy handling and storage.

## **5.0 MARKING**

- 5.1** On each black protective cover the following shall be marked by suitable means "Maintain cover or provide separate cover on bags until use. Ensure proper protection from oil, dirt, sunlight etc."
- 5.2** Each geo-textile bag shall be marked by indelible paint or other suitable methods with the following minimum information:
- Product model
  - Name of Manufacturer
  - Dimensions of bag in mm.
  - Weight carrying capacity (Total weight when filled)
  - Year, month of manufacture and product batch number

## **6.0 OTHER TECHNICAL REQUIREMENTS**

- 6.1** Manufacturer shall provide skilled persons for initial assistance / on the job training during filling and installation of supplied geo-textile bags. Schedule of installation will be communicated to manufacturer at an appropriate time. The duration of technical assistance shall be limited to five calendar days during which period it is expected that the pipeline installation contractor will get trained in filling & installation of 'PIPESAK'.

## **7.0 DOCUMENTATION**

- 7.1** Manufacturer shall furnish the following documents at the time of bidding:
- All necessary calculations to demonstrate the suitability of proposed geo-textile bags for pipeline anti-buoyancy measures under the specified design conditions. The manufacturer shall provide an undertaking that the proposed geo-textile bags are suitable for and complying with the requirements indicated in Material requisition.
  - All details of proposed geo-textile bags (such as dimensions, material used etc.) shall be furnished. Bidder shall highlight any special features if any.
  - General arrangement drawings of all items viz. set of geo-textile bags, hopper, loading arrangement etc.
  - Details of all associated equipment's (hoppers etc.), spares, tools etc. required to fill, transport and install geo-textile bags on the pipeline.
  - Complete descriptive technical catalogues describing the materials offered along with samples of geo-textile bags, its properties and installation instruction as applicable specifically to the project.
- 7.2** Prior to shipment of materials from manufacturer's works, Vendor shall furnish six copies of the following:
- Specific and detailed installation instructions with pictorial illustrations. Manufacturer shall highlight any precautions / safety measures to be taken.
  - Specific storage and handling instructions
  - Copies of final approved design calculations.

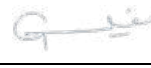


## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR WELDING OF ONSHORE HYDROCARBON PIPELINE

VCS-SS-PP-2019

|                                         |            |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-----------------------------------------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                                         |            |  |  |  |  |
| 04                                      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                    | GW                                                                                    |
| 03                                      | 04.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                    | HK                                                                                    |
| Rev. No                                 | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                           | Authorized By                                                                         |
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| CONTROLLED COPY : If in soft and signed |            |                                                                                     |                                                                                     |                                                                                       |                                                                                       |

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|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                    |                                                                   |
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|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                    |                                                                   |
| 04              |               |  |  |  |  | VCS QMS Integration                                               |
|                 | 29.04.2022    | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                    |                                                                   |

## ABBREVIATIONS:

|      |                                                |
|------|------------------------------------------------|
| ANSI | American National Standards Institute          |
| API  | American Petroleum Institute                   |
| ASME | American Society of Mechanical Engineers       |
| BS   | British Standard                               |
| CRT  | Cathode Ray Tube                               |
| CTOD | Crack Tip Opening Displacement                 |
| GMAW | Gas Metal Arc Welding                          |
| GTAW | Gas Tungsten Arc Welding                       |
| HAZ  | Heat Affected Zone                             |
| HV   | Vickers Hardness                               |
| IIW  | International Institute of Welding             |
| IQI  | Image Quality Indicator                        |
| ISO  | International Organization for Standardization |
| MPI  | Magnetic Particle Inspection                   |
| PQR  | Procedure Qualification Record                 |
| SMAW | Shielded Metal Arc Welding                     |
| UT   | Ultrasonic Testing                             |
| UTS  | Ultimate Tensile Strength                      |
| WPS  | Welding Procedure Specification                |

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## **1.0 SCOPE**

This specification covers the welding of carbon and low-alloy steel pipeline used in the transmission of hydrocarbons, covers welding of distribution systems. This specification applies to new construction of pipeline projects. The welding may be done by a shielded metal arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, plasma arc welding or oxyacetylene welding process or by a combination of these processes using a manual, semiautomatic or mechanized welding technique or a combination of these techniques. The welds may be produced by position or roll welding or by a combination position and roll welding.

This specification also covers the procedures for radiographic, magnetic particle, liquid penetrant and ultrasonic testing as well as the acceptance standards for destructive testing in Procedure Qualification and Non-Destructive testing methods viz. Radiographic, Magnetic Particle, Liquid Penetrant, Ultrasonic and visual.

It is intended that all work performed in accordance with this specification meets or exceeds the requirements of this specification

Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his Responsibilities and guarantees.

## **2.0 APPLICABLE CODE AND STANDARDS**

All welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions (editions in force at the time of floating the enquiry) of the codes, standards and specifications listed below:

- a) Code for Gas Transmission and Distribution Piping Systems, ASME B 31.8
- b) Standard for welding of Pipelines and Related Facilities, API 1104
- c) Specification for welding Electrodes and Filler Materials ASME Sec. II C
- d) Non-Destructive examination, ASME Sec. V

## **3.0 BASE MATERIAL**

In general carbon steel is used in this specification. The details of material specifications are given in the welding Specification Chart attached along with

other project data sheets. The CONTRACTOR will arrange and maintain the record of test certificates of all the materials for the reference of the welding engineer.

#### 4.0 WELDING CONSUMABLES

- a) The CONTRACTOR shall provide at his own expense all the welding consumables necessary for the execution of the job such as electrodes, oxygen, acetylene etc. and These shall bear the approval of the COMPANY.
- b) The welding electrodes / filler wires supplied by the CONTRACTOR shall conform to the class specified in the welding specification chart attached along with other project data sheets. The materials shall be of the make approved by the COMPANY.
- c) The electrode shall be suitable for the welding process recommended and the base metal used. Physical properties of the welds produced by an electrode recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in the Welding Specification Chart and shall correspond to the physical properties of the class of electrode adopted. The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and shall be the sole prerogative of the COMPANY.
- d) The CONTRACTOR shall submit batch test certificates from each electrode manufacturers giving details of physical and chemical tests carried out by them for each batch of electrodes to be used.
- e) Electrode Qualification test records shall be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the CONTRACTOR for obtaining the approval of the COMPANY.
- f) All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers (except cellulosic coated electrodes) shall be kept in the holding ovens, at the temperature recommended by the electrode manufacturer. Ovens shall be used for the low hydrogen electrodes only. Out-of-the oven time of electrodes before they are consumed shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering. Different grades of electrodes shall be stored separately. Cellulosic electrodes used shall however be used as per the specific recommendations of manufacturer.

- g) The electrodes used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.
- h) **Shielding Gas**: The composition and the purity of shielding gas when required by the welding  
Processes other than shielded metal arc welding, when permitted by the COMPANY shall bear the approval of the COMPANY. Where appropriate, gases or gas mixture of the following quality shall be used.
- I. Argon gas complying with BS 4365.
  2. Carbon dioxide gas complying with type 1 specified in BS 4105
  3. Gas mixtures that have been proved to be satisfactory as a result of procedure approval tests.
- When a gas mixture is used, which has specified additions, e.g. 2% O<sub>2</sub>, 5% CO<sub>2</sub> the variation of such addition shall not exceed  $\pm 10\%$  of that stated. Moisture content shall correspond to a dew point of -30°C or lower.

## 5.0 EQUIPMENT & ACCESSORIES

The CONTRACTOR shall have sufficient number of welding and cutting equipment, Auxiliaries and accessories of sufficient capacities to meet the target schedules.

- 5.1 All the equipment for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders with suitable calibration arrangements, etc. shall be provided by the CONTRACTOR, at his own expense and these shall bear the approval of the COMPANY. Adequate means of measuring current and voltage shall be available.
- 5.2 Redoing of any work necessitated by faulty equipment or operation used by the CONTRACTOR, will be done at his own expense.

## 6.0 WELDING PROCESSES

- 6.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc Welding process (SMAW) with the approval of the COMPANY.
- 6.2 The welding processes to be employed are given in the welding specification chart attached along with other project data sheets. Any deviation desired by the CONTRACTOR shall be obtained through the express consent of the COMPANY.
- 6.3 Automatic process shall be employed only with the express approval of the COMPANY. The welding procedure adopted and the consumables used shall be specifically approved.
- 6.4 A combination of different welding processes or a combination of electrodes of different classes / makes could be employed for a particular joint only after duly

qualifying the welding procedures to be adopted and obtaining the approval of the COMPANY.

## 7.0 BEVEL CLEANING / BEVEL INSPECTION

The Line Pipe supplied by COMPANY shall have bevel ends as specified in the applicable specification for the Line Pipe attached with the Bid Package. Any modification thereto, if required by the CONTRACTOR due to his special welding technique, shall be carried out by the CONTRACTOR at his own cost. Before welding, all the rust and the foreign matter shall be removed from the beveled ends by power operated tools. This shall be affected inside and outside and for a minimum distance of 25 mm from the edge of the weld bevel. The bevels shall be thoroughly inspected at this stage. If any of the ends of the pipe joints are damaged to the extent that, in the opinion of the COMPANY, satisfactory weld spacing cannot be obtained and local repair by grinding cannot be successfully done, the damaged ends shall be cut and beveled to the satisfaction of the COMPANY, with an approved beveling machine. Manual cutting and weld repairs of bevels is not allowed. Should laminations, split ends or inherent manufacturing defects in the pipe be discovered, the lengths of pipe containing such defects shall be removed from the line to the satisfaction of COMPANY. On pipes, which have been cut back, a zone extending 25 mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from laminations. The new bevel shall be 100% visual and 100% dye penetrant/MPI tested. A report shall be written for all the testing and records kept.

## 8.0 ALIGNMENT AND SPACING

Immediately prior to line-up CONTRACTOR shall inspect the pipe ends inside and outside for damage, dents, laminations etc. Pipe for welding shall be set up, correctly spaced, allowing for the temperature changes during welding. In correct alignment shall in no circumstances be sprung into position. Temporary attachments of any kind shall not be welded to the pipe. Welds joining the sections of the pipeline, valve installation or similar welds classified as tie in welds shall be made in the trench. Otherwise, the alignment and welding shall be made alongside the ditch with the pipe supported on skids and pack pads or other suitable means approved by COMPANY, at least 500 mm above the ground unless approved by the COMPANY in specific cases.

Seam orientation of welded pipe shall be selected to ensure that at the circumferential welds, the longitudinal welds shall be staggered in the top 90° of the pipelines, or 250 mm whichever is the lesser. A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50 mm. Should a section of the line containing uncompleted welds fall from the skids, the CONTRACTOR shall immediately inform the COMPANY.

Every effort shall be made to reduce misalignment by the use of the clamp and rotation of the pipes to the best fit. For pipe of same nominal wall thickness the offset shall not exceed 1.6 mm. The offset may be checked from outside using dial gauges. Any branch connection sleeve, etc. shall be at least 150 mm from any other weld. The welds for fittings shall be so located that the toe of the weld shall not come within 50 mm of any other weld. Cold dressing is permissible only in cases of slight misalignment and may only be carried out with a bronze headed hammer. Hot dressing shall not be permitted. When welding pipes of different wall thickness (as directed by COMPANY) a special transition piece shall be used. This shall have a minimum of 1:4 taper. The welds shall be subject to both ultrasonic and radiographic inspection.

The root gap shall be accurately checked and shall conform to the qualified welding procedure. The use of internal Line-up Clamps is mandatory for pipe diameters 10" and above. However, in some cases (tie-in welds, flanges, fittings, diameter of pipe 10" etc.) where it is impossible to use internal clamps, an external line-up clamp may be used.

The internal line-up clamp shall not be released before the entire first pass has been completed.

When an external line-up clamp is used, all the spaces between the bars or at least 60% of the first pass shall be welded before the clamp is released and the pipe remaining adequately supported on each side of the joint.

Segments thus welded shall be equally spaced around the circumference of the pipe. Slag, etc. shall be cleaned off and the ends of the segments shall be prepared by grinding, so as to ensure continuity of the weld bead.

## 9.0 WEATHER CONDITIONS

The parts being welded and the welding personnel shall be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be

carried out. The completed welds shall be suitably protected in case of bad weather conditions.

## 10.0 WELDING

### 10.1 Root Pass

- a) The root pass shall be made with the electrodes/filler wires recommended in the welding specification chart attached along with the other project data sheets. The size of the electrodes used shall be as per the approved welding procedure.
- b) Position or roll welding may be permitted. The vertical up method of welding shall be used for the root pass of the tie-ins, special crossings, fittings and special parts, fillet welds, repairs and when an external line up clamp is used. The downhill welding may be used for the root run welding of tie-ins and special crossings when (a) the edges are machined or have equivalent preparation (b) line up clamps are used and the fit up is geometrically and mechanically similar to one of the ordinary line welding without misalignment or unevenness.
- c) The root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall not exceed 3 mm wherever not specified by the applicable code.
- d) Any deviations desired from the recommended welding technique and electrodes indicated in the welding specification chart shall be adopted only after obtaining express approval of the COMPANY.
- e) Welding shall be continuous and uninterrupted during a pass.
- f) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling.
- g) While the welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibration and stresses to prevent occurrence of weld cracks.
- h) Fillet welds shall be made by shielded metal arc welding process irrespective of the thickness and class of piping. Electrode size shall not exceed 3.25 mm diameter for the socket joints. At least two passes shall be made on the socket weld joints.
- i) Peening shall not be used.

### 10.2 Joint Completion

In case of manual welding, for sizes 12" and above, the first pass shall be carried out by a minimum of two welders, working simultaneously and so placed as to cause minimum distortion of the pipe.

The number of welders and the allowable welding sequences shall be as those laid down in the qualified welding procedure specification. Once the deposit of the first pass has been started, it must be completed as rapidly as possible, reducing interruptions to the minimum. The welding and wire speed shall be approximately same as that established in the qualified welding procedure specification.

The pipe shall always be adequately supported and must not be bumped or shaken during welding. The clamp shall be removed, as indicated in clause 8.0 above. Before starting the second pass, the first pass shall be cleaned and flattened with rotating grinders.

The interruption between completion of the first pass and starting the second pass shall be as stated in the procedure specification, normally not exceeding four minutes.

For crack prevention a top and bottom reinforcement of at least one electrode shall be applied before lowering the pipe on the skid.

The welding speed selected shall enable production of a bead which is sufficiently thick and which shows no under cutting.

The time lapse between the second and the third pass shall be as stated in the procedure specification, normally not exceeding five minutes. After completion of the third or following passes, welding operations may be suspended, so allowing the joint to cool down, provided that the thickness of the weld metal deposited is equal to at least 50% of the pipe thickness. Upon restarting, depending on the materials, wall thickness and welding process, a preheating of at least 100°C shall be applied. Subsequent passes up to weld completion shall be protected to avoid rapid cooling, if meteorological conditions so dictate. Cleaning between the passes shall be done carefully so as to reduce the possibility of inclusions.

The electrode starting and finishing points shall be staggered from pass to pass. Arc-strikes outside the bevel on the pipe surface are not permitted. Arc-strike or arc-burn on the pipe surface outside the weld, which are caused accidentally by electrical arcs between the electrode, electrode holder, welding cable or welding cable round and the pipe shall be removed by grinding in accordance with a procedure approved by the COMPANY and the repair checked by ultrasonic, radiographic, magnetic particle or dye penetrant tests which the COMPANY feels



necessary. The pipe wall thickness after grinding shall not be less than the minimum thickness limit permitted for the pipe. Repair of arc strikes by welding is prohibited.

The completed weld shall be carefully brushed and cleaned and shall appear free from spatters, scales, etc.

These requirements apply not only to completed welds but also to the bare strip at least so wide as to allow full skid examination at both ends of the pipe to allow a good ultrasonic inspection when it is required.

## **11.0 HEAT TREATMENT**

### **11.1 Preheating**

- a) Preheating requirements for the various materials shall be as per the welding Specification chart attached along with other project data sheets.
- b) Preheating shall be performed using resistance or induction heating methods. Pre-heating for tie-in welds, repair welds or welds at point spreads may be done using a propane gas burner ring with prior approval from PMC/owner. The contractor may be asked to demonstrate the effectiveness of the arrangement.
- c) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- d) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature indicating crayons or other temperature indicating devices shall be provided by the CONTRACTOR to check the temperature.

### **11.2 Post Weld Heat Treatment**

- a) Post weld heat treatment, wherever required for joints between pipes and fittings, pipe body and supports shall be carried out by the CONTRACTOR at his expense as per the relevant specifications, applicable standards and the instructions of the COMPANY.
- b) The heat treatment of welded joints shall be carried out as per the requirements laid down in ASME B31.8 and other special requirements mentioned in welding Specification chart.
- c) The CONTRACTOR shall submit for the approval of the COMPANY, well before Carrying out actual heat treatments the details of the post weld heat treatment Procedure, as per Exhibit 'B' attached, that he proposes to adopt for each of the Materials/assembly/part involved.
- d) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction heating equipment, as decided by the COMPANY.



- e) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat- treated. Care shall be taken to ensure that width of heated band over which specified post weld heat treatment temperature is attained is at least as that specified in the relevant applicable standards/codes.
- f) The width of the heated band centered on the weld shall at least be equal to the width of weld plus 2" (50 mm). The temperature gradient shall be such that the length of the material on each side of the weld, at a temperature exceeding half the heat treatment temperature, is at least  $2.5 \sqrt{rt}$  where  $r$  is the bore radius and  $t$  is the pipe thickness at the weld.
- g) Throughout the cycle of heat treatment, the portion outside the heat band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose, temperature at the exposed surface of the pipe shall not be allowed to exceed 400°C.
- h) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples shall be attached to the pipe directly at equally spaced locations along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 2 up to 10" dia and 3 for 12" dia and above. However, the COMPANY can increase the required minimum number of thermocouples to be attached if found necessary.
- i) Automatic temperature recorders, which have been suitably calibrated, shall be Employed. The calibration chart of each recorder shall be submitted to the COMPANY prior to starting the heat treatment operation and its approval shall be Obtained.
- j) Immediately on completion of the heat treatment, the post weld heat treatment charts/records along with the hardness test results on the weld joints (whenever required as per the welding specification chart) shall be submitted to COMPANY for its approval.
- k) Each joint shall bear an identification number, which shall be maintained in the piping sketch to be prepared by the CONTRACTOR. The joint identification number shall appear on the corresponding post weld heat treatment charts. The same identification numbers shall also be followed for identification of corresponding radiographic films. The chart containing the identification number and the piping sketch shall be submitted to the COMPANY in suitable folders.
- l) Vickers hardness/Brinell hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester and shall not exceed the maximum hardness specified in the welding

specification chart. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified limit, at the CONTRACTOR'S own expense.

- m) The CONTRACTOR shall arrange for the hardness testing and shall maintain the Records of all the joints tested. These records shall be checked by the plant COMPANY'S inspector.

## 12.0 INSPECTION & TESTING

### 12.1 General

- a) The COMPANY'S Inspector shall have free access to all the concerned areas, where the actual work is being performed. The CONTRACTOR shall also afford the COMPANY'S inspector all means and facilities necessary to carry out inspection.
- b) The COMPANY is entitled to depute its own inspector to the shop or field where prefabrication and erection of pipelines are being done, with (but not limited to) the following objectives:
- i) To check the conformance to relevant standards and suitability of various Welding equipment and the welding performance.
  - ii) To supervise the welding procedure qualification.
  - iii) To supervise the welders' performance qualification.
  - iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in pipe construction.
- c) CONTRACTOR shall intimate sufficiently in advance the commencement of the Qualification tests, welding works and acceptance tests, to enable the COMPANY'S inspector to be present to supervise them.

### 12.2 Welding Procedure Qualification

- a) Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 latest edition (edition in force at the time of floating the enquiry) or other applicable codes and other job requirements by the CONTRACTOR at his expense. The CONTRACTOR shall submit the welding procedure specifications in format as per Exhibit-C (attached) immediately after the receipt of the order.
- b) COMPANY'S inspector will review, check and approve the welding procedure submitted and shall release the procedure for procedure qualification tests. The Procedure qualification test shall be carried out by the CONTRACTOR under field conditions at his own expense. A complete set of the test results in format as per Exhibit-C (attached) shall be submitted to the COMPANY'S Inspector for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard tests as

specified in the code shall be carried out in all cases. In addition to these tests, other tests like radiography, macro/micro examination, hardness tests, dye penetrant examination, Charpy v-notch etc. shall be carried out on the specimens. It shall be the responsibility of the CONTRACTOR to carry out all the tests required to the satisfaction of the COMPANY'S Inspector. The destructive testing of welded joints shall be as per Annexure - 1.

### 12.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the API 1104 and other applicable specifications by the CONTRACTOR at his expense. The butt weld test pieces of the qualification test shall meet the radiographic test requirements specified in Clause 12.5 and Annexure-3 of this specification. The COMPANY'S inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the COMPANY'S inspector shall be employed for welding. CONTRACTOR shall submit the welder qualification test reports in the standard format as shown in Exhibit - D and obtain express approval, before commencement of the work. It shall be the responsibility of CONTRACTOR to carry out qualification tests of welders.
- b) The welders shall always have in their possession the identification card as shown in Exhibit-E and shall produce it on demand by the COMPANY'S Inspector. It shall be the responsibility of the CONTRACTOR to issue the identity cards after the COMPANY has duly certified it.
- c) No welder shall be permitted to work without the possession of identity card.
- d) If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the CONTRACTOR.

### 12.4 Visual Inspection

COMP ANY shall carry out inspection of all welds as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity, shrinkage, cracks, under-cuts, dimensions, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard I code.

### 12.5 Non Destructive Examination

The non-destructive examination shall mainly consist of examination using x-ray radiography as detailed in Annexure 3.

Radiographic examination of one hundred percent (100%) girth welds will be required by the COMPANY. Welds shall meet the standards of acceptability as set forth in API 1104 and as well as the requirements laid in subsequent paragraphs.

The CONTRACTOR shall make all the arrangements for the radiographic examination of work covered by the specification at his expense.

The COMPANY will review all the radiographs of welds and inform the CONTRACTOR regarding unacceptable welds. The decision of the COMPANY shall be final and binding in this regard.

All the requirements mentioned in the specification shall be arranged and executed by the CONTRACTOR through his own resources. In addition, ultrasonic inspection is required in the following cases as per Annexure - 2 of this Specification.

- a) When 20 mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20 mm to assure no laminations exist.
- b) When in the opinion of COMPANY, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.
- c) When automatic procedure is used at least 10 cm on each weld shall be ultrasonically inspected at COMPANY's discretion.
- d) UT on Golden Joints.

All fillet and groove welds other than those radiographed shall be subjected to dye penetrant! MP inspection. The non- destructive test system used for inspecting welds must be approved by the COMPANY.

### 12.5.1 Acceptance Criteria

Weld quality as judged on the basis of the acceptability criteria mentioned below:

- i) Any weld, which as a result of radiographic and/or ultrasonic examination in the opinion of COMPANY exhibits imperfections greater than the limits, stated in API 1104 latest edition or as superseded in this article shall be considered defective and shall so be marked with an identification point marker.
- ii) In addition to the API 1104 requirements, the welds containing cracks including crater cracks regardless of size or location are unacceptable.

Lack of fusion and lack of root penetration may be permitted only up to a maximum individual length of 25mm. Cumulative length of the defect shall not exceed 25 mm in any 300 mm length of weld. For welds less than 300 mm length, the aggregate length shall not exceed 8 percent of the weld length. Defects situated in line and separated by less than the length of the shortest defect shall be considered as one defect. However, no Lack of fusion or lack of root penetration is permitted at any intersections of welds.

Suitable records shall be maintained by the CONTRACTOR as desired by the COMPANY on the day-to-day work done on welding radiography, ultrasonic testing. The CONTRACTOR shall present the records to the COMPANY on day-to-day basis and whenever demanded, for approval.

### 12.6 Destructive Testing

The COMPANY has the authority to order the cutting of up to 0.1 % of the total number of welds completed for subjecting to destructive tests at no extra cost to

COMPANY. The destructive testing of weld joints shall be made as per Annexure - 1. In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. The sampling and the re-execution of welds shall be carried out by the CONTRACTOR at his own expense. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the CONTRACTOR has adopted measures, which guarantee acceptable results. If it is necessary in the COMPANY's opinion the procedure shall be requalified. The weld joint represented by unsatisfactory welds shall stand rejected unless investigation proves otherwise.

### 13.0 REPAIRS OF WELDS

13.1 With the prior permission of COMPANY welds, which do not comply with the standards of acceptability, shall be repaired or the joint cut out and re-welded. A separate welding procedure specification sheet shall be formulated and qualified by CONTRACTOR for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) through thickness repair (b) partial thickness repair (c) cover pass repair and (d) Double repair. Welders shall be qualified in advance for repairs. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure test to API-1104 including the special requirements of the specification, and shall also be subjected to metallographic examination, hardness surveys and Charpy tests to determine the effects of repair welding on the associated structure.

Root sealing or single pass repair deposit shall not be allowed. Internal root defects shall be ground thoroughly and welded with a minimum of two passes. However, while grinding for repairs, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere.

The repair shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld. After the repair of the circumferential weld, re-radiography of the full joint shall be carried out. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall be done.

Repairs are limited to a maximum of 30% of the weld length. Not more than two repairs are permitted on the same location. All repairs shall be carried out the day after initial radiography or earlier. A full report of all repairs made shall be submitted every day to the COMPANY.

### 13.2 Weld Rejected by Accumulation of Defects

Where a weld is rejected by the accumulation of defect clause, as defined by API-1104 and this specification, repairs within these limitations are permitted. Defects in the filling and capping passes shall be repaired preferentially.

## ANNEXURE-I

### 1.0 DESTRUCTIVE TESTING OF WELDED JOINT - BUTT WELDS

#### 1.1 Preparation

Having passed the visual and the non-destructive inspection, the test weld shall be subjected to mechanical test.

After satisfactory completion of all visual and non-destructive testing the procedure test weld shall be set-aside for a period not less than 24 hours. No further work on the test weld and no cutting of test specimens from the weld shall be performed until a period of at least 24 hours has expired.

Weld specimens shall be taken from the positions indicated in fig.1, 2, 3 & 4 of this specification from areas as free from defects as possible; for this reason, it is necessary to take the previous non-destructive tests into account. The minimum number of tests to be carried out is given in Table - 1 of this specification.

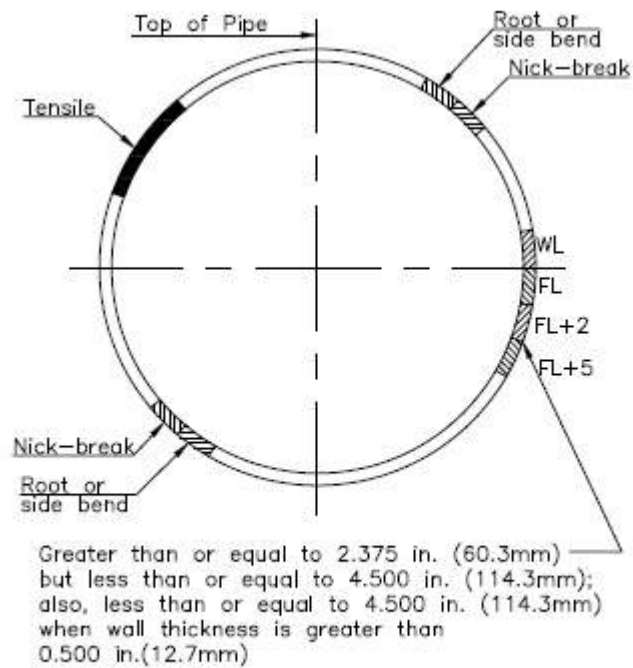
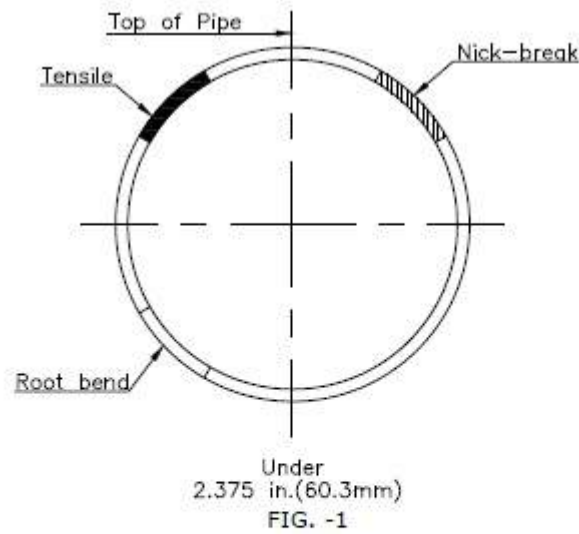
The test shall be carried out at laboratories approved by the COMPANY. The specimens shall be prepared in accordance with the figures given in the paragraphs that refer to the individual test.

#### 1.2 Tensile Strength

Specimens shall be taken from the position indicated in fig.1, 2, 3 & 4 of this specification and Table-1 of this specification.

##### 1.2.1 Method

The test shall be carried out in accordance with API 1104.





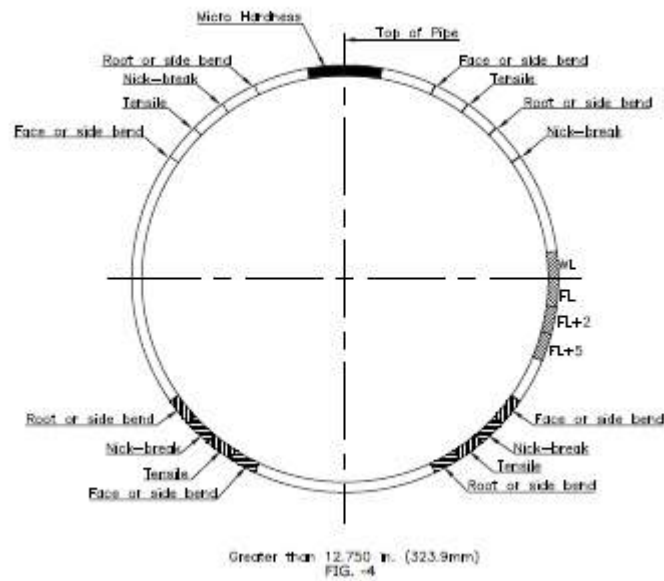
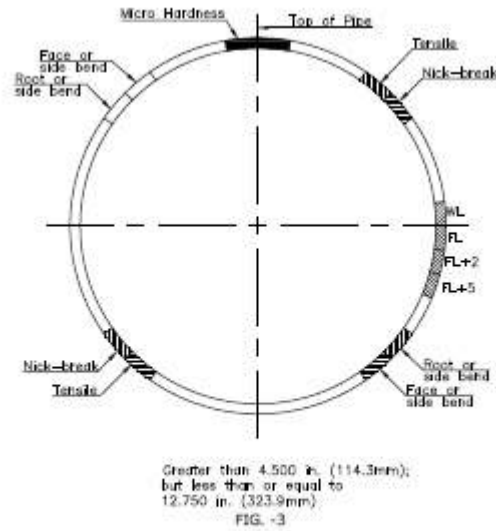




**TABLE 1**

| OUTSIDE DIAMETER OF PIPE (mm) | NUMBER OF SPECIMENS             |            |           |           |           |                  |        |       |
|-------------------------------|---------------------------------|------------|-----------|-----------|-----------|------------------|--------|-------|
|                               | TENSILE STRENGTH                | NICK BREAK | ROOT BEND | FACE BEND | SIDE BEND | MACRO & HARDNESS | IMPACT | TOTAL |
|                               | WALL THICKNESS $\leq$ (12.7 mm) |            |           |           |           |                  |        |       |
| <60.3                         | 1                               | 2          | 2         | 0         | 0         | 0                | 0      | 5     |
| 60.3 to 114.3                 | 1                               | 2          | 2         | 0         | 0         | 0                | 12     | 17    |
| >114.3 to 323.9               | 2                               | 2          | 2         | 2         | 0         | 2                | 12     | 22    |
| >323.9                        | 4                               | 4          | 4         | 4         | 0         | 2                | 12     | 30    |
|                               | WALL THICKNESS > (12.7 mm)      |            |           |           |           |                  |        |       |
| $\leq$ 114.3                  | 1                               | 2          | 0         | 0         | 2         | 0                | 12     | 17    |
| >114.3 to 323.9               | 2                               | 2          | 0         | 0         | 4         | 2                | 12     | 20    |
| >323.9                        | 4                               | 4          | 0         | 0         | 8         | 2                | 12     | 30    |

### 1.3 Nick-Break Test

#### 1.3.1 Preparation

Specification for nick-break test with notches thus worked can break in the base metal, instead of in the fusion zone; therefore, an alternative test piece may be used after authorization by the COMPANY with a notch cut in the reinforcement of outside weld bead to a maximum depth of 1.5mm, measured from the surface of the weld bead.

### 1.4 Macroscopic Inspection

#### 1.4.1 Preparation

Specimens shall be taken from the positions indicated in Fig. 1 of this specification and shall be prepared in accordance with ASTM E2 and E3. The width of the macro section has to be at least three times the width of the weld. The section is to be prepared by grinding and polishing and etched to clearly reveal the weld metal and heat affected zone.

#### 1.4.2 Method

Specimens shall be carefully examined under the microscope, with a magnification of at least 25 times (25:1). The COMPANY may ask for a macrograph with 5 times (5:1) magnification, for DOCUMENTATION purposes.

#### 1.4.3 Requirements

Under macroscopic examination, the welded joints shall show good penetration and fusion, without any defect exceeding the limits stated in the evaluation criteria of the nick break test

### 1.5 Hardness Test

#### 1.5.1 Preparation

The prepared macro section is to be used for hardness testing using the vickers method with 10 kg load indentations are to be made along traverses each approximately 1 mm below the surface at both side of the weld.

In the weld metal a minimum of 6 indentations equally spaced along the traverses are to be made. The HAZ indentations are to be made along the traverses for approximately 0.5 mm each into unaffected material, and starting as close to the fusion line as possible.

One indentation at each side of the weld along each traverse has to be made on parent metal. Reference is made to Fig. 3 of this specification. The indentations are to be made in the adjacent region as well as on the opposite side of the macro section along the specified traverses.

#### 1.5.2 Method

The test shall be carried out in accordance with recommendation ISO R81, Vickers hardness, using a laboratory type machine controlled as pre-recommendation ISO R 146 and using a diamond pyramid penetrator set at 2.37 rad (136") with a load of 10 kg.

#### 1.5.3 Requirements

Hardness value shall not exceed the limit specified in welding specification chart. In case of a single reading strictly (+ IOHV) higher than the specified limit, further indentations shall be made to check if the high value was an isolated case.

All the hardness values contained from the heat-affected zone shall not exceed 100 HV with respect to the average hardness of the values obtained for the base metal. If these additional tests give hardness within the specification limit the slightly higher value may be accepted.

## 1.6 Charpy V-Notch Impact Test

**1.6.1** Specimens shall be taken from the position indicated in Fig. 2, 3 & 4 of this specification. The test specimens will be prepared in accordance with API 1104. Charpy V-Notch specimens shall have dimensions as given in Fig. 6 of the specification. Three test specimens shall be taken from each sample and they shall be cut and worked so that their length is transversal and perpendicular to the weld bead with the notch position as shown in Fig. 6 of this specification. The notch shall be to the roller surface perpendicular to the roller surface. The test shall be conducted at -29 deg C and as per ASTM A370.

### 1.6.2 Requirements (Note 1)

The impact energy shall be:

| Test specimen in (mm) | Average of three specimen (Note 2) joule (Min.) | Minimum single value (Note 1) |
|-----------------------|-------------------------------------------------|-------------------------------|
| 10.0                  | 27.0                                            | 22.0                          |
| 7.5                   | 21.5                                            | 17.5                          |
| 5.0                   | 18.5                                            | 15.0                          |
| 2.5                   | 10.0                                            | 8.0                           |

#### Note:

- (1) These values are specified for resistance to brittle fracture only. Where additional requirements are specified in project data sheet (Ex. pipeline materials with arrest properties i.e., a higher upper shelf Charpy V energy for resistance against propagating ductile fractures) the same shall be followed.
- (2) Only one value is permitted to be lower than average value up to the value specified.

## 1.7 Bend Test Requirements

The Bend test Specimens shall be made and tested as per the requirements of API 1104 Latest edition (edition in force at the time of floating enquiry). The acceptance criteria shall be as per API 1104.

## ANNEXURE-2

### 1.0 ULTRASONIC INSPECTION

In addition, the radiographic inspection, ultrasonic inspection is required as per conditions listed in paragraph 12.5 of this specification. This section concerns manual ultrasonic inspection. However ultrasonic inspection by automatic equipment may be used if approved by the COMPANY.

#### 1.1 General:

The CONTRACTOR who carries out the ultrasonic inspections shall have sufficient no. of qualified personnel, equipment and instruments at his disposal to be able to affect the tests without hindering or delaying the pipeline assembly operations. The CONTRACTOR appointed to carry out ultrasonic inspections shall supply all the instruments necessary for their execution on site.

#### 1.2 Specification for Ultrasonic Testing Procedure Qualification

Before work begins, the CONTRACTOR shall present a specification describing the proposed U.T. procedure qualification. This specification shall state, all the parameters described in API 1104 and the following information:

- a) Type of U.T. Equipment used;
- b) Type and dimensions of transducers
- c) Frequency range
- d) Details for calibration
- e) Coupling medium
- f) Inspection technique
- g) Record details
- h) Reference to the welding procedure where it is intended to adopt the specification
- I) Temperature range of the joints to be inspected.

#### 1.3 Qualification of Ultrasonic Inspection Procedure

The ultrasonic inspection procedure shall be approved by the COMPANY. Before inspection begins, the COMPANY may require the qualification test of the ultrasonic inspection procedure. This specification test consists in testing (under normal operating conditions) some CONTRACTOR welds made according to the same production procedure, where there are typical defects the test intends to detect.

This test shall be conducted in the presence of the COMPANY.

#### 1.4 Test Procedure

Circumferential welds shall be inspected from both sides using angle probes. The surface with which the probe comes into contact shall be free of metal spatter, dirt, iron oxide, and scales of any type; therefore, it shall be necessary to clean a strip at least 50 mm wide on both sides of the weld with steel-wire brushes and anyhow the cleaned strip must be at least wide enough to allow one and a half skip examination.

If, during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interfered with the ultrasonic beam.

By way of an example, the equipment shall include but not be limited to the following:

- a) Ultrasonic equipment and coupling medium
- b) Sample sections for calibration of instruments
- c) Equipment for cleaning of surface to be examined
- d) Rules calibrated in centimeters for exact location of the position of defects.

The characteristics of the above listed instruments and equipment shall guarantee:

- a) That the required standards of the inspection procedure, as previously established and approved by the COMPANY, are satisfied.
- b) Continuous operation

All the instruments and equipment shall be approved by the COMPANY before being used. The COMPANY has the authority to reject any item that is considered unsuitable. The decision of the COMPANY is final. The CONTRACTOR appointed to carry out ultrasonic inspections shall also ensure the operational efficiency and maintenance of the instruments and equipment, and shall immediately substitute any item rejected by the COMPANY.

All the instruments and equipment necessary for carrying out ultrasonic inspection on site shall satisfy the requirements laid down by the public boards of institutions that regulate 'safety at work'.

## 1.5 Ultrasonic Instruments

The ultrasonic instrument:

- a) Shall be pulse echo type, able to generate, receive and display, on the screen a Cathode Ray Tube (CRT), pulse at frequencies between 1 and 6 MHz. The useful part of the CRT screen shall be at least 70mm wide and at least 50mm high shall have variable amplification, with steps of 1 or 2 dB over a range of at least 60 dB.

- b) the regulation control shall be accurate to within  $\pm 1$  dB and this accuracy shall be certified by the instrument manufacturer.
- c) may be powered by a battery or an electric generator. In the first case, the autonomy of operation (endurance) of the instrument shall be sufficient to carry on working without frequent interruptions, and the instrument shall be equipped with an automatic switch which switches it off when the battery runs down; in the second case, there must be a voltage stabilizing device with a tolerance of  $\pm 2$  Volts.

## 1.6 Probes

The probes used shall have dimensions, frequencies, and a refraction angle suited to the type of steel, the diameter, and the thickness of the pipeline and to the joint design.

## 1.7 Reference Sample Pieces

The efficiency of the equipment used, the effective refraction angle of the probe, and the beam output point, shall be checked using a VI and V2 sample block, IIW type or the calibration block ASTM E-428.

For manual ultrasonic testing and automated ultrasonic testing, the reference sample pieces shall be as described in API 1104, Nineteenth Edition, para 11.4.5.

## 1.8 Calibration

The calibration, qualification of the testing procedure shall be done as provided in API 1104.

## 1.9 Regulation of Amplification during Production Testing

Scanning sensitivity shall be as provided in API 1104 para 11.4.7.2 & 11.4.7.3.

1.10 Qualification of Ultrasonic Testing Operators for Automatic UT. Before the inspection begins or during the same inspection, the COMPANY may require a qualification test for the ultrasonic equipment operators.

The operators shall be fully qualified as per a recognized standard (ASME Sec V or equivalent) and they shall have as minimum level II as described in API 1104. The operators shall be able to:

- a) calibrate the equipment;
- b) perform an operational test under production conditions;
- c) interpret the screen picture;
- d) evaluate the size and location of reflectors
- e) interpret the type of defects detected

The COMPANY has the option of checking the ability of personnel employed for ultrasonic

Testing by means of qualification tests.

### 1.11 Evaluation of Indications given by Ultrasonic Tests

Each time that echoes from the weld bead appear during production testing, the instrument amplification shall be altered to coincide with the reference amplifications and the probe shall be moved until maximum response is obtained, paying attention all the time to the probe-tube coupling.

If, under these conditions, the height of the defect echo is equal to or greater than that of the reference echo, the defect shall be evaluated according to clause 12.5 of this specification. If the defect has also been detected by the radiographic and/or visual examination, the dimensions shall be judged according to the type of examination which detects the greater defect. Returns that are less than 50% of the reference echo will not be considered. If returns are above 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the COMPANY. Moreover, when there is a defect to be repaired, such defect shall be removed for a length corresponding to the one where no more return echo is given.

### 1.12 Other Equipment

The use of rules calibrated in centimeters, attached if possible, to the probe, for the precise location of the position of welding defects, is recommended. Defect location is affected by measuring the projection distance between the probe output and the reflecting surface.

The operators carrying out the tests shall have, besides the probing instrument, tools for cleaning the pipe surface (files, brushes, etc.) as well as the coupling liquid or paste appropriate for the temperature of the section to be examined.

## ANNEXURE-3

### RADIOGRAPHY

#### 1.0 SCOPE

This annexure covers the radiographic inspection of all types of welded joints of the main pipeline.

The welded joints shall include the following:

- i) Full girth welds on the mainline construction including double jointing of pipe, if adopted.
- ii) Welds for installation of block valves, insulating joints and other appurtenances and tie-ins.
- iii) Welds at scraper launching and receiving barrels.
- iv) Terminal Piping

#### 2.0 APPLICABLE STANDARDS

This specification shall apply in conjunction with the following (all latest editions):

- i) API 1104, Standard for welding Pipelines and Related Facilities
- ii) ANSI B 31.8, Code for Gas Transmission and Distribution Piping Systems.
- iii) ANSI B 31.4, Code for Transportation System for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia and Alcohols.
- iv) ASTM E 94, Recommended practice for Radiographic Testing
- v) ASTM E 142, Standard Method for Controlling Quality of Radiographic Testing
- vi) The American Society for Nondestructive Testing. Recommended Practice no. SNT-TC-IA Supplement A.

#### 3.0 PROCEDURE

3.1 The radiographic examination procedure to be adopted shall be submitted by the CONTRACTOR as per Exhibit-F.

3.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of COMP ANY prior to use. It shall include but not be limited to the following requirements:

- i) Lead foil intensifying screens, at the rear of the film shall be used for all exposures.
- ii) Type 2 and 3 films as per ASTM E-94 shall be used.



- iii) A densitometer shall be used to determine film density. The transmitted film density shall be between 2.0 and 3.5 throughout the weld. The unexposed base density of the film shall not exceed 0.30.
  - iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.
- 3.3 The CONTRACTOR shall qualify each procedure in the presence of the COMPANY prior to use.
- 3.4 The procedure of radiographic examination shall produce radiographs of sufficient density, clarity and contrast so that defects in the weld or in the pipe adjacent to the weld are clearly discernible.
- 3.5 One Check shot of the full joint on main line welds shall be taken per 100 circumferential welds or one per day of the production whichever is more for cross checking the correctness of the radiographs of weld joints executed by the contractors. For taking check shots on completed/accepted sections, contractor has to separately mobilize either internal crawler/external X-ray unit, as appropriate.
- 3.6 All the girth welds of mainline shall be subjected to 100% radiographic examination. The CONTRACTOR shall furnish all the radiographs to the COMPANY, immediately after processing them, together with the corresponding interpretation reports on approved format. The details of the radiographs along with the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the COMPANY for approval.
- 3.7 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source of film distance used is a minimum of 12 inch.
- 3.8 Three copies of each acceptable radiographic procedure (as per Exhibit-F) and three copies of radiographic qualification records shall be supplied to COMPANY. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorized representative to be used as a standard for the quality of production radiographic during the job. The other two sets shall be retained by COMPANY for its permanent record.
- 3.9 Three copies of the exposure charts relating to material thickness, kilo voltage, source of film distance and exposure time shall also be made available to COMPANY by the CONTRACTOR.
- 3.10 The CONTRACTOR shall, on a daily basis, record for each radiograph (1) radiograph's number, (2) approximate chainage of weld location, (3) whether or not the welds meet the specified acceptance standards and (4) the nature and approximate location of unacceptable defects observed. It must be possible to relate back to a particular butt weld and welder on piping drawing and pipeline alignment drawing.

- 3.11 Each day's production of processed radiographs shall be properly packaged separately, identified by at least the (1) date, (2) radiographic unit, (3) job locations, (4) starting and ending progress survey stations and (5) shall include original and three copies of the daily radiographic record. The package shall be submitted to the COMPANY daily when possible, but in no event later than noon of the following day.
- 3.12 The CONTRACTOR shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the COMPANY to examine the radiographs.
- 3.13 The CONTRACTOR, if found necessary, may modify the procedure of radiographic examination suiting to the local conditions prevailing. This shall, however, be subject to the approval of the Company.
- 3.14 COMPANY shall have free access to all the CONTRACTOR's work facilities in the field.
- 3.15 Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his responsibilities and guarantees.

#### 4.0 RADIATION SOURCE

- 4.1 Radiographic examination shall be carried out using X-radiations; radiographic examination by Gamma rays using slow speed films may be allowed, at the discretion of the COMPANY, in case of inaccessible joints. Radiography by Gamma ray for tie-in-joints shall be acceptable provided D4 AGF A film or equivalent is used and the required sensitivity obtained.
- 4.2 Whenever possible, pipeline welds will be inspected by placing the radiation source inside the pipe. on the pipeline axis. with a radiation of 6.28 red. (360).

#### 5.0 LEVEL OF QUALITY

The quality level of Radiographic sensitivity required for radiographic inspection shall be at least equivalent to the values in Figure-7.

#### 6.0 PENETRAMETERS

The Image Quality Indicator (abbreviation: IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameter). The Penetrameter shall be selected according to DIN-54109 or ISO-I 027. For radiographs made with the source on the outside, a Penetrameter shall be placed on each side of the film with the smaller wire of the Penetrameter turned towards the end of the film itself. When a complete weld is radiographed in a single exposure using a source inside the piping, four penetrameters approximately equally spaced around the circumference shall be used. During the procedure qualification, IQI shall be placed both on the source side and on the film side.

The sensitivity obtained with IQI on the source side shall not be less than the values shown in Fig. 7 of this specification. The sensitivity limit may be considered to have

been reached when the outline of the IQI, its identification number and the wire of the required diameter show up clearly on the radiograph.

The COMPANY may authorize use of types of IQI other than those planned, provided that they conform with recognized standards and only if the CONTRACTOR is able to demonstrate that the minimum sensitivity level required is obtained. For this demonstration, a test shall be carried out comparing the IQI specified and the CONTRACTORS to show up the identification number and other details of the proposed IQI, which must be visible in the test radiograph.

## 7.0 FILM IDENTIFICATION MARKERS

All films shall be clearly identified by lead numbers, letters, and/or markers. The image of the markers shall appear on the films, without interfering with the interpretation. These markers positions shall also be marked on the part to be radiographed and shall be maintained during radiography.

## 8.0 PROTECTION AND CARE OF FILM

- 8.1 All unexposed films shall be protected and stored properly as per the requirements of API1104 standard and ASTM E.94.
- 8.2 The exposed and unexposed film shall be protected from heat, light, dust and moisture. Sufficient shielding shall be supplied to prevent exposure of film to damaging radiation prior to and following the use of the film for radiographic exposure.

## 9.0 RE-RADIOGRAPHY

- 9.1 The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.
- 9.2 All the repaired weld joints shall be re-radiographed at no extra cost to the COMPANY in the same manner as that followed for the original welds. In addition, the repaired weld areas shall be identified with the original identification number plus the letter R to indicate the repair.
- 9.3 When evaluating repair film, radiographers shall compare each section (exposure) of the weld with the original film to assure repair was correctly marked and original defect removed.
- 9.4 The COMPANY will review prior to any repair of welds, all the radiographs of welds that contain, according to the CONTRACTOR's interpretation, unacceptable defects. The final disposition of all unacceptable welds shall be decided by the COMPANY.

## 10.0 QUALIFICATION OF RADIOGRAPHERS

- 10.1 Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 and to the full satisfaction of COMPANY.
- 10.2 Certification of all the radiographers, qualified as per 10.1 above, shall be furnished by the CONTRACTOR to the COMPANY before a radiographer will be

permitted to perform production radiography. The certificate record shall include:

- i) Background and Experience Record
- ii) Training Course Record
- iii) Technical Examination Record
- iv) Doctor's report on radiographer's Jacque 0-1 acuity eye test
- v) Date of qualification

- 10.3 The radiographers shall be required to qualify with each radiographic procedure they use, prior to performing the work assigned to him in accordance with the specification.

## 11.0 PRESERVATION OF RADIOGRAPHS

- 11.1 The radiographs shall be processed to allow storage of films without any discoloration for at least three years. All the radiographs shall be presented in suitable folders for preservation along with necessary documentation.
- 11.2 All radiographs shall become property of the COMPANY.

## 12.0 EQUIPMENT AND ACCESSORIES

- 12.1 CONTRACTOR shall make necessary arrangements at his own expense, for providing the radiographic equipment, radiographic films and all the accessories for carrying out the radiographic examination for satisfactory and timely completion of the job.
- 12.2 For carrying out the mainline radiographic examination the CONTRACTOR shall be equipped with suitable mobile/stationary type dark rooms. These shall have all the required facilities for film processing. Film viewer used shall be equipped with the film illuminator that has a light source of sufficient intensity and suitably controlled to allow viewing film densities up to 4.0 without damaging the film.

## 13.0 RADIATION PROTECTION

- 13.1 CONTRACTOR shall be responsible for the protection and personnel monitoring of every man with or near radiation sources.
- 13.2 The protection and monitoring shall comply with local regulations.
- 13.3 In view of visual hazards in the handling of Radioactive source of material, CONTRACTOR shall be solely responsible for complying with all rules and regulations set forth by Atomic Energy Commission or any other Government agencies of India in this regard and COMPANY shall not be responsible and shall be kept indemnified by the CONTRACTOR for default (s) of whatever nature by the CONTRACTOR. Safety equipment as considered adequate by the COMPANY

for all necessary personnel shall be made available for use and maintained for immediate and proper use by the CONTRACTOR.

#### **14.0 DISPLAY OF SAFETY INSTRUCTIONS**

The safety provisions shall be brought to the notice of all concerned by display on a notice board at prominent place at the work spot. The person responsible for the "Safety" shall be named by the CONTRACTOR.

#### **15.0 ENFORCEMENT OF SAFETY REGULATIONS**

To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangement made by the CONTRACTOR shall be open to inspection by COMPANY or its representatives.

#### **16.0 FIRST AID AND INDUSTRIAL INJURIES**

- 16.1 CONTRACTOR shall maintain first aid facilities for its employees and those of sub-Contractors.
- 16.2 CONTRACTOR shall make outside arrangements for ambulance service and for treatment of industrial injuries. Names of those providing these services shall be furnished to COMPANY prior to start of work and their telephone no. Shall be posted prominently in CONTRACTOR'S field office.
- 16.3 All critical industrial injuries shall be reported promptly to the COMPANY and a copy of CONTRACTOR's report covering each personal injury requiring the attention of physician shall be furnished to the COMPANY.

#### **17.0 NO EXEMPTION**

Notwithstanding the above there is nothing in these to exempt the CONTRACTOR from the operation of any other act or rules in force.



## EXHIBIT- A

### ELECTRODE QUALIFICATION TEST RECORD

- A.** Tested at (Site name) : Date:
- Manufacturer's Name :
- Brand Name: :
- Batch Number & Size tested :
- Classification & Code :
- Intended for welding in position: :
- In combination with (if any) :
- Code of Reference (used for testing) :
- Special Requirements (if any) :
- B.** All-weld Tensile Test :
- Base Material used :
- Pre-heat temperature :
- Post weld heat treatment details: :
- Visual examination :
- Radiographic examination results :
- Tensile test results :

| Identification No. | U.T.S. | Yield Point | Elongation | Remarks |
|--------------------|--------|-------------|------------|---------|
| 1.                 |        |             |            |         |
| 2.                 |        |             |            |         |

### C. Impact Test Results

- Test Temperature : Notch in
- Type of Specimens (Charpy) :
- Size of Specimens

| Specimen No. | Impact Value | Average |
|--------------|--------------|---------|
| 1            |              |         |
| 2            |              |         |
| 3            |              |         |
| 4            |              |         |
| 5            |              |         |

#### D. Chemical Analysis Results

Electrode Size Result :

Batch No. :

| %C | %S | %P | %Si | %Mn | %Cr | %Ni | %Mo | Other |
|----|----|----|-----|-----|-----|-----|-----|-------|
|    |    |    |     |     |     |     |     |       |

.....  
**PREPARED BY  
(CONTRACTOR)**

.....  
**REVIEWED BY  
(CONTRACTOR)**

.....  
**APPROVED  
(PMC/OWNER)**

## EXHIBIT- B

### STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Name of the Heat-treater :  
Name of the Project : Specification Reference No.

1. General Detail:  
Name of the Equipment:  
Name of the Assembly/Part:  
Drawing No:  
Material:
2. Furnace Details  
Type of Heating : Gas/Oil/Elect.  
Res/ induction Type of Heating  
Capacity (Size)  
Maximum Temp. (C) :  
Method of temp. Measurement  
Atmosphere Control :
3. Heat Treatment Cycle Details  
Charging Temp. C  
Rate of heating, C/Hr.  
Soaking Temp. C  
Soaking Time, hrs.  
Rate of Cooling, C/Hr.  
Mode of Cooling
4. Other Details, if any :  
Notes:

The following documents shall be furnished along with the specifications:

- i) Material test certificates
- ii) Assembly/Part Drawing.

.....  
**PREPARED BY  
CONTRACTOR)**

.....  
**REVIEWED BY  
(CONTRACTOR)**

.....  
**APPROVED BY  
(PMC/OWNER)**



## EXHIBIT- C

| QUALIFICATION WELD REPORT                                                                                                                                                                                                                                                                                            |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------|---------------------|--------------|--------------|--------|--------|--------|--------|--------|
| Date _____                                                                                                                                                                                                                                                                                                           |                                  | Test No. _____                           |                                                    | Test Type: _____                      |                                 | Procedure _____     |              | Welder _____ |        |        |        |        |        |
| Location _____                                                                                                                                                                                                                                                                                                       |                                  | Welder (s) _____                         |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Material Grade 1 _____                                                                                                                                                                                                                                                                                               |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Material Grade 2 _____                                                                                                                                                                                                                                                                                               |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Outside Diameter _____                                                                                                                                                                                                                                                                                               |                                  |                                          |                                                    | Wall Thickness _____                  |                                 |                     |              |              |        |        |        |        |        |
| Joint Type _____                                                                                                                                                                                                                                                                                                     |                                  |                                          |                                                    | Bevel Angle _____                     |                                 |                     |              |              |        |        |        |        |        |
| Backing Type (if applicable) _____                                                                                                                                                                                                                                                                                   |                                  |                                          |                                                    | Roll or Fixed Position _____          |                                 |                     |              |              |        |        |        |        |        |
| RECORDED WELDING PARAMETERS                                                                                                                                                                                                                                                                                          |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Pass                                                                                                                                                                                                                                                                                                                 | Process and Direction of Welding | Filler Metal Classification and Diameter | Shielding Gas type and flow rate or shielding flux | Preheat / Interpass Temperature       | Voltage                         | Amperage            | Travel Speed | Heat Input   |        |        |        |        |        |
| Root Bead                                                                                                                                                                                                                                                                                                            |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Second Bead                                                                                                                                                                                                                                                                                                          |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes.<br>Time between passes: Root Bead to 2 <sup>nd</sup> Bead: _____, 2 <sup>nd</sup> bead to 3 <sup>rd</sup> bead: _____<br>Cooling Method (if applicable) _____<br>PWHT _____ |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| MECHANICAL TEST RESULTS                                                                                                                                                                                                                                                                                              |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| TENSILE TESTS Report Number : _____                                                                                                                                                                                                                                                                                  |                                  |                                          |                                                    | NICK BREAK TEST Report Number : _____ |                                 |                     |              |              |        |        |        |        |        |
| Specimen Number                                                                                                                                                                                                                                                                                                      | Tensile 1                        | Tensile 2                                | Tensile 3                                          | Tensile 4                             | Specimen Number                 | Nick 1              | Nick 2       | Nick 3       | Nick 4 | Nick 5 | Nick 6 | Nick 7 | Nick 8 |
| Location                                                                                                                                                                                                                                                                                                             |                                  |                                          |                                                    |                                       | Location                        |                     |              |              |        |        |        |        |        |
| Original specimen dimensions                                                                                                                                                                                                                                                                                         |                                  |                                          |                                                    |                                       | Result                          |                     |              |              |        |        |        |        |        |
| Original specimen area                                                                                                                                                                                                                                                                                               |                                  |                                          |                                                    |                                       | BEND TESTS Report Number: _____ |                     |              |              |        |        |        |        |        |
| Maximum load                                                                                                                                                                                                                                                                                                         |                                  |                                          |                                                    |                                       | Specimen Type and Number        |                     |              |              |        |        |        |        |        |
| Tensile strength                                                                                                                                                                                                                                                                                                     |                                  |                                          |                                                    |                                       | Location                        |                     |              |              |        |        |        |        |        |
| Fracture Location                                                                                                                                                                                                                                                                                                    |                                  |                                          |                                                    |                                       | Result                          |                     |              |              |        |        |        |        |        |
| Remarks                                                                                                                                                                                                                                                                                                              |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 |                     |              |              |        |        |        |        |        |
| Test made at _____                                                                                                                                                                                                                                                                                                   |                                  |                                          |                                                    |                                       |                                 | Date _____          |              |              |        |        |        |        |        |
| Tested by _____                                                                                                                                                                                                                                                                                                      |                                  |                                          |                                                    |                                       |                                 | Supervised by _____ |              |              |        |        |        |        |        |

### Sample Qualification Weld Report Form

| WELDING PROCEDURE SPECIFICATION                                                                                                          |                                      |                                      |                |                                                                |               |                |                    |                  |
|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|----------------|----------------------------------------------------------------|---------------|----------------|--------------------|------------------|
|                                                                                                                                          |                                      |                                      |                |                                                                |               |                |                    | WPS Number _____ |
| Process(es)/Method of Application _____                                                                                                  |                                      |                                      |                |                                                                |               |                |                    |                  |
| Material grade(s) _____                                                                                                                  |                                      |                                      |                |                                                                |               |                |                    |                  |
| Outside diameter _____                                                                                                                   |                                      |                                      |                | Wall thickness _____                                           |               |                |                    |                  |
| Joint type _____                                                                                                                         |                                      |                                      |                | Bevel angle _____                                              |               |                |                    |                  |
| Backing type (if applicable) _____                                                                                                       |                                      |                                      |                | Roll or fixed position _____                                   |               |                |                    |                  |
| Direction of welding _____                                                                                                               |                                      |                                      |                | Number of welders _____                                        |               |                |                    |                  |
| Preheat temperature _____                                                                                                                |                                      |                                      |                | Interpass Temperature _____                                    |               |                |                    |                  |
| Method of Heating _____                                                                                                                  |                                      |                                      |                |                                                                |               |                |                    |                  |
| Filler metal(s) and Flux _____                                                                                                           |                                      |                                      |                |                                                                |               |                |                    |                  |
| Flame characteristics _____                                                                                                              |                                      |                                      |                | Cleaning and/or grinding tools _____                           |               |                |                    |                  |
| Type and removal of lineup clamp _____                                                                                                   |                                      |                                      |                | Minimum number of passes _____                                 |               |                |                    |                  |
| Maximum time between root pass and start of the second pass _____                                                                        |                                      |                                      |                | Maximum time between second pass and start of third pass _____ |               |                |                    |                  |
| Method of cooling _____                                                                                                                  |                                      |                                      |                | PWHT procedure _____                                           |               |                |                    |                  |
| JOINT DESIGN                                                                                                                             |                                      |                                      |                |                                                                |               |                |                    |                  |
| SEQUENCE OF BEADS                                                                                                                        |                                      |                                      |                |                                                                |               |                |                    |                  |
| WELDING PARAMETERS                                                                                                                       |                                      |                                      |                |                                                                |               |                |                    |                  |
| Pass                                                                                                                                     | Process / Electrical Characteristics | Filler Metal Group or Classification | Electrode Size | Shielding Gas Type and Flow Rate or Shielding Flux             | Voltage Range | Amperage Range | Travel Speed Range | Heat Input Range |
| Root Bead                                                                                                                                |                                      |                                      |                |                                                                |               |                |                    |                  |
| Second Bead                                                                                                                              |                                      |                                      |                |                                                                |               |                |                    |                  |
|                                                                                                                                          |                                      |                                      |                |                                                                |               |                |                    |                  |
| Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes. |                                      |                                      |                |                                                                |               |                |                    |                  |
| Supporting qualification weld report No(s) _____                                                                                         |                                      |                                      |                |                                                                |               |                |                    |                  |
| Approved by: _____                                                                                                                       |                                      |                                      |                |                                                                |               |                |                    |                  |

**Sample Qualification Weld Report Form**

**PREPARED BY  
CONTRACTOR)**

**REVIEWED BY  
(CONTRACTOR)**

**APPROVED BY  
(PMC/OWNER)**

## EXHIBIT- D

### Example of record form for welder qualification test

|                         |              |
|-------------------------|--------------|
| Welder test certificate | Test no      |
| Project/Contract        | Date         |
| Contractor              | Inspector    |
| Welder's name           |              |
| Address                 |              |
| Pipe material           |              |
| Pipe thickness          |              |
| Pipe outside diameter   |              |
| Welding process         | Root         |
|                         | Fill and Cap |
| Reason for failure      |              |
| Visual                  |              |
| Non-destructive testing |              |
| Butt joint              |              |
| Fillet weld             |              |
| 'Number of attempts     |              |
| Comments                |              |
| Accepted date/Time      |              |

Signed by Contractor

Signed by Inspector

\*Delete as necessary



## EXHIBIT- E

### Welder's Identification Card

|                             |   |            |
|-----------------------------|---|------------|
| Name                        | : |            |
| Identification              | : | Photograph |
| Date of Testing             | : |            |
| Valid till                  | : |            |
| Approval of Welding         | : |            |
| Welding Position            | : |            |
| Material                    | : |            |
| Diameter                    | : |            |
| Diameter range approved     | : |            |
| Wall thickness              | : |            |
| Thickness range approved    | : |            |
| Type of welding consumables | : |            |

Approved by:

Employers' Signature with seal

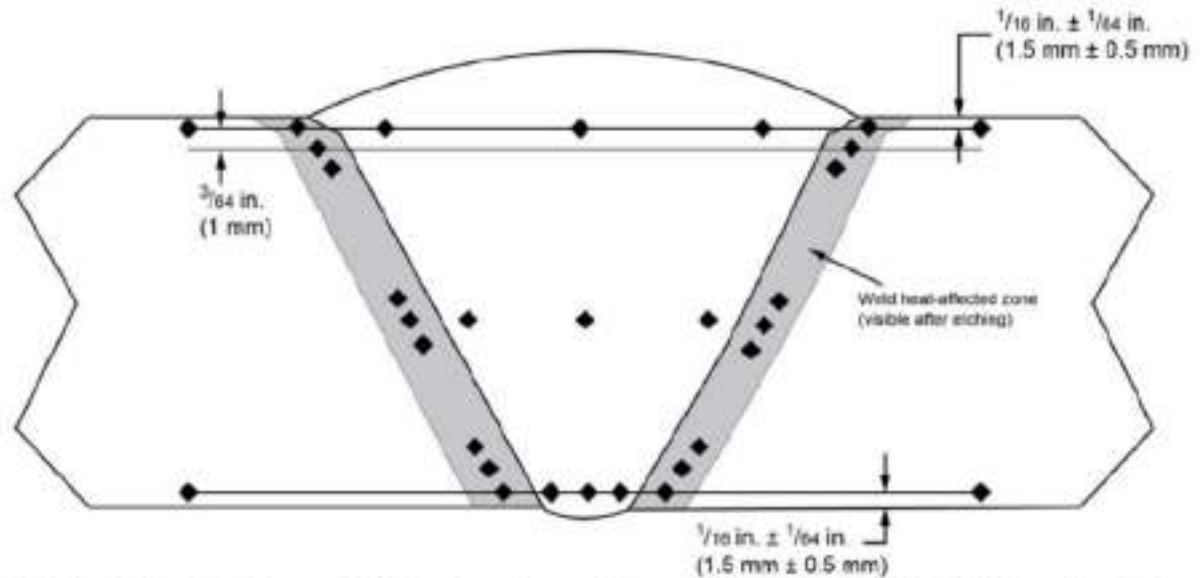
## EXHIBIT- F

### Radiographic Procedure for Pipe Welding

1. Location
2. Date of Testing
3. Name of Supervised Contractor
4. Material
5. Dia & Thickness
6. Type of weld joint
7. Radiation Source (X-ray, iridium)
8. Type of equipment (External/Internal)
9. Intensifying screens and material
10. Filter type and placement mask, Diaphragm Lead screen etc. adjacent to radiation source or specimen,
11. Exposure Geometry (Source focal spot size, object to film distance, radiation angle with respect to weld and film).
12. Limit of film coverage
13. Film type and make
14. Exposure Conditions (rna, KV, time)
15. Processing (time temperature for development stop bath or rinse, fixation, washing, drying etc.)
16. Density
17. Sensitivity
18. Type of penetrameter
19. Essential wire to be seen on source side:
20. Essential wire accepted for film side viewing:

Approval of the COMPANY

Signature of CONTRACTOR with seal



NOTE Heat-affected zone (HAZ) hardness impressions must be entirely within the HAZ and located as close as possible to the fusion boundary (between the weld metal and HAZ). The wall thickness of the specimen may prevent all the indents as shown from being made, particularly along the mid-point of the specimen.

### HARDNESS TESTING – BUTT WELDS

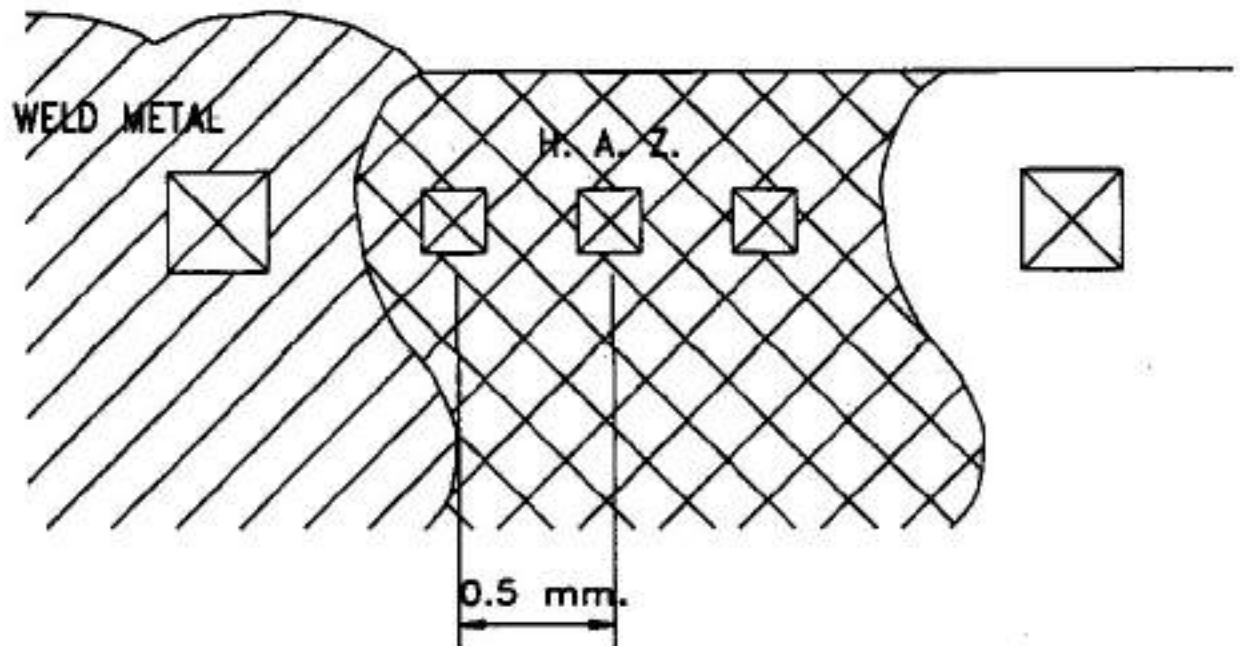


**FIGURE 5**  
**HARDNESS TESTING OF WELD JOINTS – SCHEMATIC**

## NOTCH POSITIONS

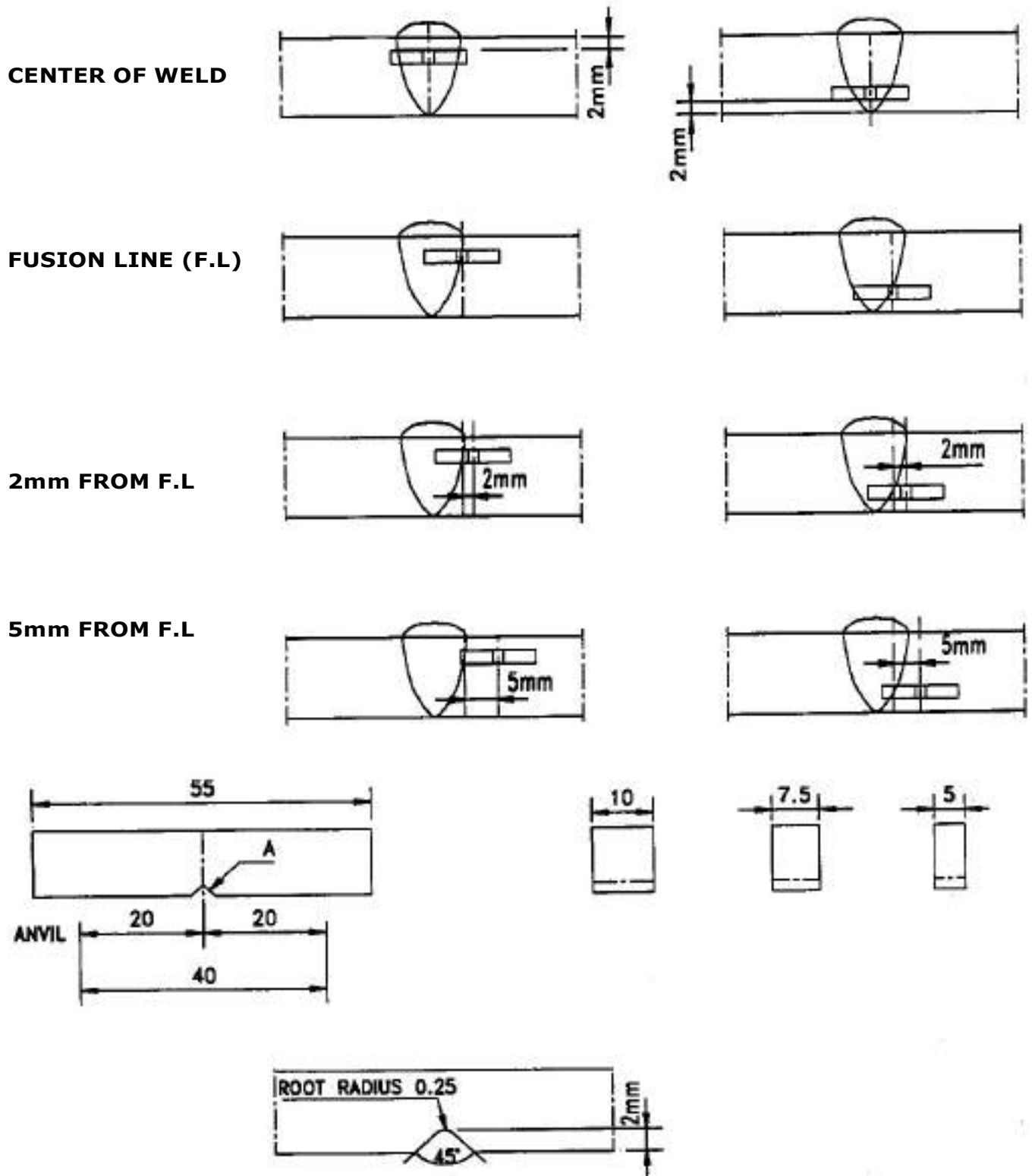


**FIGURE 6**  
**CHARPY V – NOTCH TEST SPECIMEN**

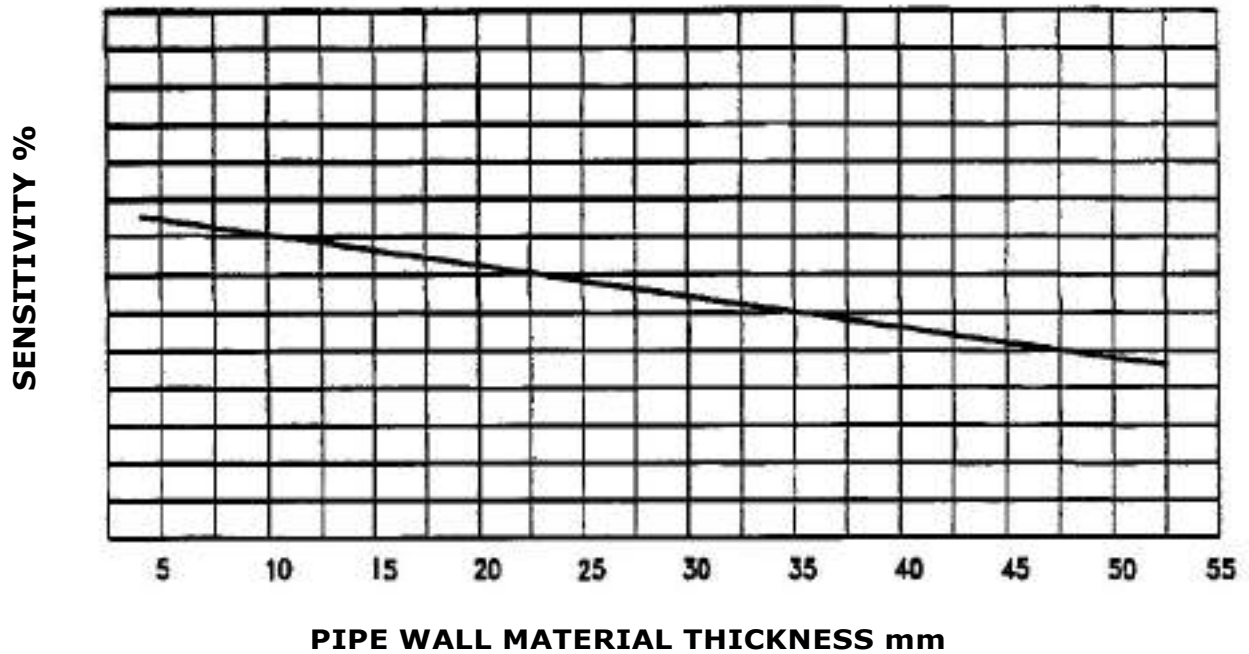


Figure-7

**NOTE:-**

FOR PRODUCTION RADIOGRAPHY, SENSITIVITY REDINGS BASED ON FILM ON SIDE PENTRAMETERS ARE TO BE JUDGED AS PER RESULT FROM THE PROCEDURE QUALIFICATION WITH PENTRAMETERS PLACED ON THE SOURE SIDE





## WELDING SPECIFICATION CHART FOR PIPING WELDING

DOCUMENT NO : VCS-WS-PP-2039B

REVISION :00

PIPING CLASS: 15HC, 30HC, 60HC (UPTO Y.S  $\leq$  490 MPa)

|                        |          |                                                                                                                                                                                                                                     |
|------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MATERIAL SPECIFICATION | PIPES    | ASTM A106 Gr. B, API 5L Gr. B (PSL-2), API 5L Gr. X-70 (PSL-2), API 5L Gr. X-65 (PSL-2), API 5L Gr. X-60 (PSL-2), API 5L Gr. X-56 (PSL-2), API 5L Gr. X-52 (PSL-2), API 5L Gr. X-46 (PSL-2), API 5L Gr. X-42 (PSL-2), IS 1239 BLACK |
|                        | FITTINGS | ASTM A105, ASTM A234 Gr. WPB, ASTM A234 Gr. WPB-W, MSS-SP-75 Gr. WPHY70/65/60/56/52                                                                                                                                                 |
|                        | FLANGES  | ASTM A105, ASTM A694 Gr. F-52/65/70, ASTM A516 Gr. 70                                                                                                                                                                               |
|                        | OTHERS   | -                                                                                                                                                                                                                                   |

BASE METAL "P" NO. 1

|                 |                                         |                            |                         |                            |
|-----------------|-----------------------------------------|----------------------------|-------------------------|----------------------------|
| WELDING PROCESS | GROOVE JOINTS                           |                            |                         |                            |
|                 | BUTT                                    |                            | OTHER THAN BUTT         |                            |
|                 | ROOT PASS:<br>GTAW/SMAW                 | OTHER PASSES:<br>GTAW/SMAW | ROOT PASS:<br>GTAW/SMAW | OTHER PASSES:<br>GTAW/SMAW |
|                 | FILLET JOINTS/SOCKET JOINTS : GTAW/SMAW |                            |                         |                            |

|                  |                                                    |                                                                      |                                                       |                                                                       |
|------------------|----------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------|
| WELDING MATERIAL | GROOVE JOINTS                                      |                                                                      |                                                       |                                                                       |
|                  | BUTT                                               |                                                                      | OTHER THAN BUTT                                       |                                                                       |
|                  | ROOT PASS:<br>SFA-5.18 ER 70 S-2<br>/SFA-5.1 E6010 | OTHER PASSES:<br>SFA-5.18 ER 70 S-2<br>/SFA-5.5 E7018-1 /<br>E8018-1 | ROOT PASS:<br>SFA-5.18 ER 70<br>S-2 /SFA-5.1<br>E6010 | OTHER PASSES:<br>SFA-5.18 ER 70 S-2<br>/ SFA-5.5 E7018-1<br>/ E8018-1 |
|                  | FILLET JOINTS/SOCKET JOINTS : SFA-5.5 E7018-1      |                                                                      |                                                       |                                                                       |
|                  | BACKING RING: NA                                   |                                                                      | CONSUMABLE INSERT: NA                                 |                                                                       |

|                   |                            |
|-------------------|----------------------------|
| JOINT PREPARATION | ASME B 31.8 / ASME SEC.-IX |
|-------------------|----------------------------|

|                 |                            |                              |
|-----------------|----------------------------|------------------------------|
| GASES           | PURGING                    | SHIELDING: ARGON             |
| GAS COMPOSITION | PURGING                    | SHIELDING: 99.995%           |
| PRE-HEATING     | PRE-HEAT TEMP: 100°C (min) | INTER-PASS TEMP: 250°C (max) |

|                          |                    |    |                    |    |
|--------------------------|--------------------|----|--------------------|----|
| POST WELD HEAT TREATMENT | HOLDING TEMP:      | NA | HOLDING TIME:      | NA |
|                          | RATE OF HEATING:   | NA | MIN. HOLDING TIME: | NA |
|                          | METHOD OF COOLING: | NA | RATE OF COOLING:   | NA |

|                                  |                                     |                            |      |           |     |
|----------------------------------|-------------------------------------|----------------------------|------|-----------|-----|
| MECHANICAL PROPERTY REQUIREMENTS | CHARPY 'V' NOTCH IMPACT TEST VALUE: | MIN. :                     | 22 J | AVERAGE : | 27J |
|                                  | AT TEMPERATURE:                     | -29°C                      |      |           |     |
|                                  | HARDNESS:                           | $\leq$ 248HV <sub>10</sub> |      |           |     |

|                     |                                          |
|---------------------|------------------------------------------|
| CODE OF FABRICATION | ASME SECTION IX & APPLICABLE DESIGN CODE |
|---------------------|------------------------------------------|

**NOTE:**

1. Procedure shall be qualified based on thickness and P no. and G no., qualification ranges as per Section IX.
2. For piping up to diameter of 2", welding shall be carried at by GTAW.
3. Electrode E8018-1 will be used for pipe  $\geq$  API 5L Gr. X 60 (PSL-2)



## WELDING SPECIFICATION CHART FOR LTCS PIPING WELDING

DOCUMENT NO : VCS-WS-PP-2039C

REVISION :00

PIPING CLASS: 15HLT, 30HLT, 60HLT (LOW TEMPERATURE AND UPTO SMYS ≤ 490 MPa)

|                                  |                                                    |                                                              |                                                     |                                                         |           |     |
|----------------------------------|----------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------|-----------|-----|
| MATERIAL SPECIFICATION           | PIPES                                              | ASTM A333 Gr. 6                                              |                                                     |                                                         |           |     |
|                                  | FITTINGS                                           | ASTM A350 Gr. LF-2, ASTM A420 Gr. WPL6, ASTM A420 Gr. WPL6-W |                                                     |                                                         |           |     |
|                                  | FLANGES                                            | ASTM A350 Gr. LF-2                                           |                                                     |                                                         |           |     |
|                                  | OTHERS                                             | -                                                            |                                                     |                                                         |           |     |
| BASE METAL “P” NO. 1             |                                                    |                                                              |                                                     |                                                         |           |     |
| WELDING PROCESS                  | GROOVE JOINTS                                      |                                                              |                                                     |                                                         |           |     |
|                                  | BUTT                                               |                                                              |                                                     | OTHER THAN BUTT                                         |           |     |
|                                  | ROOT PASS:<br>GTAW/SMAW                            | OTHER PASSES:<br>GTAW/SMAW                                   | ROOT PASS:<br>GTAW/SMAW                             | OTHER PASSES:<br>GTAW/SMAW                              |           |     |
|                                  | FILLET JOINTS/SOCKET JOINTS : GTAW/SMAW            |                                                              |                                                     |                                                         |           |     |
| WELDING MATERIAL                 | GROOVE JOINTS                                      |                                                              |                                                     |                                                         |           |     |
|                                  | BUTT                                               |                                                              |                                                     | OTHER THAN BUTT                                         |           |     |
|                                  | ROOT PASS:<br>SFA-5.18 ER 70 SG<br>/ SFA-5.1 E6010 | OTHER PASSES:<br>SFA-5.18 ER 70 SG<br>/ SFA-5.5 E7018-1      | ROOT PASS: SFA-<br>5.18 ER 70 SG /<br>SFA-5.1 E6010 | OTHER PASSES:<br>SFA-5.18 ER 70 SG<br>/ SFA-5.5 E7018-1 |           |     |
|                                  | FILLET JOINTS/SOCKET JOINTS : SFA-5.5 E7018-1      |                                                              |                                                     |                                                         |           |     |
|                                  | BACKING RING: NA                                   |                                                              |                                                     | CONSUMABLE INSERT: NA                                   |           |     |
| JOINT PREPARATION                | ASME B 31.8 / ASME SEC.-IX                         |                                                              |                                                     |                                                         |           |     |
| GASES                            | PURGING                                            |                                                              | SHIELDING: ARGON                                    |                                                         |           |     |
| GAS COMPOSITION                  | PURGING                                            |                                                              | SHIELDING: 99.995%                                  |                                                         |           |     |
| PRE-HEATING                      | PRE-HEAT TEMP: 100°C (min)                         |                                                              | INTER-PASS TEMP: 250°C (max)                        |                                                         |           |     |
| POST WELD HEAT TREATMENT         | HOLDING TEMP:                                      | NA                                                           | HOLDING TIME:                                       | NA                                                      |           |     |
|                                  | RATE OF HEATING:                                   | NA                                                           | MIN. HOLDING TIME:                                  | NA                                                      |           |     |
|                                  | METHOD OF COOLING:                                 | NA                                                           | RATE OF COOLING:                                    | NA                                                      |           |     |
| MECHANICAL PROPERTY REQUIREMENTS | CHARPY ‘V’ NOTCH IMPACT TEST VALUE:                |                                                              | MIN. :                                              | 22J                                                     | AVERAGE : | 27J |
|                                  | AT TEMPERATURE:                                    |                                                              | -46.5°C                                             |                                                         |           |     |
|                                  | HARDNESS:                                          |                                                              | ≤ 248HV <sub>10</sub>                               |                                                         |           |     |
| CODE OF FABRICATION              | ASME SECTION IX & APPLICABLE DESIGN CODE           |                                                              |                                                     |                                                         |           |     |

**NOTE:**

1. Procedure shall be qualified based on thickness and P no. and G no., qualification ranges as per Section IX.
2. For piping up to diameter of 2", welding shall be carried at by GTAW.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR WARNING MAT

VCS – SS – PP -2020

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 03.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |

| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                  |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                             |
| 00              | 23.02.2019    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Issued as Standard Specification                                 |
|                 |               | PK                                                                                  | DG                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 01              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document numbering updated from VPC-SS-PL-0034 to VPC-SS-PP-2020 |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 02              | 18.12.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Re-Issued as Standard Specification                              |
|                 |               | PNS                                                                                 | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 03              | 03.01.2022    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Revised after VCS Internal Technical Review                      |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |                                                                  |
| 04              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                              |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                  |

---

**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |

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## 1.0 SCOPE

This specification covers the minimum requirements for the various activities to be performed by for the procurement of Warning Mat.

Warning Mats shall be laid in the ground above the gas main line in order to indicate their presence.

This specification shall be read in conjunction with the condition of all specifications and documents included in the contract between company and contractor.

## 2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

The latest edition(edition in force at the time of floating enquiry) of following Codes, Standards and regulations are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation system for liquid Hydrocarbon & other liquids.

B 31.8 : Gas Transmission and Distribution Piping Systems.

### AMERICAN PETROLEUM INSTITUTE (API)

1102 : Pipeline Crossing Railroads and Highways

1109 : Marking Liquid Petroleum Pipeline Facilities

1104 : Welding of Pipelines and Related Facilities

### PNGRB REGULATIONS :

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

### US DOT PIPE LINE SAFETY STANDARD

Part 192, Title 49 : Transportation of Natural and other Gases by Pipe Line

Part 195 : Transportation of Liquid by Pipe Line

### 3.0 FEATURES

Warning mat material shall be non-biodegradable type. It shall have non-toxic & anti-rodent properties.

### 3.1 MATERIAL

Warning Tape, Type 1 as per EN 12613 shall be used for the present project.

The material grade of Warning Mat shall be High density polyethylene (PE)/ PP material with warning sticker / stamp. The material shall be having the density between 0.913 to 0.923 g/cc at 27 deg. Celsius as per IS 2508.

The tape shall be uniform in colour, texture and finish and shall be free from holes and foreign materials.

Rodent repellent chemicals to be added to the plastic master batch for protection against rodents.

The material and colour, if used, for printing shall have no detrimental effects on the environment.

### 3.2 MECHANICAL PROPERTIES

Mechanical properties of the Warning Mat (Type I) shall be in accordance with the code EN 12613.

Minimum tensile withstand load in longitudinal direction shall not be less than 200 N. The test piece shall not exhibit a reduction of more than 20% of its width after removal of the specified load.

### 3.3 COLOUR

The Warning Mat shall be of bright golden yellow colour. This colour must not take any alteration in the course of time.

### 3.4 DIMENSIONS

Warning Mat shall have following dimensions:

|           |                             |
|-----------|-----------------------------|
| Width     | $(D+500) \pm 2$ mm (Note-1) |
| Thickness | 1.0 mm (Minimum)            |

'D' is diameter of mainline pipe.

Negative tolerance on the thickness is not allowed.

**Note:** Width of Mat shall be finalized during drawing approval stage.

### 3.5 MARKING

**3.5.1** The warning mat shall be marked at intervals not exceeding 1 meter. Marking on the mat shall be approved by owner. The marking shall be legible and durable. The



warning mat must be printed with "Caution: High Pressure Gas Pipeline Below" in English and Hindi/ Local Language, Chainage marking along with owner's logo and owner's 24 Hours Emergency Number -----, ----- at a frequency of every meter. In addition, name or trademark of the manufacturer, year of manufacture and reference of code of manufacture of warning mat shall be included in the marking.

**3.5.2** Vendor shall submit proposed Artwork to be marked on the Warning Mat for approval from Owner / Owner's representative before start of production.

### **3.6 TESTS**

All the tests and test procedures for Warning Mats shall be as per EN 12613 or as per required National/ International standards mentioned in EN 12613. In addition, all requirements pertaining to statutory requirements, if any, as specified from time to time shall be complied.

The required tests are briefed as below:

#### **Colouring**

Three separate tests shall be carried out in accordance with:

- As per normative annexure B of EN 12613, using 20% ammonium sulphide.
- As per EN ISO 175, using 10% nitric acid & 20% sodium carbonate solution.

The tests shall be repeated for each colour (if any).

There shall be no discolouration or change of the initial colour of the warning tape after the tests.

#### **Tensile Withstand Strength**

The test sample shall be selected as per mentioned in EN 12613. The test samples shall be preconditioned for not less than 12 h at  $23 \pm 2$  °C. Static loads shall be carried out to the samples over a period of 10 s.

After the test, the test piece shall withstand without starting to separate at weak points (if any) for not less than 5 minutes. Also it should not exhibit a reduction of more than 20% of its width after removal of specified load.

The minimum tensile withstand load for the warning mat in the longitudinal direction shall be not less than 200 N.

#### **Visual Warning Characteristics**

The test shall be carried out in accordance with normative annexure A of EN 12613.

#### **Permanence of Printing**

The test shall be performed as per CL. 9.3 of IEC 60898:1995.

The test is made by rubbing the marking by hand for 15 sec with a piece of cotton soaked with water and again for 15 sec with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of max. 0.1% by volume, a kauributanol value of 29, an initial boiling point value of approx. 65°C, a dry point of approx. 69°C and a density of approx. 0.68 gm/cm<sup>3</sup>.

After the test, the marking shall be easily legible.

### **Test of laying Characteristics**

The test is for the assessment of transverse rigidity of the warning mats.

The test shall be performed as per EN 12613.

### **Warning Mat Virginity Test**

Differential Scanning Calorimeter (DSC) Scan test along with the temperature of melting (T<sub>m</sub>) shall be performed for the Warning Mat and its raw polymer i.e. virgin low density polyethylene (LDPE).

The Differential Scanning Calorimeter (DSC) Scan curve of the Warning Mat obtained from its DSC Scan test along with its Temperature of Melting (T<sub>m</sub>) shall then be compared with the DSC Scan curve and the Temperature of Melting (T<sub>m</sub>) of its raw polymer (i.e. virgin LDPE).

To ensure the virginity of the Warning mat, the DSC Scan curve and T<sub>m</sub> of the Warning Mat (finished product manufactured from the raw polymer) shall match on overlapping with its corresponding raw polymer's DSC Scan curve and T<sub>m</sub>.

## **4.0 PACKING**

The warning mat shall be delivered in rolls of minimum 50 meters. Packing size to be mentioned to ensure uniformity in delivery conditions of the materials being procured. Packaging of the Warning Mat shall be such that there won't be any deterioration due to Ultraviolet (UV) effect during transportation and storage of the Warning Taps prior to use.

## **5.0 QUALITY ASSURANCE (QA)**

Manufacturer shall prepare detailed Inspection Test Procedure (ITP) and submit for the approval from Owner / Owner's representative.

## **6.0 DEFECT LIABILITY**

Defect liability period shall be as Specified in Tender.

## **7.0 RECOMMENDED MANUFACTURER FOR RAW MATERIAL**

1. INEOS
2. BOREALIS
3. TOTAL PETROCHEMICALS
4. DOW
5. BASSELL

6. RELIANCE
7. GAIL
8. HALDIA

However, any other reputed national or international Manufacturer may also be considered for supply of Raw material with approval of Owner / Owner's representative.



# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION FOR HEALTH, SAFETY & ENVIRONMENT

**VPC – SS – PP - 2021**

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 01      | 28.01.2020 | MB          | MC         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |                         |
|-------------------|-------------------------|
| UNCONTROLLED COPY | : If printed            |
| CONTROLLED COPY   | : If in soft and signed |

| REVISION RECORD |               |             |            |             |               |                                                                                       |
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| Rev.            | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description                                                                  |
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|                 |               |             |            |             |               |                                                                                       |
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|                 |               |             |            |             |               |                                                                                       |

---

**ABBREVIATIONS:**

|      |                               |
|------|-------------------------------|
| TPIA | THIRD PARTY INSPECTION AGENCY |
| QA   | Quality Assurance             |
| QC   | Quality Control               |
| LOI  | Letter of Indent              |
| QAP  | Quality Assurance Procedure   |
| ISS  | International Standard Space  |
| UPS  | Uninterruptible Power Supply  |



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## 1.0 SCOPE

This specification establishes the Health, safety and Environment (HSE) aspects to be complied with by the contractor during construction at site.

## 2.0 REFERENCES

This document should be read in conjunction with following.

- General Condition of Contract (GCC)
- Special Condition of Contract (SCC)
- Job Specifications
- Relevant IS codes
- Reporting Formats

## 3.0 RESPONSIBILITY & ORGANISATION

Safety activities at site shall be under control of contractor's RCM. He shall be responsible for implementation of HSE provisions. The nominated or designated safety engineer/ officer shall assist and perform day to day HSE work as per his advice.

## 4.0 GENERAL REQUIREMENT

**4.1** The contractor should follow HSE policy of owner as applicable to construction site.

**4.2** The contractor shall deploy a full time HSE engineer / officer to coordinate the site.

The HSE officer shall be duly qualified in Industrial Health & Safety management with an experience of 4 -5 years.

**4.3** The contractor shall ensure that HSE requirements are clearly understood & faithfully implemented at all level, at each site.

**4.4** The contractor shall organize safety awareness programs regularly.

**4.5** The contractor shall ensure his participation in the every HSE meeting called by owner/owner representative.

**4.6** The contractor's shall conduct daily tool box talk.

**4.7** The contractor shall submit Monthly HSE reports (Form attached in ANNEXURES).

**4.8** The contractor shall provide all help and support to the injured person got injury at site during construction work and arrange compensation as per insurance policy / Act.

**4.9** The contractor shall adhere consistently to all provisions of HSE. In case of non-compliance or continuous failure the owner/ owner representative may impose stoppage of work without any cost time implication to owner. A penalty amount of Rs 1000/- shall be imposed on the contractor for the serious HSE violation.



- 4.10** Three times of this penalty may count as a serious violation of contractor in line with HSE. This may affect to new work assignment/award of contractor.

## **5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING**

### **Accident**

Unintended occurrence arising out of and in the course of employment of a person, which results in to injury with or without damage to plant/equipment/materials.

### **Incident**

means an unplanned and uncontrolled event which results in damage to plant or equipment or loss of material without causing any injury to persons, like fire, spill, leak, property damage etc.

### **Near-miss**

An unexpected, unwanted event not causing loss, injury or illness but which under slightly altered conditions can lead to an accident.

can be defined as "Any event which under slightly un favorable circumstances, may have resulted in any of the following:

- Injury, fatal or otherwise or ill health to people
- Loss of property, damage to plant or materials
- Damage to the environment
- A business interruption"

Accident, Incident and Near miss reporting form listed in ANNEXURES

## **6.0 HSE REQUIREMENTS AT SITE**

### **6.1 Personnel Protective Equipment's**

The contractors shall provide sufficient numbers of following personal protective equipment's (PPEs) to workmen and supervisors/engineers to use them properly at work site.

Following five numbers of Personnel protective equipment's are identified as MANDATORY for all.

- Safety Helmet
- Coverall
- Safety shoes/footwear
- Safety Glasses
- Hand Gloves (as per job requirement)

Other PPEs are depending upon nature of job like

Arc Welding – Welding face shield

Grinding – Grinding face shield

Height work – Full Body harness (above 2 meters)

Ask site supervisor for proper use and selection of protective clothing / equipment for specialized jobs

## **6.2 Welding**

- Ensure that welding machine is in order and approved by site engineer.
- Ensure that welding cables are in order.
- Ensure that welding machine is properly earthed.
- Remove all combustible material from welding area to avoid fire
- Place a fire extinguisher nearby welding premises.
- Ensure welding holder, cable and its lugs in good condition and use only industrial power socket and plugs (3 Pin) to avoid electricity risk.
- Make sure that welding machine is provided with ON/OFF switch and is earthed/grounding.
- Do not over load electrical appliances and cable, Shocked pin etc,
- Ground the work piece separately from the welding return connection only.

## **6.3 Gas Cutting**

- Check the cylinder and its valve or leakage and move out any leaking cylinder immediately.
- Ensure that flash back arresters are installed with torch and NRV (Non-return valve) on the gas cylinders side.
- Ensure cylinders in vertical position (Cylinder trolley) and far away from fall of sparks and hot metal.
- Check the regulator and torches that they are inspected prior to every use.
- Check for leaks around regulators, hoses/fittings & nozzle with soap solution.
- Check the entire hose length if it is cracked or worn out cut that length of hose or replace the hose.
- Check that flash back arrester used for the purpose is of approved make/specification only.
- Place a fire extinguisher nearby welding premises.

## **6.4 Grinding Operation**

- Grinding wheels should be stored in dry place.
- After expiry date, grinding wheel must be condemned, broken in to pieces.
- Power supply cable of adequate current carrying capacity shall be used and it should be in good workable condition without abrasions, cuts or puncture in outer insulation.
- Socket pin provided at supply end and on/off switch in working condition.
- Proper earthing of the body in case of metallic body.
- Wheel guard properly fitted in position.

- Machine body without any damage like crack etc.
- Moving part (wheel) must be properly fixed to the machine with the help of spanner.
- Grinding wheel must be of suitable size as per the speed of grinding machine.
- Grinding wheel without manufacturer's sticker showing size, speed and expiry date must be condemned.
- Don't use portable grinding machine as bench grinder.
- Don't fit over size wheel than recommended size by machine/wheel manufacturer.
- Don't grind small, unstable object without fixing it in the vice.
- Don't over press the grinding wheel against the job for fast removal of metal.
- Put OFF the main switch, while machine is not in use (tea break etc.)
- Don't chip off grinding/cutting wheel for achieving fast cutting rate.

**PPEs:**

- Use of helmet, face shield or safety goggles (where face shield is not possible.) and hand gloves.

## **6.5 Use of Power Tools and Cables**

- All electrical equipment and tools used by the contractors and their employees shall be properly checked by contractor's supervisor before use.
- All power tools must have proper guard at all time.
- Leads /cables must be placed so that they do not create a tripping hazard.

## **6.6 Material Handling and storage**

The Contractor will only use crane/Hydra and lifting equipment that has been tested and certified as fit for purpose by 3rd Party. All crane operators and riggers will be adequately trained and certified. The Contractor will keep records of tests and certification of all lifting equipment crane employed on the Works. Maintenance records shall be routinely inspected by the Contractor and made available for Safety audits.

**LIFTING GEAR:** Lifting machine, chains, ropes and lifting tackles used at site shall conform to the following:

- All parts shall be good construction, sound material and adequate strength and free from defects.
- Shall be properly maintained, thoroughly examined, load tested by competent person.
- No lifting machine and no chain, rope or lifting tackle shall except for purpose of test be loaded beyond safe working load must be plainly marked on the gear concerned.
- All material must be properly stacked and secured to prevent sliding, falling or collapse.
- Stairs and passage ways must be kept clear at all time.

## **6.7 Trenches and Excavation**

Before commencing any excavation work the Site in charge will ensure that the proposed works have been adequately assessed and planned to ensure that they are executed safely and without risks to Health and safety. The factors to be assessed and planned will include: -

- The nature and stability of the material being excavated and the need for any support of walls.
- The effect of excavation on nearby area.
- The foreseeable presence of hazardous contaminants.
- The proximity of mobile plant.
- The provision of edge protection (fall prevention of people and materials)
- Access and egress

## **6.8 Pipe Transportation and lowering**

- All drivers shall hold a valid driving license for the class of vehicle.
- Securing of the load shall be according to established and approved methods.
- All overhangs shall be made clearly visible and restricted to acceptable limits.
- Load shall be checked before moving off and after traveling a suitable distance.
- All vehicles used by Contractors shall be in worthy condition and in conformance to the Land Transport requirement.
- Use of certified side booms after 3rd Party inspection.
- Effective communication should be done among all involved personals.
- Signaling shall be done by authorized foreman only.
- Ensure appropriate measures are taken for overhead hazards.
- Persons are not allowed towards trench side / under the boom at the time of lowering.
- Co-ordination of lowering in by a single man only.
- Inspection of equipment before use.
- All personnel should stay clear of moving equipment.
- Use of certified lifting tools and tackles.

## **6.9 Pressure / Leak Testing**

### **Hydraulic and Pneumatic Test**

Access to the test area shall be limited to essential personnel only. before the test commences compliance is required with the following points:

- Persons supervising pressure or leak tests must have sufficient knowledge and experience of testing to fully understand the hazards of the activity and the precaution, which must be taken.
- Effective communication, including formal procedures, must be established between sites whenever the test envelope extends beyond one site, for example, pipelines.
- The area shall be cordoned off (using tape, shields or barriers, etc) at an adequate

distance from the equipment to be tested, as specified on the Permit to Work

- Warning signs shall be posted at access ways, at other strategic positions, and on the equipment to be tested (including the doors of test workshops or other designated areas)
- Pressuring equipment shall be provided with suitably calibrated pressure control / regulator devices.
- Pressuring equipment shall not be left unattended at any time during the test.
- Pressuring equipment shall be isolated from the equipment under test and where practicable disconnected, when the test pressure has been reached.
- Care must be taken to ensure that materials of construction have the required ductility at the test temperature to prevent brittle fracture.
- A safety valve should be fitted to the equipment/system being tested, set to relieve at a pressure that will prevent over pressurization
- Sufficient venting / draining points shall be provided in order to prevent trapping of pressurizing medium behind non-return valves, check valves, between isolation valves, or within dead legs of the pressure envelope
- The equipment/plant to be pressure tested must be subjected to thorough examination prior to testing. It may be necessary to 100% inspect all welds using visual, radiographic or other NDT techniques
- The gas supply must be isolated when test pressure has been achieved
- The pressure envelope must contain sufficient vents, to a safe location.
- De-pressurization after pneumatic testing must be gradual

#### **6.10 Scaffolding and Ladder**

- All working platform must be constructed with the specific requirement of job.
- All portable ladders must be in good condition as per the site norms.
- If the working platform is not permanent then safety belt must be used.
- There shall be firm foundation for all scaffoldings. All scaffolding shall be made of sound material.
- Scaffolding material shall be inspected and used, only if found in good condition.
- Provide metal base plate is used under all upright or standard scaffoldings. Correct type of couplers shall be used for all connections.
- Plumb and level scaffoldings as erection proceeds, so that braces will fit without forcing. Fasten all braces securely.
- Working platforms shall be provided with guards. This should consist of top rail, mid rail, and toe board. The toe board shall be of minimum height 100 mm, while the mid rail and top rail shall be at heights of 600 mm and 1200 mm respectively.
- Do not use ladders or makeshift devices on top of scaffoldings to increase the height.

- Shall be placed at least 75 deg. to the floor.
- Ladder shall extend 3" to 4" above the point of Landing and topmost 3 rungs shall not be used.
- Ladder is checked visually for defects before every use.
- Ladders shall not be used in a horizontal position as runways or scaffoldings.
- Ladders shall not be placed in front of a door that opens toward the ladder unless the door is locked, blocked or guarded.
- Fall arrestor to be used where ever applicable.

#### **6.11 Work Permit Procedure**

- For working at more than 10' height the permission must be obtained from site in-charge.
- For doing any Hot work in the fire risk areas the permission must be obtained from site in charge or safety officer.
- For any Excavation work it must be ensured that there are no under group utilities like cables, Water pipeline etc.
- For any work inside confined space, entry permit must be obtained from site engineer.

#### **6.12 Barricades and Warning Signs**

- Area where work is being carried out above man height or below 1' ground depth must be barricaded.
- Follow the instruction of all types of warning signs like "NO SMOKING" "NO ENTRY" "DANGER" "Work at height"

#### **6.13 Emergency Plan and Procedures**

- All Contractor's employees should be aware of site Emergency control plan
- Periodic drill to train employees for their awareness & information should be followed.

#### **6.14 Road Safety Norms**

- For roadside working site to be barricaded as per approved barricading norms Penalty clause for road safety & barricading shall be applicable as per relevant clause of commercial part of tender.
- Only eligible driver can drive required vehicle inside site
- Speed limit norms of site must be followed
- No riding or travelling on the back of open-end vehicle, fork lift or trailers should be done.

#### **6.15 Labour Welfare & Legal Requirement**

- All mandatory provisions with regard to safety as prescribed under contract Labour (Abolition & Regulation) Act 1970 and Rules made there under are applicable.
- Workmen compensation insurance and registration under ESI should be maintained.
- Time to time, all rules and regulations suggested by safety committee of site must be

followed and implemented

## ANNEXURE – A

### RELEVANT IS-CODES FOR PERSONNEL PROTECTION

|                                   |   |                                                                    |
|-----------------------------------|---|--------------------------------------------------------------------|
| IS : 2925 – 1984                  | : | Industrial Safety Helmets.                                         |
| IS : 4770 – 1968                  | : | Rubber gloves for electrical purposes                              |
| IS : 6994 – 1973 (Part – I)       | : | Industrial Safety Gloves (Leather & Cotton)                        |
| IS : 1989 – 1986 (Part – I & III) | : | Leather safety boots and shoes                                     |
| IS : 3738 – 1975                  | : | Rubber knee boots                                                  |
| IS : 5557 – 1969                  | : | Industrial and Safety rubber knee boots                            |
| IS : 6519 – 1971                  | : | Code of practice for selection, care and repair of Safety footwear |
| IS : 11226 – 1985                 | : | Leather Safety footwear having direct moulding sole                |
| IS : 5983 – 1978                  | : | Eye protectors                                                     |
| IS : 9167 – 1979                  | : | Ear protectors.                                                    |
| IS : 3521 – 1983                  | : | Industrial Safety belts and harness                                |

---

**ANNEXURE – B**

FORMAT - 1.0

**1.0: HEALTHY, SAFETY & ENVIRONMENT (HSE) PLAN**

Project: -----

Contractor: -----

Date: -----

Owner: .....

(To be prepared & submitted by each Construction Agency)

| Activity<br>Description | Procedure/<br>W.I./ Guidelines | Code of<br>Conformance | Performing Function |         |          | Audit Function                         |
|-------------------------|--------------------------------|------------------------|---------------------|---------|----------|----------------------------------------|
|                         |                                |                        | Performance         | Checker | Approver | Customer Review/<br>Audit Requirements |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |

PREPARED BY

REVIEWED

APPROVED BY



## 2.0 MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (1/6)

Project: \_\_\_\_\_ Contractor : \_\_\_\_\_  
Date: \_\_\_\_\_ Owner : \_\_\_\_\_  
Inspection By: \_\_\_\_\_

**Note: write 'NC' (Not Concern) wherever any of the items are not applicable**

| Item                                             | Yes | No | Remarks | Action |
|--------------------------------------------------|-----|----|---------|--------|
| <b>HOUSEKEEPING</b>                              |     |    |         |        |
| Waste containers provided and used               |     |    |         |        |
| Sanitary facilities adequate and Clean           |     |    |         |        |
| Passageways and Walkways Clear                   |     |    |         |        |
| General neatness of working areas                |     |    |         |        |
| Proper Material Storage                          |     |    |         |        |
| Wooden Boards properly stacked and nails removed |     |    |         |        |
| Cords, leads out of walk and traffic ways        |     |    |         |        |
| Scraps removed from the work site                |     |    |         |        |
| Other                                            |     |    |         |        |
| <b>PERSONNEL PROTECTIVE EQUIPMENT</b>            |     |    |         |        |
| Goggles: Shields                                 |     |    |         |        |
| Face protection                                  |     |    |         |        |
| Hearing protection                               |     |    |         |        |
| Safety Shoes provided                            |     |    |         |        |
| Hand protection                                  |     |    |         |        |
| Respiratory Masks etc.                           |     |    |         |        |
| Safety Belts                                     |     |    |         |        |
| Safety Helmets                                   |     |    |         |        |
| Other                                            |     |    |         |        |
| <b>EXCAVATIONS / OPENINGS</b>                    |     |    |         |        |
| Excavation permit                                |     |    |         |        |
| Excavated earth kept away from edge              |     |    |         |        |
| Dewatering pump kept away from edge              |     |    |         |        |
| Safe access into excavated area                  |     |    |         |        |
| Opening properly covered or barricaded           |     |    |         |        |
| Excavations shored                               |     |    |         |        |
| Excavations barricaded                           |     |    |         |        |
| Overnight lighting provided                      |     |    |         |        |
| Other                                            |     |    |         |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (2/6)**

| Item                                                       | Yes | No | Remark | Action |
|------------------------------------------------------------|-----|----|--------|--------|
| Welding Cutting                                            |     |    |        |        |
| Valid not work permit                                      |     |    |        |        |
| Flashback arrester provided for cylinders                  |     |    |        |        |
| Power cable not crossing the welding cable                 |     |    |        |        |
| Adequate earthing provided                                 |     |    |        |        |
| No combustible materials kept near welding & cutting works |     |    |        |        |
| Gas cylinder chained upright & kept in trolleys            |     |    |        |        |
| Cables and hoses not obstructing                           |     |    |        |        |
| Screens or shields used                                    |     |    |        |        |
| Flammable materials protected                              |     |    |        |        |
| Fire extinguisher (s) accessible                           |     |    |        |        |
| Other                                                      |     |    |        |        |
| SCAFFOLDING                                                |     |    |        |        |
| Fully decked platform                                      |     |    |        |        |
| Guard and intermediate rails in place                      |     |    |        |        |
| Toe boards in place & tied properly                        |     |    |        |        |
| Adequate shoring                                           |     |    |        |        |
| Adequate access                                            |     |    |        |        |
| Other                                                      |     |    |        |        |
| LADDERS                                                    |     |    |        |        |
| Extension side rails I'm above                             |     |    |        |        |
| Top of landing                                             |     |    |        |        |
| Properly secured at top & bottom                           |     |    |        |        |
| Angle $\pm 70^\circ$ from horizontal                       |     |    |        |        |
| Other                                                      |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (3/6)**

| Item                                           | Yes | No | Remark | Action |
|------------------------------------------------|-----|----|--------|--------|
| <b>HOISTS, CRANES AND DERRICKS</b>             |     |    |        |        |
| Condition of cables and sheaves OK             |     |    |        |        |
| Condition of slings, chains, hooks and eyes OK |     |    |        |        |
| Inspection and maintenance logs maintained     |     |    |        |        |
| Outriggers used                                |     |    |        |        |
| Singh/ barricades provided                     |     |    |        |        |
| Signals observed and understood                |     |    |        |        |
| Qualified operators                            |     |    |        |        |
| Other                                          |     |    |        |        |
| <b>MACHINERY, TOOLS AND EQUIPMENT</b>          |     |    |        |        |
| Proper instruction                             |     |    |        |        |
| Safety devices                                 |     |    |        |        |
| Proper cords                                   |     |    |        |        |
| Inspections and maintenance                    |     |    |        |        |
| Other                                          |     |    |        |        |
| <b>VEHICLE AND TRAFFIC</b>                     |     |    |        |        |
| Rules and regulations observed                 |     |    |        |        |
| Inspection and maintenance                     |     |    |        |        |
| Licensed drivers                               |     |    |        |        |
| Others                                         |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (4/6)**

| Item                                       | Yes | No | Remark | Action |
|--------------------------------------------|-----|----|--------|--------|
| TEMPORARY FACILITIES                       |     |    |        |        |
| Emergency instruction posted               |     |    |        |        |
| Fire extinguishers provided                |     |    |        |        |
| Fire-aid equipment                         |     |    |        |        |
| Secured against storm damage               |     |    |        |        |
| General nemeses                            |     |    |        |        |
| In accordance with electrical requirements |     |    |        |        |
| Other                                      |     |    |        |        |
| Fire Prevention                            |     |    |        |        |
| Personnel instructed                       |     |    |        |        |
| Fire extinguishers checked                 |     |    |        |        |
| No smoking in prohibited areas             |     |    |        |        |
| Hydrants clear                             |     |    |        |        |
| Other                                      |     |    |        |        |
| ELECTRICAL                                 |     |    |        |        |
| Proper wiring & earthing                   |     |    |        |        |
| ELCB's provided                            |     |    |        |        |
| Ground fault circuit interrupters          |     |    |        |        |
| Protection against damage                  |     |    |        |        |
| Prevention of tripping hazards             |     |    |        |        |
| Proper electrical cable joints             |     |    |        |        |
| Light poles secured                        |     |    |        |        |
| Clear way to power distribution board      |     |    |        |        |
| Proper rating of fuses                     |     |    |        |        |
|                                            |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (5/6)**

| Item                                                                                             | Yes | No | Remark | Action |
|--------------------------------------------------------------------------------------------------|-----|----|--------|--------|
| <b>HANDLING AND STORAGE OF MATERIALS</b>                                                         |     |    |        |        |
| Properly stored or stacked                                                                       |     |    |        |        |
| Passageways clear                                                                                |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>FLAMMABLE GASES AND LIQUIDS</b>                                                               |     |    |        |        |
| Containers clearly identified                                                                    |     |    |        |        |
| Proper storage                                                                                   |     |    |        |        |
| Fire extinguishers nearby                                                                        |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>WORKING AT HEIGHT</b>                                                                         |     |    |        |        |
| Erection plan                                                                                    |     |    |        |        |
| Safety nets                                                                                      |     |    |        |        |
| Safety belts tied properly                                                                       |     |    |        |        |
| Illumination                                                                                     |     |    |        |        |
| No loose material at height                                                                      |     |    |        |        |
| No body under working area                                                                       |     |    |        |        |
| All openings covered                                                                             |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>ENVIRONMENT</b>                                                                               |     |    |        |        |
| Chemical and other Effluents properly disposed                                                   |     |    |        |        |
| Cleaning liquid of pipes disposed of properly                                                    |     |    |        |        |
| Seawater used for hydrotesting disposed off as per agreed proceeding                             |     |    |        |        |
| Lubricant Waste/ Engine oils properly disposed                                                   |     |    |        |        |
| Waster from Canteen office, sanitation etc. disposed properly                                    |     |    |        |        |
| Disposal of surplus earth stripping materials, Oily rags and combustible materials done properly |     |    |        |        |
| Green belt protection.                                                                           |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (6/6)**

| Item                                                        | Yes | No | Remark | Action |
|-------------------------------------------------------------|-----|----|--------|--------|
| HEALTH CHECK                                                |     |    |        |        |
| Hygienic conditions at labour camps OL                      |     |    |        |        |
| Availability of First Aid facilities                        |     |    |        |        |
| Proper sanitation at site, office and labour camps          |     |    |        |        |
| Arrangements of medical facility                            |     |    |        |        |
| Measures for dealing with illness                           |     |    |        |        |
| Availability of potable drinking waters for workmen & staff |     |    |        |        |
| Provision of cretches for children                          |     |    |        |        |
| ERECTION                                                    |     |    |        |        |
| Slings/ D'shakle checked                                    |     |    |        |        |
| Signal Man                                                  |     |    |        |        |
| Tag line for guiding the load                               |     |    |        |        |
| Protecting the slings from sharp edges                      |     |    |        |        |
| No loose materials at height                                |     |    |        |        |
| Ladder & platform welding inspected                         |     |    |        |        |
| No one under the suspended load                             |     |    |        |        |
| Stay rope                                                   |     |    |        |        |
| SWL                                                         |     |    |        |        |

-----  
Signature of Resident  
Engineer with Seal



**Monthly Health, Safety & Environmental (HSE) Report  
(To be submitted by each Contractor)**

Actual work start date: \_\_\_\_\_

For the month of: \_\_\_\_\_

Project: \_\_\_\_\_

Report No.: \_\_\_\_\_

Name of the Contractor: \_\_\_\_\_

Status as on: \_\_\_\_\_

Name of Work: \_\_\_\_\_

Name of Safety officer: \_\_\_\_\_

| Item                                                 | This Month | Cumulative |
|------------------------------------------------------|------------|------------|
| Total strength (Staff – Workmen)                     |            |            |
| Number of HSE meeting organised at site              |            |            |
| Number of HSE awareness programmes conducted at site |            |            |
| Whether workmen compensation policy taken            | Y/N        |            |
| Whether workmen compensation policy valid            | Y/N        |            |
| Whether workmen registered under ESI Act             | Y/N        |            |
| Number of Fatal Accident                             |            |            |
| Number of Loss Time Accident (Other than Fatal)      |            |            |
| Other accident (non loss time)                       |            |            |
| Total No. of accident                                |            |            |
| Total man-hours worked                               |            |            |
| Man-hour loss due to fire and accident               |            |            |
| Compensation cases raised with insurance             |            |            |
| Compensation cases resolved and paid to workmen      |            |            |

Remark

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Safety Officer/RCM

(Signature and name)

To: OWNER..... 1 COPY

RCM/SITE-IN-CHARGE 1 COPY



**SUPPLEMENTARY ACCIDENT, INCIDENT&NEAR MISS REPORT**

Project: \_\_\_\_\_ Supplementary to Report No.: \_\_\_\_\_

(Copy enclosed)

Site: \_\_\_\_\_ Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

NAME OF THE INJURED.....  
FATHER'S NAME.....  
SUB-CONTRACTOR M/S.....  
DATE & TIME OF ACCIDENT.....  
LOCATION.....

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT

NATURE OF INJURY / DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICITIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER 1 COPY

: RCM/SITE-IN-CHARGE 1 COPY





**ACCIDENT REPORT**

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No. \_\_\_\_\_

Date: \_\_\_\_\_

Name of Site: \_\_\_\_\_

COTRACTOR \_\_\_\_\_

NAME OF THE INJURED .....

FATHER'S NAME.....

SUB-CONTRACTOR M/S.....

DATE & TIME OF ACCIDENT.....

LOCATION.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER  
: RCM/SITE-IN-CHARGE

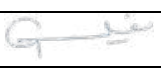
1 COPY  
1 COPY



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR PRE-COMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM

VCS – SS – PP - 2022

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 03      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 02      | 21.12.2020 | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

|                   |                         |
|-------------------|-------------------------|
| UNCONTROLLED COPY | : If printed            |
| CONTROLLED COPY   | : If in soft and signed |

| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                  |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                             |
| 00              | 04.06.2019    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Issued as Standard                                               |
|                 |               | JV                                                                                  | MD                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 01              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Document numbering updated from VPC-SS-PL-0039 to VPC-SS-PP-2022 |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 02              | 21.12.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Re-Issued as Standard                                            |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |                                                                  |
| 03              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                              |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                  |

---

**ABBREVIATIONS:**

|        |                                                           |
|--------|-----------------------------------------------------------|
| NACE   | National Association of Corrosion Engineers               |
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society of Testing of Materials                  |
| BHN    | Brinell hardness number                                   |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| LTCS   | Low temperature Carbon Steel AS Alloy Steel               |



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## **CONTENTS**

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## 1.0 SCOPE

The specification covers the minimum technical requirements for testing and commissioning of entire pipeline facilities including Commissioning activities such as pre-commissioning checks, dewatering, swabbing, flushing/blowing, leak testing etc.

## 2.0 GENERAL

The scope of work for testing & commissioning including Pre – Commissioning activities shall include but not limited to the manpower, machinery & equipments, detailed Procedures, Materials & Consumable, Communications etc. to perform the work satisfactorily.

Contractor shall prepare detailed procedures for piping, dewatering, swabbing, pigging & commissioning of the pipeline, covering all aspects of work for owner's approval.

Contractors shall design & supply all temporary line connections Valves, Instruments, as required during the various operations.

In the event of any details which are not fully addressed, it is warranted by Contractor that work shall be performed in accordance with the specification & the best recognized practices in the onshore pipeline industry.

## 3.0 RESPONSIBILITY OF CONTRACTOR

The pipeline contractor shall be responsible for all the pre-commissioning and commissioning activities that need to be carried out for the project.

### 3.1 Pre-commissioning

In order to execute and perform pre-commissioning activities, the pipeline contractor shall be responsible for (but not limited to) the following: -

- Carrying out pre-commissioning checks of the pipeline system including Tap-off Stations/Receipt Stations, Sectionalizing Valve (SV) Stations and their associated facilities under the scope of work to ascertain that the project has been mechanically completed in all respects.
- Checking of field instruments, laying out survey of pipeline, checking of communication system, checking of Electrical, Instrumentation system, controls & interlock etc.
- Dewatering of Pipeline and above ground piping, flushing/air-blowing and leak testing of piping i.e. piping and equipments under their scope of work.
- Supply and supervision of manpower for pre-commissioning.
- Operation of machinery and equipment for pre-commissioning.
- Supply and use of materials/consumables as required for the pre-commissioning activities.

- Erection of all temporary facilities like pig launcher/receiver, line connections, spool pieces, pigs and requisite accessories, valves, instruments, manpower etc. as required during various operations.
- Preparation of detailed pre-commissioning procedures, activity schedules, bar charts, schemes etc.

This shall include preparation of detailed procedures for dewatering, electronic geometric pigging / caliper pigging (By other Contractor), idle time preservation (if applicable), removal of idle time preservers (if applicable, flushing/blowing, leak testing and shall address the sequence and methodology describing all operations, data on materials, equipments, instruments, consumables (e.g. Pigs and associated items), communication systems, necessary calculations, detailed time schedule and organization chart.

- All necessary work to perform the job successfully including all modifications that would be required at various stages.

The pipeline contractor shall demonstrate to the Owner / Consultant (for approval) the successful completion of all the above-mentioned activities.

In the event of any detail, which is not fully addressed, the pipeline contractor should warrant that work shall be performed in accordance with the relevant codes, Owner / Consultant's specifications and the best recognized engineering guidelines and practices being followed in the on-shore gas pipeline industry.

### **3.2 Commissioning**

In order to execute and perform commissioning related activities, the pipeline contractor shall be responsible for providing all support/ assistance required for commissioning under the overall guidance and supervision of Owner / Consultant. Contractor shall submit a detailed commissioning procedure for Owner / Consultant approval.

The pipeline contractor shall be also responsible to coordinate with the Composite Contractor(s), who is responsible for commissioning of the cathodic protection of the entire pipeline so that the commissioning process can proceed uninterruptedly in a harmonious manner for the entire project.

Commissioning assistance broadly covers the following activities:

- Commissioning checks including Safety Review prior to start of commissioning activities to achieve 'Ready for commissioning' status for pipeline
- Surveillance of pipeline and attending leaks and operation of SVs and metering station (at Dispatch Station/Tap-Off Station/Receipt Stations, IDS whenever required).
- Supply and supervision of manpower for commissioning. Manning of SV and Tap-Off Station/Receipt Stations for pig tracking, pig receiving and other activities.
- Supply and operation of machinery and equipment for commissioning, if required.
- Supply of Nitrogen and its associated accessories for purging required for carrying out commissioning.
- Supply and use of materials/consumables as required for the commissioning activities.

- Any other assistance required by Owner / Consultant.
- Erection and supply of all temporary line connections, spool pieces, strainers, valves, instruments, manpower etc. as required during various operations.
- Ensuring all communication facilities is in place and in proper working condition prior to start of commissioning activities of the pipeline system.
- Stabilization and total system operation for 72 hrs. with all instruments controls & interlocks working satisfactorily at normal operating conditions. On completion of this stage one-month operating run period will start.
- All necessary work to perform the job successfully including all modifications that would be required.

In the event of any detail, which is not fully addressed, contractor should warrant that work should be performed in accordance with the relevant codes, Owner's specifications and the best recognized engineering guidelines and practices being followed in the onshore pipeline industry.

### 3.3 Pre-commissioning Activities

#### 3.3.1 PRE-COMMISSIONING CHECKS

Pre-commissioning checks shall be carried out for the pipeline system to ascertain that the pipeline system has been mechanically completed in all respect. These checks shall cover all the facilities of the main pipeline, including Metering Stations, tap-Off Stations, Receipt Stations, Sectionalizing Valve Stations, as applicable. The pre-commissioning checks shall include the following:

##### a) System Checks

The entire facilities shall be checked against the latest P&ID's, Engineering and Vendor Drawings/Documents and other design specifications. Any shortcoming observed shall be listed down in the form of punch lists and these should be duly attended or liquidated. The pipeline contractor should check the stations systems from the angle of pre-commissioning and commissioning and spell out any additional requirement of vents/drains, temporary arrangement/modification etc. that may be required during the pre-commissioning and commissioning activities and arrange for the same in consultation with the Owner / Consultant representative.

##### b) Checking of Field Instrument

All the field instruments like actuated valves, shutdown valves, transmitters, solenoid valves, shut down switches, alarms etc. shall be checked physically and also for their intended application by simulating the actual conditions. It will also include checking of different meters, gauges, action of actuated valves, control valves, shutdown valves etc.

##### c) Survey of the Pipelines

This shall be performed to confirm that proper fittings/ supports, Cathodic protection system, route markers, warning signs, fencing around SV stations, etc. have been installed along the pipeline.



d) Checking of Communication System

This is to check that there is proper communication with adequate back-up power to ensure uninterrupted communication.

e) Checking of Electrical Distribution System

This is to ensure safety and also to ensure an uninterrupted power supply during start-up and normal pipeline operation.

f) Checking of Instrument, controls & Interlocks

This is to check that instrument controls and interlocks are functional as per the normal operating conditions.

g) Checking of Utilities

This is to check that utilities like power system, etc. are available prior to start-up.

h) Any other checks as may be considered necessary.

3.3.2 PRE-COMMISSIONING WORKS FOR THE ABOVE GROUND PIPING/ UG PIPELINE  
(DISPATCH STATION, METERING STATIONS, RECEIPT STATIONS ETC. UNDER THE SCOPE  
OF WORK)

3.3.2.1 Dewatering (Hydro Test Water)

- General

Dewatering of a piping system shall be done subsequent to the hydro-test of the respective piping section. During the dewatering operation, the major quantity (to the maximum extent possible) of hydro-test water shall be removed from the main interconnecting piping work in the stations. A standard blind shall be arranged and provided at the inlet and outlet nozzles of pumps and sump tank to avoid entry of debris/dirt/mud etc., before start-up of pre-commissioning activities.

- Operational Requirements

The dewatering operation of the piping work in the stations shall consist of physically draining the water content in the piping work by opening low point drains and/or end flanges. If required, air shall be used to push-off water from the pipes. The pipeline contractor shall arrange suitable compressor for such purposes.

- Flushing/Blowing of Aboveground Piping in the Terminal

Flushing/blowing of the above ground piping with water/air to remove debris/dirt/mud from within the piping has to be performed by the pipeline contractor. Subsequent to water flushing, to ensure complete cleanliness of the piping work, air blowing/cardboard blasting method has to be adopted. All instruments, control valves, orifice plates etc. to be dismantled from the piping work and any gap produced should be bridged with suitable temporary spool. Proper supporting of the piping, during such flushing/blowing activities is to be ensured by the pipeline contractor.

The pipeline contractor has to make arrangement of clean water/air for these flushing / blowing activities.

The pipeline contractor should submit a plan/methodology for carrying out such activities detailing out each aspect/step.

- Acceptance Criteria

The pipeline contractor shall specify when flushing/air blowing is completed to the satisfaction of the Owner/Consultant, and shall obtain approval of the Owner/Consultant before proceeding to the next step.

#### Pipeline

The pipeline contractor has to dewater the pipeline section after hydrotest. After dewatering, swabbing shall be done.

The pipeline contractor should submit a plan/methodology for carrying out such activities detailing out each aspect/ step for review & Approval of Client /EIC/PMC.

The disposal of the water shall be performed such a way that no harm is done to the environment and animals and the Dewatering procedure should indicate this disposal methodology.

### 3.3.2.2 Swabbing

The swabbing operation, which shall be done subsequent to the dewatering operation, is meant to reduce the remaining water in the pipeline to acceptable condition and to ensure removal of free water left inside the pipeline prior to final drying/ purging and commissioning of the Pipeline system. This is done by driving number of foam pigs propelled by oil free compressed dry air, which can pick up free water in the pipeline.

- Acceptance Criteria

It is recommended that before foam pig run, number of batch pig run shall be done to minimize free water in the pipeline section. Then only foam pig run shall be started. Dewatering is considered as complete, when foam pig received is in touch dry condition & same is subjected approval of Client /EIC/PMC.

Dewatering & Swabbing procedure shall be submitted for review & approval of Client /EIC/PMC.

Contractor shall obtain approval of the Owner/ Consultant before proceeding to the next step.

### 3.3.2.3 Drying

The pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations, all Terminal station, CGS/ PRS stations and hook-up / tap-of points needs to be dried prior to charging natural gas if specified in bid. Drying is required to prevent internal corrosion of the pipeline & to meet the supply specification and also as a means of preservation of the pipeline sections subsequent to the pre-commissioning activities. The pipeline shall be dried by using super dry air / vacuum method or by any other suitable method.

Contractor shall submit the detailed procedure and the duration of the drying operation and obtain Company's approval on the same prior to start of the drying operation.

Commissioning contractor shall assess any requirement of swabbing for entire pipeline to reduce the time for drying and shall carryout such activity.

- Acceptance Criteria

Contractor shall ensure that drying operation is complete before proceeding to the next step of inertization/ purging. The drying of the pipeline system shall be considered to be achieved on attaining a water dew point of -8°C at atmospheric pressure and this water dew point in pipeline shall be continuously maintained till inertisation or commissioning of the pipeline.

#### 3.3.2.4 Internal Cleaning of Equipment

- General

Equipment's like filters, Corrosion Inhibitor Dosing Tanks, Sump Tanks are to be checked for internal cleanliness and shall be ensured by the pipeline contractor.

- Acceptance Criteria

The laying contractor has to demonstrate cleanliness of the internals of all equipment to the satisfaction of the Owner/Consultant and obtain approval for final box up of the equipment.

3.3.2.5 After dewatering / swabbing is over & all functional checks carried out as specified in pre-commissioning checks, drying of the pipeline is to be closed out with compressed air. The pipeline shall be dried to achieve a content dew point of -8 Deg C.

#### 3.3.2.4 Trial Run of Rotating Equipments

The pipeline contractor has to arrange for trial run of the sump pump with water for short duration of time.

The pipeline contractor has to arrange all temporary arrangements required for such trial runs. The pipeline contractor has to submit procedure/method statement regarding how he plans to take such trial runs and take approval of the Owner/Consultant, before actually proceeding for the same. If pump vendor(s) is available for such trial run, the pipeline contractor has to provide all sorts of assistance to the vendor and help the vendor in completing the successful trial run.

### 3.4 Commissioning Related Activities

#### 3.4.1 Safety Review Prior to Start of Commissioning Activities

A pre-start-up safety review of the cross-country pipeline system shall be arranged by the pipeline contractor, involving all concerned in the commissioning. The Owner/Consultant shall also participate in the pre-start-up safety review. The pipeline contractor shall generate all requisite formats to record the findings of such Safety Review.

### 3.4.2 Ready for Commissioning

After completion of pre-commissioning activities and Owner approved safety start-up review followed by liquidation of review punch list points, the pipeline contractor shall notify the Owner/Consultant that the pipeline systems in totality are ready in all respects for hydrocarbon-in. 'Ready for commissioning status' shall be jointly assessed by Owner/Consultant, composite work contractor, Pipeline contractor. After such joint assessment, if all the criteria are met, it will then be declared by the Owner that the entire pipeline system has reached a stage of 'Ready for Commissioning'.

#### **Inertization/ Purging**

Contractor shall carry out Inertization/ Purging of the entire pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap-of points).

#### **Operational requirements:**

During the Inertization/ Purging operation, the dry air left in all the pipeline shall be replaced by dry nitrogen before filling the natural gas into the pipeline for safe commissioning. Depending on the commissioning plan/ strategy, sections of the pipeline system may be taken up for commissioning in steps. One of the suggested methods for Inertization/ Purging of the underground pipeline is by the usage of nitrogen slugs separated by pigs. Depending on the length of the pipeline portion to be taken up for commissioning, the amount of the nitrogen use may vary. In general, the total volume of the nitrogen slug train must be at least 10% (by volume) of the total length of the pipeline under consideration. The last pig in the pig train shall be propelled by natural gas (during commissioning stage of the pipeline).

For above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap-of points, the piping shall be purged with nitrogen

Nitrogen required for Inertization/ purging purpose of the pipeline and aboveground piping shall be supplied by the contractor and should be of purity level 99.9% or above. Nitrogen gas at ambient temperatures (AND NOT LIQUID NITROGEN) and in completely vaporized and gaseous state shall be used as the Energizing medium. In case, the source of gaseous nitrogen is from liquid nitrogen tankers, then all precautions (including verification of the lowest tolerable temperature of all components in the system under commissioning) should be ensured. All temporary connections required for nitrogen purging shall be done by contractor.

The contractor shall submit the detailed procedure (in line with the above suggested method or any other acceptable one) and the duration of the Inertization/ Purging operation and obtain approval of the company before starting the operation. Inertization/ Purging shall be followed immediately by charging of pipeline by natural gas.

- Acceptance Criteria

Inertization of the entire pipeline may be accepted to be complete when the required quantity of nitrogen has been introduced into the pipeline. The contractor has to ensure this condition for safe commissioning of the pipeline. For above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap- of points, the inertization

may be accepted to be complete when the residual oxygen content in the piping is below 1% (vol/vol).

### 3.4.3 Commissioning and Pressure Stabilization

The pipeline contractor shall be responsible for providing all necessary assistance to carry out commissioning activities under the overall guidance and supervision of Owner/Consultant for the entire pipeline system.

Pipeline shall be commissioned and stabilized in 2 phase, i.e. up to 5 kg/cm<sup>2</sup> g pressure and then up to operation pressure. Pipeline shall be kept for 24 hours after I<sup>st</sup> phase for pressure stabilization.

Low Pressure leak check for aboveground piping

- General

The aboveground piping sections of the pipeline system shall be checked for leaks at flange points of piping and equipment, instrument impulse tubing points etc. This shall be done by pressurizing the system piping / equipment with dry compressed air (for this purpose, oil free air compressors shall be used) and testing the system by means of soap solution for leaks.

The contractor shall submit the detailed procedure and the duration of the leak check operations and obtain approval of the company before starting the operation.

- Acceptance Criteria

The leak check operation shall be considered to be completed when the piping system / equipment is free of leaks, after equipment pressure stabilization. This shall be subject to Company's approval.

Commissioning of pipeline shall be considered completed when the line is charged with product natural gas at operating pressure and the total system operated at normal operating pressure for a minimum period of 72 hrs. with all the instruments, controls & interlock satisfactorily at normal operating conditions. Contractor shall submit a detailed commissioning procedure for owner's approval.

## 3.5 Commissioning Check List

Check list to be filled up for commissioning approval of the pipeline:

| S. NO.     | GENERAL INFORMATION                                                                                                                        | OBSERVATION/ COMMENTS |            |        |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|--------|
|            |                                                                                                                                            | CONTRACTOR            | CONSULTANT | CLIENT |
| a. GENERAL |                                                                                                                                            |                       |            |        |
| 1          | a) Name of the Pipeline:<br>b) Services (NG)<br>c) Design/ OISD code followed:<br>d) Design capacity:<br>e) Length of the Pipeline in kms: |                       |            |        |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |  |  |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
|                                          | <p>f) Size - Outside Dia. / Wall Thickness / Grade of Pipeline:</p> <p>g) Is the pipeline designed for scrapper / intelligent pigging?</p> <p>h) No. &amp; location of isolation Valve(s) with chainages:</p> <p>(i) Hand Operated valves</p> <p>(ii) Remote Operated valves</p> <p>i) No. of water bodies crossings with Chainages:</p> <p>(i) Name of River</p> <p>(ii) Pond / Lake crossings</p> <p>(iii) Canal crossings</p> <p>(iv) Marshy land / creek</p> <p>j) No. of cased crossings Railway</p> <p>k) No of Road crossings (NH &amp; SH)</p> <p>i) Cased</p> <p>ii) Non cased</p> |  |  |  |
| <b>b. CROSS COUNTRY PIPELINE DETAILS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |  |  |
| 1                                        | Design pressure of the pipeline (In Kg/Cm2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |
| 2                                        | Maximum allowable operating pressure of the pipeline, and normal Operating Pressure (In Kg/Cm2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |
| 3                                        | Corrosion allowance for the pipeline. (In mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
| 4                                        | <p>Whether the pipeline has been hydrostatically tested.</p> <p>(i) Hydrotest Pressure (In Kg/Cm2)</p> <p>(ii) Period of Hold</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |
| 5                                        | Type of Sectionalizing Valves used on the pipeline.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |
| 6                                        | Whether the pigging facility has been installed and the pipeline is piggable by scraper pig.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |

|                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |  |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 7                                              | Whether the gauging pig was passed through the pipeline to prove its internal diameter and was it satisfactory.                                                                                                                                                                                                                                                                                                                  |  |  |  |
| 8                                              | Whether EGP was carried out for the pipeline. Details to be provided.                                                                                                                                                                                                                                                                                                                                                            |  |  |  |
| 9                                              | Whether the pipeline has been cleaned and swabbed.                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
| 10                                             | Whether adequate product is available for commissioning.                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |
| 11                                             | Whether mechanical completion report for the pipeline is available.                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 12                                             | Whether ROU restoration completed.                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
| 13                                             | Whether following approvals have been obtained for pipeline before construction?<br>- PESO (CCOE) approval for laying of pipeline/ construction of facilities.<br>- State Pollution Control Board consent to establishment.<br>- Registration of establishment from Central/ State Govt. labour commissioner under Contract Labour (Regulation and Abolition) Act'1970.<br>- Permission from Irrigation/ PWD authority/ NHA etc. |  |  |  |
| 14                                             | Whether following Clearances obtained before Commissioning?<br>- Commissioning clearances from PESO (CCOE).<br>- CCOE License as required.<br>- Consent for operation from state pollution control board for Air and Water.<br>- Factory License as required.                                                                                                                                                                    |  |  |  |
| 15                                             | Whether pre-tested Insurance Stock pipes earmarked and kept separately.                                                                                                                                                                                                                                                                                                                                                          |  |  |  |
| <b>COATING AND CATHODIC PROTECTION DETAILS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |  |

|                          |                                                                                                                                                     |  |  |  |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 1                        | Type of External Coating used in the Pipeline (CTE/ 3LPE/ FBE/ Other) Coating (Thickness in mm).                                                    |  |  |  |
| 2                        | Whether the pipeline is adequately protected cathodically:<br>Presently protected by TCP.<br>Expected date of Commencing of PCP.                    |  |  |  |
| 3                        | Post Construction Coating Survey carried out or not?                                                                                                |  |  |  |
| 4                        | Whether Interference survey for the pipeline has been carried out and mitigation measures taken.                                                    |  |  |  |
| 5                        | Whether electrical Surge diverter provided across IJs?                                                                                              |  |  |  |
| 6                        | Whether corrosion coupons have been installed for internal corrosion monitoring.                                                                    |  |  |  |
| 7                        | Whether all cased crossings have been checked and are free from any electrical shorting.                                                            |  |  |  |
| 8                        | Whether Natural PSP of the Pipeline has been taken?                                                                                                 |  |  |  |
| <b>c. STATION PIPING</b> |                                                                                                                                                     |  |  |  |
| 1                        | Whether station piping has been provided as per the latest approved P&IDs.                                                                          |  |  |  |
| 2                        | Whether mechanical completion certificate for the station is issued                                                                                 |  |  |  |
| 3                        | Whether all the flange connections have been checked for tightness and length of bolts are adequate.<br><b>All short bolting have been checked?</b> |  |  |  |
| 4                        | Whether flow direction has been marked on station piping and equipment.                                                                             |  |  |  |
| 5                        | Whether proper direction for check valves and flow meters has been ensured.                                                                         |  |  |  |



|                      |                                                                                                                                          |  |  |  |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 6                    | Whether adequate crossovers for crossing and platforms to operate valves have been provided <b>with safety hand rails?</b>               |  |  |  |
| 7                    | Whether access to all operating equipment's including vessels, valves, sump pump, scraper barrel is adequate.                            |  |  |  |
| 8                    | Whether CI dosing facilities with adequate stock is available for dosing in water and product.                                           |  |  |  |
| 9                    | Whether proper arrangement has been made for drainage and disposal of the water during commissioning.                                    |  |  |  |
| 10                   | Whether alignment of motor with main pump/ compressor and suction/ discharge piping is done and acceptable to the vendor/ owner.         |  |  |  |
| 11                   | <b><i>MOVs which are on remote operation have been functionally tested for opening and closing operation?</i></b>                        |  |  |  |
| 12                   | <b><i>Whether Vent lines have been provided as per code/ standard/ specifications.</i></b>                                               |  |  |  |
| <b>MISCELLANEOUS</b> |                                                                                                                                          |  |  |  |
| 1                    | Power System Details:<br>i) Transformer Rating & Type<br>ii) HT Breaker Type & Rating<br>iii) DG Set's Details                           |  |  |  |
| 2                    | Communication system details:<br>i) Telephones<br>ii) PA/Paging<br>iii) VHF<br>iv) Walkie/ Talkie<br>v) Hot Line<br>vi) VCS<br>vii) CCTV |  |  |  |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 3                          | Whether firefighting equipment are provided as per code/ standard/ specifications.                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |  |
| 4                          | Whether list of contact persons has been displayed with telephone nos.                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 5                          | Check availability of Visitor/ attendance Registers at the gate.                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| <b>STATUTORY APPROVALS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |
| 1                          | Whether following approvals have been obtained for construction.<br>- PESO (CCOE) approval for construction of facilities (Ref no. and Date).<br>- Environmental clearance for the project (No. & date)<br>- Pollution control.                                                                                                                                                                                                                                                     |  |  |  |
| 2                          | Whether following licenses/ approvals are available before commissioning:<br>- CCOE License No., date, validity.<br>- Is there any change with respect to approved CCOE layout?<br>- NOC from District Magistrate/ District Collector in case CCOE License is not applicable<br>- Govt. Notification for protected area declaration<br>- Clearance from CEA/ State Electrical Inspectorate.<br>- DG Set Installation approval<br>- Any other applicable statutory license/ approval |  |  |  |

## 4.0 DOCUMENTATION

The pipeline contractor shall submit the complete description, detailed procedures and time schedule for all of the following activities for approval of the Owner/Consultant.

- Pre-commissioning Checks
- Dewatering
- Swabbing
- Flushing / Blowing
- Low Pressure Leak Test with Air
- Drying
- Idle Time Preservation (if applicable), including Removal of Preservers

All these documents should be prepared covering all aspects of HSE, quality assurance and quality control plans.

The pipeline contractor shall ensure that his documents are related to "as-built" conditions of the pipeline, equipment and structures involved.

Documents shall also contain all safety plans, procedures to be followed while carrying out the activities.

Upon successful completion of the work, the pipeline contractor shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings, daily logs, measurements, details of the operation etc. Report shall also include all certificates of calibration of instruments required, together with records of calibration performed at site prior to the start of any operation and the approved pre-commissioning and commissioning formats and check sheets.

## **5.0 SPARES AND CONSUMABLES**

The pipeline contractor shall identify and arrange for supply of manpower, spares, tools, tackles and consumables as required for pre-commissioning and commissioning activities.

## **6.0 SAFETY**

The pipeline contractor shall follow the safety practices during execution of pre-commissioning and commissioning works as detailed in the scope of work. The pipeline contractor shall also maintain and follow all safety practices equivalent or better than those being practiced by the industry during pre-commissioning and commissioning activities. A dedicated safety department from the pipeline contractor's side should be available for the job.

## **7.0 OTHERS**

The pipeline contractor, along with his bid documents, is required to submit the following:

- Execution plan and method statement for pre-commissioning and commissioning activities.



**STANDARD SPECIFICATION  
FOR PRE-COMMISSIONING AND  
COMMISSIONING OF PIPELINE SYSTEM**

**DOCNO: VCS-SS-PP-2022  
Rev No : 03**

- Past experience of pre-commissioning and commissioning activities carried out for a similar pipeline system / network.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR SEAMLESS FITTINGS AND FLANGES {SIZE UPTO DN 400MM (16")}

VPC – SS – PP - 2024

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
|         |            |             |            |             |               |
|         |            |             |            |             |               |
| 00      | 28.01.2020 | MB          | MC         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |



STANDARD SPECIFICATION  
FOR SEAMLESS FITTINGS & FLANGES {SIZE  
UPTO DN 400 mm (16")}

DOCNO: VPC-SS-PP-2024  
Rev No : 00

| REVISION RECORD |               |             |            |             |               |                      |
|-----------------|---------------|-------------|------------|-------------|---------------|----------------------|
| Rev.            | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description |
| 00              | 28.01.2020    |             |            |             |               |                      |
|                 |               | MB          | MC         | AD          | SK            |                      |
|                 |               |             |            |             |               |                      |
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|                 |               |             |            |             |               |                      |
|                 |               |             |            |             |               |                      |
|                 |               |             |            |             |               |                      |
|                 |               |             |            |             |               |                      |

## **ABBREVIATIONS:**

|        |                                                           |
|--------|-----------------------------------------------------------|
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society for Testing and Materials                |
| API    | American Petroleum Institute                              |
| BHN    | Brinell hardness number                                   |
| HAZ    | Heat Affected Zone                                        |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| RTJ    | Ring Type Joint                                           |
| SSPC   | Steel Structures Painting Council                         |
| CE     | Carbon Equivalent                                         |
| LTCS   | Low Temperature Carbon Steel                              |
| LPG    | Liquefied Petroleum Gas                                   |

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## 1.0 SCOPE

This Technical specification specifies the minimum requirements for the design, manufacture and supply of following carbon steel flanges (such as welding neck flanges, blind flanges, spectacle blinds, spacers and blind etc.) and seamless fittings (such as tees, elbows, reducers, caps, outlets etc.) size DN up to 400 mm (16") to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

|              |   |                                                                               |
|--------------|---|-------------------------------------------------------------------------------|
| B31.4        | : | Pipeline Transportation system for liquid Hydrocarbon & other liquids.        |
| B 31.8       | : | Gas Transmission and Distribution Piping Systems.                             |
| B16.5        | : | Pipe Flanges and Flanged Fitting.                                             |
| B16.9        | : | Factory made Wrought Butt Weld Fittings.                                      |
| B 16.11      | : | Forged Steel Fittings, Socket welding and Threaded.                           |
| B 16.48      | : | Steel Line Blanks.                                                            |
| Section VIII | : | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels. |
| Section IX   | : | Welding and Brazing Qualifications.                                           |

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

|      |   |                                                                                 |
|------|---|---------------------------------------------------------------------------------|
| A370 | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |
|------|---|---------------------------------------------------------------------------------|

### MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

|       |   |                                                                                            |
|-------|---|--------------------------------------------------------------------------------------------|
| SP-25 | : | Standard Marking System for Valves, Fittings, Flanges and Unions.                          |
| SP-97 | : | Forged Carbon Steel Branch Outlet Fittings- Socket Welding, Threaded and Butt Welding Ends |

In case of conflict between various requirements of this specification and the requirements of above referred Codes and Standards, more stringent requirement shall apply unless otherwise agreed by Purchaser.

### 3.0 MATERIALS

The Material of flanges & fittings shall be as indicated in purchase requisition. In addition, the material shall also meet the requirements specified hereinafter.

- 3.1** The Carbon Steel used for the manufacture of flanges and fittings shall be fully killed.
- 3.2** The carbon equivalent (CE) shall not exceeding 0.45, based on check analysis calculated in accordance with following.

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

- 3.3** For flanges and fittings specified to be used for gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0° C in accordance with the impact test provisions of ASTM A 370 for flanges and MSS-SP-75 for all fittings.

The average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analysed as above shall not be less than 22 Joules.

When Low Temperature Carbon Steel (LTCS) materials are specified for flanges and fittings in Purchase Requisition, the Charpy V-notch test requirements of applicable material standard shall be complied with.

- 3.4** For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, Weld metal and heat affected zone shall not exceed 248 HV<sub>10</sub>.
- 3.5** In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring joint.

### 4.0 DESIGN AND MANUFACTURE

- 4.1** Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B 16.5.
- 4.2** Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48.
- 4.3** Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B 16.9 for sizes DN 50mm (2") to DN 400mm (16") (both sizes included) and ASME B 16.11 for sizes DN 15mm(1½") & below.
- 4.4** Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.
- 4.5** Repair by Welding on flanges and fitting is not permitted.
- 4.6** All butt weld ends shall be beveled as per ASME B 16.5/ASME B 16.9/MSS-SP-97 as applicable

- 4.7** Type, face and finish of flanges shall be as specified in purchase requisition. The interpretation of range of face finish shall be as follows:

|                          |   |                                          |
|--------------------------|---|------------------------------------------|
| Serrated Finish/125 AARH | : | Serration with 125 to 250 $\mu$ in AARH. |
| 63 AARH                  | : | 32 to 63 $\mu$ in AARH.                  |

- 4.8** Flanges and fittings manufactured from bar stock are not acceptable.

## **5.0 INSPECTION AND TESTS**

The Manufacture shall perform all inspections and tests in accordance with the requirements of this specification and the relevant codes, at his works, prior to shipment. Such inspection and testing shall include, but not be limited to, the following:

### **5.1 TESTING OF MATERIALS**

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

### **5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK**

All flanges and fittings shall be visually inspected. The internal and external surface of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.

Dimensional checks shall be carried out on finished products as per ASME B 16.5 for flanges, ASME B 16.48 for spacers and blinds and ASME B 16.9/MSS-SP-97 as applicable for fittings and as per this specification.

### **5.3 NON-DESTRUCTIVE EXAMINATION**

All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger than 6.35 mm shall not be acceptable.

- 5.4** The Purchaser reserves the right to perform stage wise inspection and witness tests as indicated above, at the Manufacturer's works, prior to shipment. The Manufacturer shall give reasonable notice of date and time for such inspection and shall provide reasonable access and facilities required for inspection, to the Purchaser's Inspector.

The Purchaser reserves the right to require additional testing, at any time, to confirm Or further investigate a suspected fault. All costs incurred shall be for the Manufacturer's account. In no case shall any action of the Purchaser, or his Inspector, relieve the Manufacturer of his responsibility for material, design, quality, or Performance of the materials concerned. Inspection and tests performed/witnessed by the Purchaser's Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

## **6.0 PAINTING**

Once all inspection and test have been carried out all external surface shall be thoroughly cleaned to remove grease, dust & rust. Standard mill coating shall be applied on external surface to protect against corrosion during transmit and storage. The coating shall be removable in field.

## 7.0 MARKING

All Flanges & fittings shall be stamped with the requirements of applicable dimensional manufacturing standard. The marking shall also include following:

- PO Number.
- Item Code.

## 8.0 TEST CERTIFICATES

Manufacture who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provision of ASME 16.9/MSS-SP-75, as applicable.

Manufacturer shall furnish the following certificates:

- Test certificates relevant to the chemical analysis and mechanical properties, including hardness of the materials used for manufacture of flanges and fittings in accordance with the requirement of relevant standards and this specification.
- Test reports on radiography, ultrasonic and magnetic particle examination.
- Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

## 9.0 PACKING & SHIPPING

Ends of all fittings and weld neck flanges shall be suitable protected to avoid any damage during transit. Metallic or high impact plastic bevel protected shall be provided for flanges and fittings. Flanges face shall be suitably protected to avoid any damage during transit.

## 10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR REPAIR OF POLYTHYLENE COATING

**VCS – SS – PP -2027**

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 02      | 29.04.2022 | RP          | MC         | HK          | GW            |
| 01      | 28.01.2020 | MB          | MD         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

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| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                  |
|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description                                             |
| 00              | 21.02.2019    |                                                                                   |                                                                                   |                                                                                   |                                                                                     | Issued as Standard Specification.                                |
|                 |               | SS                                                                                | MC                                                                                | AD                                                                                | SK                                                                                  |                                                                  |
| 01              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     | Document numbering updated from VPC-SS-PL-0043 to VPC-SS-PP-2027 |
|                 |               | MB                                                                                | MD                                                                                | AD                                                                                | SK                                                                                  |                                                                  |
| 02              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                              |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                                                                  |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                  |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                  |

---

## **ABBREVIATIONS:**

|    |   |                   |
|----|---|-------------------|
| DC | : | Direct Current    |
| EN | : | European Standard |
| KV | : | Kilo Volt         |

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| 4.0 | INSPECTION AND TEST .....    | 6 |
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## 1.0 SCOPE

This specification covers the minimum requirements for materials and equipment, application procedure and inspection of repair of damaged Polyethylene coatings on steel pipes. This specification is applicable for repairing damages less than 100mm x 100 mm for pipe sizes less than 10", 150mm x 150mm for pipe sizes between 12" to 28" and 300mm x 300mm for pipe sizes more than 28".

If damaged area of coating of the pipeline is larger than above, heat shrinkable sleeve is recommended.

The repair shall be carried out using repair patch made of radiation cross-linked polyolefin backing, coated on the inside with semi-crystalline thermoplastic adhesive and filler mastic.

The repair patch shall have thermal indicators to ensure correct heat is being applied during application.

## 2.0 MATERIAL AND EQUIPMENT

### 2.1 The repair material shall be as under:

- a) Repair Patch: radiation cross-linked HDPE (Unexpanded High density polyethylene) with semi-crystalline thermoplastic adhesive.
- b) Mastic Filler
- c) Melt stick shall be Co-Polymer based and same shall be heat sensitive.
- d) Liquid Epoxy Primer (two pack)

### 2.2 The repair material shall be certified by DIN to meet the requirements of EN12068 Stress Class CHT 80

### 2.3 The material shall not be older than their period of validity at the time of application by the Contractor. Deteriorated/decomposed materials shall not be used.

### 2.4 Materials shall be stored in sheltered storages in the manufacturer's original packing away from direct sunlight and in accordance with manufacturer's instructions.

### 2.5 Contractor shall supply all equipment and manpower required for a skilful application in the field in accordance with the specification.

## 3.0 APPLICATION PROCEDURE

### 3.1 The application procedure to be followed for holiday type of damage shall be in accordance with manufacturer's instruction and minimum requirement specified below whichever are the more stringent.

#### 3.1.1 Preparation

Remove coating from damaged area with knife, scraper or power brush. Scrap off the damaged area and adjacent coating to remove oil, grease, rust, dirt and moisture. Pipe surface shall be prepared to SA 2½.

#### 3.1.2 Preheating

Preheat the exposed bare metal surface to approx. 80° C and adjacent pipe coating to approx. 60° C with a torch moved back and forth over the surface. Upon preheating, the

pipe surface shall be applied with the two pack epoxy primer to ensure a minimum wet film thickness of not less than 200 microns to cover the exposed base metal.

### 3.1.3 Application of the Filler

Plastic filler shall be cut to size and applied to all exposed metal surface. The mastic shall be heated and smoothed down with a paint scraper to cover all bare metal in a manner such that all entrapped air is removed and mill applied coating thickness of the pipe is restored.

### 3.1.4 Application of repair tape

A patch shall be cut from the tape in a manner such that it extends 50 mm (2 inch) beyond the damaged area on all sides. The patch shall be positioned over the damaged area and heated until the temperature sensitive paint on the outside of the patch changes colour or dimples on the backing vanish. It shall be smoothed down to confirm with the contour of lap, and shall be freed of any air bubbles or wrinkles.

**3.2** For cosmetic type of defects such as minor gouging, tearing, and/or scratches, which do not indicate holiday during holiday inspection, following procedure shall be adopted.

**3.2.1** The defective area shall be roughened to remove loose polyethylene coating, oil, grease, dirt, etc.

**3.2.2** This shall be followed by application of patch as detailed in clause 3.1.4.

## 4.0 INSPECTION AND TEST

**4.1** A visual inspection shall be carried out for the following:

- Mastic extrusion on ends of the patch shall be examined.
- There shall be no sign of punctures or pinholes or bend failure. The external appearance of the patch shall be smooth, free from dimples, air entrapment or void formation.
- The entire closure patch shall have changed colour uniformly.

### 4.2 Holiday Inspection

The holiday detector used shall be checked and calibrated daily with an accurate D.C. Voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

The entire surface of the repaired section shall be inspected by means of a full circle holiday detector approved by Owner set to a D.C. Voltage of at least 25 KV. Inspection of repaired patch shall be conducted only after it has cooled below 50° C.

**4.3** Procedure qualification shall be carried out for repair patch. The value for peel strength to pipe surface and to factory coating carried out as per EN 12068 shall be 0.5 N/mm minimum at 60°C.

**4.4** All repaired joint shall be approved by the Owner.

## 5.0 DOCUMENTATION

**5.1** Prior to procurement of coating repair materials, Contractor shall furnish four copies of,

but not limited to, the following for qualification of the Manufacturer and material:

- i) Complete descriptive technical catalogs describing the materials offered along with samples of repair coating materials, its properties and installation instruction as applicable specifically to the project.
- ii) Test certificate and results of previously conducted tests from independent inspection agency, for properties listed in Para 4.3 of this specification.
- iii) Reference list of previous supplies of the similar material indicating the project details such as diameter, quantity, service conditions, year of supply, project name, contact person and feedback on performance.

Once the Company's approval has been given, any change in material or Manufacturer shall be notified to Company, whose approval in writing of all changes shall be obtained before the materials are manufactured.

**5.2** Prior to shipment of materials from the Manufacturer's works, Contractor shall furnish six hard copies and an electronic copy of the following:

- i) Test certificates for each batch of materials.
- ii) Specific installation instruction with pictorial illustrations.
- iii) Specific storage and handling instructions.

**5.3** All documents shall be in English Language only.



# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM

**VPC – SS – PP - 2028**

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
|         |            |             |            |             |               |
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| 01      | 28.01.2020 | MB          | MD         | AD          | SK            |
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## 1.0 SCOPE

This document covers minimum requirement for Quality Management system (QMS) to be met with by the manufacturers, suppliers or service providers (herein after called Contractors) to ensure that only quality products/services are delivered to the purchaser/Owner (herein after called Company).

## 2.0 GENERAL REQUIREMENT

- 2.1** The Contractor shall have established and in operation a QMS which fully complies with requirements of ISO 9001 – 2008 or equivalent standard for Quality Management System. The established and in operation QMS shall be such that all quality related activities related to the execution of contract are well planned and controlled systematically to ensure end goal of delivering product/service of required standard of quality.
- 2.2** The QMS shall be well documented and understood by all, including Sub Contractors/suppliers, concerned with delivery of product/service to the Company.
- 2.3** The Contractor shall draw a project specific quality plan based on his organization's Quality Manual and standard Quality Plan and same is to be implemented throughout the period of project execution.
- 2.4** The quality plan thus prepared shall be such that specified and intended requirements of the contract are fully understood by all and duly met with while delivering produce/service.

## 3.0 QUALITY SYSTEM REQUIREMENT

### 3.1 DOCUMENTATION REQUIREMENT

#### 3.1.1 Documents to be submitted at the time of bidding.

Following QMS documents shall be submitted by the Contractor intending to bid for project at the time of submitting their bids:

- a) Corporate Quality Policy document duly signed by the Corporate Head or any other Authorized representative.
- b) Documents in support of successful implementation of Quality Management System (QMS) within the organization of the contractor such as certificate of quality system registration, previous project Quality Plans, Company's Quality Manual, and Quality Audit reports etc.

(c) Project Specific Quality Plan demonstrating the proposed method for achieving the Quality Objectives which shall as a minimum conform to ISO 9001:2008 or equivalent.

(d) CVs of the personnel proposed for job execution. Failure to submit the above Quality documents is liable to cause rejection of the bid.

### 3.1.2 Documents to be submitted after award of contract.

Within two (2) weeks after award of Contract and, in any case prior to commencement of any project related activity, the contractor shall provide, as a minimum, the following documents :

- a) Job specific Quality Plan, Procedures, and Work Instructions, job specific Inspection and Test Plans (ITP) and Reporting Formats (Quality Records)
- b) Project Specific Organization chart with responsibilities and authorities clearly defined for each specific role for complete organization and organization proposed for job execution.
- c) Procedure to calibrate and maintain required measuring and test equipment.
- d) Procedure for tracing the root cause for non-conformance and segregation of Non-confirming product/services.
- e) Procedure for Management of change.
- f) Plan and procedure for periodical internal Quality Audit for duration of contract.
- g) Procedure for control of non-confirming products
- h) Procedure for documentation control Project Contracted work can commence only after obtaining written approval of above documentation from Company.

In addition, following documentation shall be maintained by the Contractor for submission to Company on demand at any point of time during the execution of the project.

- a) Project Quality Manual
- b) Reports of internal and external Quality Audits conducted during execution of contract.
- c) Corrective Action Report on the project audits observations/non-conformities reported.

Upon completion of Contract, the Contractor shall compile and submit a dossier containing quality records including exceptions/deviations granted by Company, non-conformance records, audit records or any other quality related records applicable to the works covered under contract.



### **3.2 FUNCTIONAL REQUIREMENT FOR QUALITY SYSTEM IMPLEMENTATION**

- 3.2.1** Experienced, knowledgeable and qualified personnel shall be deployed for execution of various activities related to work covered under Contract. Contractor shall arrange for adequate infrastructure and suitable work environment to ensure that the specification and quality of the product/services are maintained. Responsibilities and Authorities shall be communicated to all personnel identified for execution of work covered under Contract.
- 3.2.2** Contractor to ensure that the Authority responsible for job execution has communicated the Contract requirements, including all identified or intended statutory and regulatory requirement, to all concerned in their organization and subcontractor's organization who are to participate in the work execution.
- 3.2.3** Contractor shall implement, maintain and operate project specific QMS approved by Company.
- 3.2.4** The Contractor shall do advance quality planning, for all activities involved in delivery Of product/services, which shall cover as minimum:
- A) Resource Planning
  - B) Identification of Product/Service characteristics required to be controlled to ensure quality
  - C) Identify process characteristics for realization of intended product/service characteristics
  - D) Identify measurement and test requirement and define acceptance criteria for same.
  - E) Generation and management of records
  - F) Any additional procedures required to be developed specific to the Project.
- 3.2.5** Based on above the Contractor shall prepare and submit, for Company review and approval, a project specific Quality Plan, Inspection and Test Plan and work execution procedures for contracted work scope. The Quality Plan shall address all of the applicable elements of ISO 9001-2008, identify responsible parties, within Contractor's organization, for the implementation / control of each area, reference the applicable procedures used to control and verify the documents produced for each area of working. Approved Quality Plan, ITP's and work procedure shall be available at its working place and well understood by concern personals.
- 3.2.6** During execution of work, Company reserves the right to undertake QMS Audit as deemed necessary to assess the effectiveness of the implementation of Contractor's quality management system.

- 3.2.7** Contractor shall validate all processes for production and/or services for which output cannot be verified by monitoring and measurements during execution. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.
- 3.2.8** Contractor shall establish a system for identification and traceability of product/deliverable throughout product realization.
- 3.2.9** Contractor shall identify, verify, protect and safeguard Company's property (materials/documents) provided for use or incorporation in to the product/service. If any property is lost, damaged, misused or otherwise found to be unsuitable for use, this shall be reported to Company at the earliest.
- 3.2.10** Contractor shall establish system to ensure that inspection and testing activities are carried out in a manner that is consistent with the requirements. Measuring equipment shall be calibrated at specified frequency against national or international standards. Where no such standard exists, the basis used for calibration shall be recorded. Calibration certificate shall be available for review by Company on demand.
- 3.2.11** Contractor shall monitor and measure the characteristics of the product/deliverable to verify that contract requirement has been met. The inspection (stage wise as well as final) by Contractor and Company personnel shall be carried out as per approved ITPs.
- 3.2.12** Non-conformities (NCs) / deficiencies found by Contractor's inspection /surveillance staff or observed by Company representative shall be duly recorded, including their disposal action and resolved. Effective corrective and preventive action plan shall be implemented by Contractor to prevent recurrence.
- 3.2.13** Deviation from the approved drawings / specification shall be intimated to Company in advance and specific waiver from Company shall be obtained. Any un-approved deviation shall be treated as non-conformity and a Non Conformance Reports (NCR) shall be raised and processed as per approved procedure.
- 3.2.14** All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, and handed over to Company as per contract requirement or disposed as per relevant project procedure.
- 3.2.15** The Contractor shall note that product/service will be considered to have been delivered after complete records have been submitted to the Company and the Company has accepted the same.

### 3.3 QUALITY CHECKS AND AUDITS

During approval of QMS document, Company will identify the stage and extent of its involvement during inspection and testing of product. Company may put on 'HOLD' activities that must be reviewed by Company before work proceeds further that could obstruct necessary verification of the submitted activity. For such inspections Company may require work to be held until Company informs whether or not its representative will attend to witness the inspection/testing.

Contractor shall plan and carryout the QMS audit for the job. Quality Audit program shall cover design, procurement, construction management and commissioning, as applicable, including activities carried out by sub-vendors and sub-contractors. This shall be additional to the surveillance audits carried out certification/recertification of QMS of Contractor`s Organization.

The audit program and audit reports shall be submitted to Company for information. Company reserves the right to attend, as a witness, any audit conducted during the execution of the works.

In addition to above, Company and/or independent Third Party Inspection Agency (TPI) engaged for the project may also perform Quality and Technical Compliance Audits. Contractor shall provide assistance and access to its systems and sub-contractor/vendor`s systems, as may be required for the purpose.

Company will not act as an inspector for the work being carried out. This responsibility lies entirely on the Contractor, who must fulfil it at all times, for all work, in accordance with the Company approved QMS. Company's actions will be to audit the compliance of the QMS by the Contractor, by varying degrees of review or involvement on the activities performed by the Contractor.



**VCS QUALITY SERVICES PVT. LTD.**

**STANDARD SPECIFICATION  
FOR  
THIRD PARTY INSPECTION AGENCY (TPIA)**

**VCS – SS – PP - 2031**

|         |            |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
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|         |            |  |  |  |  |
| 01      | 25.11.2022 | AY                                                                                  | MC                                                                                  | HK                                                                                    | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | MD                                                                                  | AD                                                                                    | SK                                                                                    |
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| 00              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
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|                 |               | AY                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
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**ABBREVIATIONS:**

|      |                               |
|------|-------------------------------|
| TPIA | THIRD PARTY INSPECTION AGENCY |
| QA   | Quality Assurance             |
| QC   | Quality Control               |
| LOI  | Letter of Indent              |
| QAP  | Quality Assurance Procedure   |
| ISS  | International Standard Space  |
| UPS  | Uninterruptible Power Supply  |



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## 1.0 INTRODUCTION

The objective is to specify the role of Third-Party Inspection Agency (TPIA) appointed by Contractor for supply items and appointed by Owner for construction work.

The Contractor will appoint an independent approved Third-Party Inspection Agency (TPIA) whose role shall be to witness, review and certify all quality related issues for supply of material. The TPIA shall ensure that all quality related requirements during manufacturing are strictly followed as per Owner/Owner's representative specifications and approved documents. Owner shall appoint its TPIA for witness, review and certification of all the construction activities.

This Standard Specification also indicates general quality control requirements for various activities pertaining to Gas Pipeline Projects and the extent of TPIA involvement as indicated in tender shall be binding on the contractor.

## 2.0 SCOPE OF WORK

### 2.1 Role of TPIA for Supply Items

TPIA, as appointed by the Contractor from Owner's approved list, shall witness, review and certify all quality related activities for supply of material for Mechanical, Civil, Electrical and Instrumentation system. The extent of TPIA involvement as a minimum is indicated in the various Quality Control Sheets attached with the tender document and shall be as per final approved QA/QC procedures or as per codes and standards, wherever applicable.

### 2.2 Role of Owner / Owner's Representative for Supply Items

For supply items, Owner / Owner's Representative reserves the right to carryout independent inspection / audit of the plant during manufacturing. The extent of inspection shall be at the discretion of Owner / Owner's Representative. All costs related to the same (excluding travel expenses) shall be borne by Contractor

### 2.3 Role of TPIA for Construction Activity

TPIA, as appointed and paid by Owner will be involved in all inspection, witness & certify construction work. The extent of TPIA involvement will be shown in the various Quality control sheets prepared by Contractor and approved by Owner/Owner's representative.

Prior to commencement of any activity pertaining to construction at site, Owner/Owner's representatives shall get the documents reviewed by the TPIA.

### 2.4

The various Hold points' involvement as mentioned in various QC sheets is indicative minimum. However, actual involvement shall be decided by Owner/Owner's Representative during review of documents, and Contractor shall be bound by the same. Contractor shall also submit the calibration certificates of all the equipment/instruments, which are part of manufacturing/Inspection & testing for TPIA review TPIA shall also be responsible to check /witness the



necessary calibration of such equipment/Instruments during visit to contractor's works.

### **3.0 ROLE OF CONTRACTOR**

Contractor shall have to carry out all necessary inspections and testing which are indicated in approved documents and shall have to provide all necessary latest tools & tackles, measuring instruments and facilities, which are required by the TPIA/Owner /Owner's representatives and all necessary assistance to carryout inspection/testing at contractor's cost. Owner/Owner's representative shall have a right to inspect any activity.

### **4.0 CO-ORDINATION WITH TPIA**

Contractor on award of the Contract/LOI shall submit the detail procurement and construction schedules within fifteen (15) days to Owner/Owner's representative for their approval. The detail item wise Manufacturing schedule indicating dates and location of manufacturer works shall be submitted by the Contractor within One (1) week from the date of issue of their internal Indent /Purchase order to sub vendor.

Contractor shall inform in writing minimum One (1) week in advance to inform the Owner/Owner's representative for Inspection Notice/Call. All coordination among Owner/Owner's representative/TPIA and Contractor's/ Vendor's works shall be the responsibility of Contractor. In case the Contractor fails to honour its inspection calls/notice, contractor has to reimburse all costs incurred by the Owner/Owner representative at actual.

Inspection of site construction activities shall be coordinated on daily basis and adequate notice shall be given to Owner/Owner's representative to mobilize TPIA, this shall be as per site conditions and requirements.

### **5.0 INVOLVEMENT OF TPIA**

**5.1** The Minimum requirements are indicated in the Quality Control Tables attached in tender document.

#### **5.2 Civil**

All procured items required for execution activities for civil works should satisfy the following conditions:

- It should be of reputed make having proven record of being successfully used in similar works earlier and as per approval by Owner / Owner's Representative.
- All materials shall be of standard quality and shall be procured from renowned sources / manufacturers approved by Owner/ Owner's representative.
- All tests of the materials as specified by the relevant codes should be carried out by the contractor in an approved laboratory and the test reports should be

duly authenticated by the laboratory and should be submitted to TPIA for his approval. If so desired by Owner/ Owner's representative, tests shall be conducted in his presence or in presence of his authorized nominee.

- Quality and acceptance of materials not covered under general technical specifications shall be governed by relevant codes.
- The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendations on storages/ application/ workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict Owner/ representative from asking fresh test results from an approved laboratory of the actual materials supplied even from an approved manufacturer.
- Contractor shall furnish the QAP for all supply and construction works.

### **5.3 Electrical**

All procured items for required execution activities for electrical works should satisfy the following conditions:

- Contractor shall furnish the QAP for Panels, Cables, UPS etc. for Owner's review.
- QA Plan will commence at the instigation of the requisition and follow through to equipment acceptance thus ensuring total conformity to the specifications.
- Type test certificates of similar equipment shall be provided.
- Routine tests shall be carried out on the panels, Cables, UPS, Flame proof equipment and other items as per ISS.
- Owner/Owner's Representative reserve the right to witness routine acceptance tests at the manufacturer works as indicated in QAP & ISS.
- Owner/Owner's Representative will witness the routine tests on Panels, UPS at the manufacturer works prior to despatch, to prove compliance with specifications.
- Owner/Owner's Representative shall carry out the inspection of the erection of equipment and witness the testing & commissioning of the equipment at site and approve the test certificates.

### **5.4 Instrumentation**

All procured items for required execution activities for Instrumentation works should satisfy the following conditions:

- Contractor shall furnish the quality assurance procedure for field instruments and cables for review of Owner/ Owner's representative.
- QAP will commence at the instigation of the requisition and follows through to

equipment acceptance. Thus, ensuring total conformity to the specifications.

- Type test certificates of similar equipment shall be provided.
- Owner/Owner's Representative shall carryout the inspection of erection of the equipment and witness the testing and commissioning and approve the certificates.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR SURVEY FOR UNDERGROUND SERVICES USING GPR

VCS-SS-PP-2037

|         |            |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 02      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                    | GW                                                                                    |
| 01      | 03.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                    | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                           | Authorized By                                                                         |

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|                 |               | SR                                                                                | MC                                                                                | HK                                                                                 | HK                                                                                  |                      |
| 02              | 29.04.2022    |  |  |  |  | VCS QMS Integration  |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                 | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |

---

**Abbreviations:**

|      |   |                           |
|------|---|---------------------------|
| 2-D  | : | Two Dimensional           |
| 3-D  | : | Three Dimensional         |
| BM   | : | Bench Mark                |
| C/C  | : | Center to Center          |
| GPR  | : | Ground Penetration Radar  |
| GPS  | : | Global Positioning System |
| LSTK | : | Lump Sum Turn Key         |
| U/G  | : | Underground               |

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## 1.0 SCOPE

The intent of this specification is to cover the basic requirements for conducting the survey works for locating and tracing underground services at the location/ area identified in tender document or identified by the CLIENT to generate requisite information for the design and field engineering activities.

### 1.1 This specification covers the following works.

- a) Establishment of base line for defining the co-ordinates of the various areas.
- b) Mapping of location, elevation, properties, and size of underground pipeline, cables and other utilities (metallic and non-metallic) including, locating the change in direction of the facility using Ground Penetration Radar (GPR).
- c) Preparation of surveys maps.
- d) Two dimensional (2-D)/ three dimensional (3-D) AutoCAD file for the underground services as per project requirement/ schedule of rates.

### 1.2 The survey maps shall show all U/G pipes, cables, other utilities (metallic and non-metallic) etc.

### 1.3 The contractors shall identify Benchmark of the area and shall carry over level from Bench Mark to the site benchmark. This reference of BM shall be recorded on survey drawings.

## 2.0 DEFINITIONS

**TRUE COORDINATE POSITION** - The position of a point as determined by field survey originating on a known control survey marker and performed to the precision and adjusted as required for second order surveys (i.e. the horizontal error of closure shall not exceed 1 in 20,000 and the angular error of closure shall not exceed ten seconds times the square root of the number of instrument stations in the traverse, all before adjustment).

**GPS (Global Positioning System)** - Describes the survey procedure conforming to the U.S. Federal Geographic Data Committee standards as outlined in their publication FGDC-STD- 007.4-2002 for using GPS relative positioning techniques.

## 3.0 DELIVERABLES BY SURVEYORS

SURVEYOR shall produce the following:

### 3.1 Drawings

The final drawing shall be prepared and submitted in latest version of AUTOCAD in 2 sets of USB Drive. In addition to the above, 3 sets of colored print of A3 Sheets of the drawing shall also be submitted.



### 3.2 Electronic Media

Electronic media on which topographic features and three dimensional surface data is delivered shall be provided in \*.dwg & \*.dgn format and the files shall be furnished on a USB Drive.

### 3.3 Property of Maps

Maps prepared by the contractor based on survey work carried out under this agreement shall be the sole property of Client. The contractor shall have no right to use, reproduce or pass on to the third party without prior written permission of Client.

### 3.4 Maps & Drawings

The survey maps shall be based on the survey work executed and shall show all relevant information pertaining to underground services; permanent bench mark etc.

### 3.5 Check Prints

Three copies of check prints of the plotted maps shall be supplied by the contractor to Client/Engineer-in-Charge for their approval along with original before submission of final deliverables.

## 4.0 PERFORMANCE REQUIREMENTS

- 4.1 The work shall be carried out by using Ground Penetration Radar (GPR) by qualified and competent surveyors under the direct supervision of qualified geophysicist.
- 4.2 The survey shall be carried out with reference to the existing permanent benchmarks.
- 4.3 The contractor shall be able to locate and map electrical and signal cables up to a depth of 2 Meters and Pipes (metallic and non-metallic) of sizes up to a depth of 6 Meters from ground level.
- 4.4 All measurements shall be in metric units.
- 4.5 The corrections arising from the standard errors shall be incorporated suitably.
- 4.6 The observations for the measurement of vertical distances on benchmarks and turning points shall be read nearest to 5 mm and for other nearest to 10mm.

## 5.0 METHODOLOGY OF SURVEY WORKS

### 5.1 Location Survey of Existing Control Points

- a) A preliminary survey to identify existing control points shall be carried out and their correctness ensured.
- b) All such control points shall be demarcated in the area plan.

- c) The nearest available permanent benchmark shall be transferred to the area either on a permanent feature or on a concrete pillar specially erected for the purpose.

## 5.2 Map Contents

### 5.2.1 Limits of Mapping

The mapped area shall include the entire area of the property identified in the contract documents.

### 5.2.2 Details

#### a) General

- Show accurately all underground features within the limits of mapping including, but not limited to, the following:
- Underground pipe lines (Carbon steel, RCC, Plastic and other non-metallic):  
Obtain location, elevation, properties, and size of underground pipelines and utilities at 10-meter intervals and at the change in direction of the pipelines.
- Underground electrical and instrumentation Cables.
- Other Underground utilities and structures.

#### b) Coordinate Grid System

Compile the map based on the plant grid system. Indicate on the drawing the permanent reference points to which the fieldwork is tied for horizontal control.

#### c) Drawing Scale

Survey contractor shall prepare drawings at a scale of 1:500.

## 5.3 Field Survey Requirements

### 5.3.1 General

The SURVEYOR shall perform survey work required to establish horizontal and vertical control sufficient to achieve the specified map accuracy. Perform sufficient supplementary field survey work to ascertain the true horizontal and vertical location of existing underground features.

Specification /Details along-with resolution of the GPR or equipment, to be used by contractor, shall be provided to Client for approval/information to ensure the competency of the GPR or equipment for application.

### 5.3.2 Accuracy

Perform field survey work with sufficient precision to ensure that the required accuracy of the finished drawing is achieved. The computed coordinate position of each horizontal

control point used in compiling the drawing shall be correct within the limits of second order accuracy.

The accuracy level of pipe sizes shall be in the order of  $\pm 10\%$ .

The accuracy level of depth of services shall be in the order of  $\pm 100\text{mm}$ .

## **5.4 Computer Graphics Data**

### **5.4.1 General Data Requirements**

- a. An electronic design file shall be provided for each of the final maps. A composite of the total mapped area shall be produced in electronic \*.dgn & \*.dwg design file in addition to the individual maps. Additional survey data required by the contract document shall be incorporated into final electronic \*.dgn & \*.dwg design file and provided in \*.ASC file format as follows:

Point Number, Northing, Easting, Elevation, Description P, \_N,\_E,\_Z,\_DESC).

### **5.4.2 3-D Data**

All 3-D elements shall be at the actual Z value.

### **5.4.3 3-D Model**

Contractor shall provide 3-D model of the underground utilities after survey.

### **5.4.4 5.4.4 Scale**

Record scale-dependent data (such as text, cells, symbols) at a scale factor suitable for display at the specified map scale.

### **5.4.5 5.4.5 Text**

Text shall be a minimum of 2.5 mm in height when plotted.

### **5.4.6 Working Units**

Set up data files on the basis of the following working units:

(MU) Master Units = 1 meter

(SU) Subunits = 1000 mm

### **5.4.7 Global Origin**

Global origin of all design files shall be at the center of the MicroStation/ Auto Cad design cube.

#### 5.4.8 Symbols and Patterns

Symbols and patterns incorporated into the map shall be of appropriate cells available to the SURVEYOR either of his own creation or as supplied by other software packages. All symbols and patterns used shall be clearly identified as such in the map legend on each drawing delivered.

### 6.0 PAYMENT

- 6.1** Payment for survey work shall be made on area basis as per schedule of items. No other payment shall be made. All connected works including supply of drawings and electronic files shall be considered as part of the total work.
- 6.2** The payment clause(s) as described in this standard specification shall not be referred / Applicable for LSTK Jobs.

### 7.0 SPECIFIC REQUIREMENTS

If, survey is carried out inside hydrocarbon plants / areas, all survey equipment to be used shall be intrinsically safe suitable for use in hazardous area.



# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

VCS – SS – PP - 2043

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
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| 01      | 30.07.2022 | RKP                                                                                 | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 20.07.2020 | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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|                 |               | RKP                                                                               | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
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|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

## Abbreviations:

|      |   |                                       |
|------|---|---------------------------------------|
| DCI  | : | Document Control Index                |
| edms | : | Electronic Document Management System |
| FOA  | : | Fax of Acceptance                     |
| HOD  | : | Head of Division / Department         |
| IC   | : | Inspection Certificate                |
| IRN  | : | Inspection Release Note               |
| ITP  | : | Inspection and Test Plan              |
| LOA  | : | Letter of Acceptance                  |
| MOU  | : | Memorandum of Understanding           |
| MR   | : | Material Requisition                  |
| PO   | : | Purchase Order                        |
| PR   | : | Purchase Requisition                  |
| PVC  | : | Polyvinyl Chloride                    |
| QMS  | : | Quality Management System             |
| TPIA | : | Third Party Inspection Agency         |
| URL  | : | Universal Resource Locator            |

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Attachments

Format for completeness of Final Documentation

Annexure-1



## 1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers. All documents/data against the PO / PR / MR shall be developed and submitted to OWNER by the suppliers for review / records, in line with this specification.

## 2.0 DEFINITIONS

### 2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who is under the process of being contracted by OWNER for delivery of some products (including service). The word is considered synonymous to bidder, contractor or vendor.

### 2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

## 3.0 REFERENCE DOCUMENTS

VCS-SS-PP-2044 Standard Specification for Quality Management System Requirements from Vendors

## 4.0 DOCUMENTATION REQUIREMENTS

### 4.1 Documents/Data to be Submitted by the Supplier

4.1.1 The Supplier shall submit the documents and data against the PO/PR/MR as per the list given in respective PO/PR/MR.

4.1.2 Review of the supplier drawings by PMC/ OWNER would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility/contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the supplier without any time and cost implications, irrespective of comments on the same were received from OWNER during the drawing review stage or not.

4.1.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent / Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS - 1 week

Drawing/Document Control Index - 2 weeks

Other Documents/Drawings - As per approved Drawing/Document Control

Index/Schedule

4.1.4 Documents as specified in PO/PR/MR are minimum requirements. Supplier shall submit any other document/data required for completion of the job as per OWNERs instructions.

### 4.2 Style and Formatting

4.2.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.2.2 Before forwarding the drawings and documents, contractor shall ensure that the following information are properly mentioned in each drawing:

Purchase Requisition Number

Name of Equipment / Package

Equipment / Package Tag No.

Name of Project

Client

Drawing / Document Title

Drawing / Document No.

Drawing / Document Revision No. and Date

### 4.3 Review and Approval of Documents by Supplier

4.3.1 The Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission. Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplier requires any sub-supplier drawings to be reviewed by OWNER, the same shall be submitted by the supplier after duly reviewed, approved and stamped by the supplier. Direct submission of sub-supplier's drawings without contractor's approval shall not be entertained.

### 4.4 Document Category

#### 4.4.1 Review Category

Following review codes shall be used for review of supplier Drawings/Documents:

|               |   |                                                                                            |
|---------------|---|--------------------------------------------------------------------------------------------|
| Review Code A | - | No comments. Proceed with manufacture/fabrication as per the document.                     |
| Review Code B | - | Proceed with manufacture/fabrication as per commented document. Revised document required. |
| Review Code C | - | Document does not conform to basic requirements as marked. Resubmit for review             |
| Review Code D | - | Document Rejected                                                                          |
| Review Code F | - | For information                                                                            |
| R             | - | Document is retained for Records. Proceed with manufacture/fabrication.                    |
| V             | - | Void                                                                                       |

## **4.5 Methodology for Submission of Documents to PMC/Owner**

### **4.5.1 Document Control Index (DCI)**

Supplier shall create and submit Document Control Index (DCI) for review based on PO/PR/MR along with schedule date of submission of each drawing/document on OWNERs eDMS. The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in scheduled date of submission on of the job as per OWNER.

### **4.5.2 Submission of Drawings/Documents**

Drawings/documents and data shall be uploaded on the eDMS Portal as per DCI

### **4.5.3 Statutory Approvals**

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to PMC/OWNER.

### **4.5.4 Details of Contact Persons of Supplier**

After placement of order supplier shall assign a Project Manager for that order. The details are to be filled online through the portal. The details include e-mail address, mailing address, telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

### **4.5.5 Schedule and Progress Reporting**

Supplier shall submit monthly progress report and updated procurement, engineering and manufacturing status (schedule vs. actual) every month, beginning within 2 weeks from FOA/LOA . In case of exigencies, PMC/Owner can ask for report submission as required on weekly/fortnightly/adhoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the Supplier during kick off meeting or within one week of receiving FOA/LOA, whichever is earlier.

### **4.5.6 Quality Assurance Plan/Inspection and Test Plan**

Inspection and test plans (ITP) attached if any, to the MR/PR are to be followed.

However for cases wherein ITPs have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for manufacturing, covering quality control of critical bought out items/materials, inspection & testing at various stages of production, quality control records and site assembly & testing as may be applicable to the specific order and obtain approval from OWNER /PMC/ third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipment's and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from OWNER. The

items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or OWNER/ OWNER appointed PMC.

#### **4.5.7 Inspection Release Note (IRN)/ Inspection Certificate (IC)**

IRN/ IC shall be issued by PMC Inspector/ third party inspection agency on the basis of successful inspection, review of certificates as per specifications & agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-A or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to PMC/TPIA as and when desired.

Note: Non fulfilling above requirement shall result into appropriate penalty or withholding of payment as per conditions of PO/PR/MR.

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Consignment with parameters greater than following shall be considered as over dimensional.

Dimensions: 4 meters width x 4 meters height x 20 meters length

Weight: 32 MT

#### **4.6 Final Documentation**

##### **4.6.1 As Built Drawings**

Shop changes made by Supplier after approval of drawings under 'Code A' by OWNER/OWNER appointed PMC and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier. These 'As-built' drawings shall be reviewed and stamped by PMC Inspector/TPIA also. Supplier shall prepare scanned images files of all marked — up 'As — built drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

##### **4.6.2 As Built Final Documents**

As built final documents shall be submitted as listed in PO/PR/MR.

##### **4.6.3 Packing/Presentation of Final Documents**

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm (10 1/2 inch x 12 1/2 inch) and shall not be more than 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where number of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15mm thick duly fixed and pressed on folder cover and will have 2 lever clips. In case of imported items documents, 4 lever clips shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by supplier. Spiral/Spico bound documents shall not be acceptable. As mentioned above,

books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer. Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

#### **4.6.4 Submission of Soft Copies**

Supplier shall submit to OWNER, the scanned images files as well as the native files of Drawings / documents, along with proper index.

In addition to hard copies, Supplier shall submit electronic file (CD-ROM) covering soft copies of all the final drawings and documents, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished).

All the above documents shall also be uploaded on the OWNERs eDMS portal.

#### **4.6.5 Completeness of Final Documentation**

Supplier shall get the completeness of final documentation verified by PMC appointed TPIA and attach the Format for Completeness of Final Documentation Format duly signed by OWNER/ OWNER appointed PMC/ Inspector or TPIA as applicable to the document folder.

## ANNEUXRE-1

### COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor :

Customer :

Project :

OWNER's Job No. :

Purchase Order No./

Contract No. :

Purchase Requisition No./

Tender No. :

Rev. No. :

Name of the Work/

Equipment :

Tag. No. :

Supplier's/ Contractor's

Works Order No. :

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier is complete in accordance with the Vendor Data Requirements of Purchase Requisition.

Signature :.....

Signature:.....

Date :.....

Date:.....

Name :.....

Name:.....

Designation :.....

Designation:.....

Department :.....

Department:.....

**Supplier/Contractor**

**OWNER/PMC/TPIA**



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENT FROM VENDORS

VCS – SS – PP - 2044

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.07.2022 | RKP                                                                                 | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 20.07.2020 | MB                                                                                  | MC                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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|                 |               | RKP                                                                               | MC                                                                                | HK                                                                                 | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
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|                 |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |



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## **Abbreviations:**

|     |   |                                                |
|-----|---|------------------------------------------------|
| CV  | : | Curriculum Vitae                               |
| ISO | : | International Organization for Standardization |
| MR  | : | Material Requisition                           |
| PO  | : | Purchase Order                                 |
| PR  | : | Purchase Requisition                           |
| QA  | : | Quality Assurance                              |
| QMS | : | Quality Management System                      |

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## 1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers/contractors after award of work/ during contract execution.

## 2.0 DEFINITIONS

### 2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

### 2.2 Project Quality Plan

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

### 2.3 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

## 3.0 REFERENCE DOCUMENTS

VCS-SS-PP-2043 Standard Specification for Documentation Requirements from Suppliers

## 4.0 QUALITY MANAGEMENT SYSTEM — GENERAL

Unless otherwise agreed with PMC / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems - Requirements." Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency. The quality system shall provide the planned and systematic control of all quality related activities for execution of contract. Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

## 5.0 QUALITY SYSTEM REQUIREMENTS

- 5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job. The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for

each area. The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production/manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

- 5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.
- 5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfilment of PO / contract. BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.
- 5.4 BIDDER shall do the quality planning for all activities involved in delivery of order. The quality planning shall cover as minimum the following:
- Resources
  - Product / deliverable characteristics to be controlled.
  - Process characteristics to ensure the identified product characteristics are realized
  - Identification of any measurement requirements, acceptance criteria
  - Records to be generated
  - Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder.

These documents shall be submitted to PMC/Owner for review/approval, before commencement of work.

- 5.5 Requirements for sub-contracting / purchasing of services specified in contract / tender shall be adhered to. In general, all outsourced items will be from approved vendors of OWNER. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements. Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (subcontractor services), constitute important components of this requirement.
- 5.6 BIDDER shall plan and carry production and service provision under controlled conditions. Controlled conditions shall include, as applicable the availability of information that describes the characteristics of the product the availability of work instructions the use of suitable equipment the availability and use of monitoring and measuring devices the implementation of monitoring and measurement the implementation of release, delivery and post-delivery activities.

- 5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.
- 5.8 BIDDER shall establish a system for identification and traceability of product /deliverable throughout product realization. Product status with respect to inspection and testing requirements shall be identified.
- 5.9 BIDDER shall identify, verify, protect and safeguard PMC / Owner property (material / document) provided for use or incorporation into the product. If any OWNER/ PMC property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the OWNER/ PMC.
- 5.10 BIDDER shall ensure the conformity of product / deliverable during internal processing and delivery to the intended destination. Requirements mentioned in the tender shall be adhered to.
- 5.11 BIDDER shall establish system to ensure that inspection and testing activities are carried out in line with requirements. Where necessary, measuring equipment's shall be calibrated at specified frequency, against national or international measurement standards; where no such standard exists, the basis used for calibration shall be recorded. The measuring equipment's shall be protected from damage during handling, maintenance and storage.
- 5.12 BIDDER shall ensure effective monitoring, using suitable methods, of the processes involved in production and other related processes for delivery of the scope of contract.
- 5.13 BIDDER shall monitor and measure the characteristics of the product/deliverable to verify that product requirement has been met. The inspection (stage as well as final) by BIDDER and OWNER / Owner personnel shall be carried out strictly as per the ITPs forming part of the contract. Product release or service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by relevant authority and where applicable by Owner / PMC.
- 5.14 BIDDER shall establish and maintain a documented procedure to ensure that the product which does not conform to requirements is identified and controlled to prevent its unintended use or delivery.
- 5.15 All non-conformities (NCs) / deficiencies found by the BIDDER'S inspection /surveillance staff shall be duly recorded, including their disposal action shall be recorded and resolved suitably. Effective corrective and preventive action shall be implemented by the BIDDER so that similar NCs including deficiencies do not recur.
- 5.16 All deficiencies noticed and reported by PMC / OWNER shall be analysed by the BIDDER and appropriate corrective and preventive actions shall be implemented. BIDDER shall intimate PMC / OWNER of all such corrective and preventive action implemented by him.

- 5.17 BIDDER should follow the standards, specifications and approved drawings. Concessions/Deviations shall be allowed only in case of unavoidable circumstances. In such situations Concession/deviation request must be made by the BIDDER through online system of OWNER/ PMCs eDMS.
- 5.18 BIDDER shall have documented procedure for control of documents.
- 5.19 All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, then handed over to PMC / Owner as per contract requirement (VCS-SS-PL-0047 Specification for Documentation Requirements from Suppliers), or disposed as per relevant project procedure.

## **6.0 AUDITS**

BIDDER shall plan and carry out the QMS audit for the job. Quality audit programme shall cover design, procurement, construction management and commissioning as applicable including activities carried out by sub-vendors and sub-contractors. This shall be additional to the certification body surveillance audits carried out under BIDDER'S own ISO 9001 certification scheme.

The audit programmes and audit reports shall be available with bidder for scrutiny by PMC / OWNER. PMC or OWNER representative reserves the right to attend, as a witness, any audit conducted during the execution of the WORKS.

In addition to above OWNER, PMC and third party appointed by PMC/Owner may also perform Quality and Technical compliance audits. BIDDER shall provide assistance and access to their systems and sub-contractor / vendor systems as required for this purpose. Any deficiencies noted shall be immediately rectified by BIDDER.

## **7.0 DOCUMENTATION REQUIREMENTS**

BIDDER shall submit following QMS documents immediately after award of work (Within one week) for record / review by PMC/ Owner.

- Organization chart (for complete organization structure and for the project)
- Project Quality Plan/Quality Assurance Plan
- Job specific Inspection Test Plans, if not attached with PR
- Job Procedures
- Inspection/Test Formats

In addition to above QMS documents, following documentation shall be maintained by the BIDDER for submission to PMC / Owner on demand at any point of time during execution of the project.

- Quality Manual
- Certificate of approval for compliance to ISO: 9001 standards
- Procedure for Control of Non-conforming Product

- Procedure for Control of Documents
- Sample audit report of the QMS internal and external audits conducted during last one year
- Customer satisfaction reports from at least 2 customers, during the last one year
- Project QMS audit report
- Technical audit reports for the project
- Corrective action report on the audits

Documents as specified above are minimum requirements. BIDDER shall submit any other document/data required for completion of the job as per PMC/Owner instructions.



## VCS Quality Services Pvt. Ltd.

### STANDARD SPECIFICATION FOR INSPECTION, FLUSHING & TESTING OF PIPING SYSTEM

VCS – SS – PP - 2501

|         |            |                      |                    |                    |                    |
|---------|------------|----------------------|--------------------|--------------------|--------------------|
| 01      | 27.01.2022 | <i>R. Srinivasan</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> |
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| 01              | 27.01.2022    | <i>Rajinikanth</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | VCS QMS Integration  |
|                 |               | SR                 | MC                 | HK                 | GW                 |                      |
|                 |               |                    |                    |                    |                    |                      |

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**ABBREVIATIONS:**

|      |                                          |
|------|------------------------------------------|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing of Materials |
| API  | American Petroleum Institute             |
| LPG  | Liquefied Petroleum Gas                  |

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## 1.0 SCOPE

This specification covers the general requirements for inspection, flushing and testing of piping systems.

Flushing and testing of all piping systems shall be witnessed by the Company Representative.

## 2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition in force at the time of floating the enquiry) of the following codes.

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation system for liquids  
and Slurries  
B31.8 : Gas Transmission and Distribution Piping  
Systems. B31.3  
: Process piping

## 3.0 INSPECTION

During various stages and after completion of fabrication and erection, the piping system shall be inspected by the Company representative to ensure that:

- Proper piping material has been used.
- Piping has been erected as per drawings and instructions.
- All supports have been installed correctly.
- Test preparations mentioned in this specification have been carried out.

## 4.0 FLUSHING

- Flushing of all lines shall be done before pressure testing.
- Flushing shall be done by 'fresh potable water' or by dry compressed air wherever water flushing is not desirable to clean the pipe of all dirt, debris or loose foreign material.
- Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line/ system shall be pressurized by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.
- In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in flushing circuit.
- The screens/ meshes shall be removed from all permanent strainers before flushing. Screens/ meshes shall be reinstalled after flushing but before testing.
- During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing, but, before testing.
- In case any equipment such as Filter, Scrubbers column, vessel etc. form part of

piping circuit during flushing, this shall be done with the approval of Company representative. However, equipments thus included in the circuit shall be completely drained and dried with compressed air after flushing is completed.

- During flushing discharged water/ air shall be drained to the place directed by the
- Company representative. If necessary, proper temporary drainage shall be provided by the contractor.
- Care shall be taken during flushing so as not to damage/ spoil work of other agencies. Precautions shall also be taken to prevent entry of water/ foreign matter into equipment's, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.
- The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following:
- Dropping of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Company representative. These flanges shall be provided with temporary gaskets at the time of flushing.
- After flushing is completed and approved, the valve distance pieces, piping specials etc. shall be reinstalled by the contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

## **5.0 EXTENT OF TESTING**

- With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding or fabrication.
- To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Company representative if the test pressure specified is equal to or less than that for the vessels and other equipments.
- Pumps, compressors and other rotary equipments shall not be subjected to field test pressure. Lines which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage.
- However, such lines if provided with block valve shall be pressure tested up to the last block valve.
- Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

- Instruments in the system to be tested shall be excluded from the test by isolation or removals, unless approved otherwise by the Company representative. Restrictions which interfere with filling, venting, draining such as orifice plates etc. shall not be installed unless testing is complete.
- Control valves shall not be included in the test system. Where bypasses are provided test shall be performed through the bypass and/ or necessary spool shall be used in place of the control valve.
- Pressure gauges which are part of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility-rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

## **5.1 GENERAL REQUIREMENTS / TEST-PREPARATION FOR TESTING**

- Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Company representative.
- No pressure test shall be carried out against closed valve unless approved by the Company representative.
- The Company representative shall be notified in advance by the Contractor, of the testing sequence and programme, to enable him to be present for witnessing the test.
- Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale, debris and other loose foreign materials.
- All piping systems to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.
- Wherever in the line any void exists due to any reasons, like absence of control valves, safety valves, check valves etc. it shall be fitted with temporary spools.
- All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressurizing the lines, each weld joint shall be cleaned by wire brush to free it from -rust and any other foreign matter.
- Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.
- Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spools have been recovered or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.
- Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system.

- For longer lines and vertical lines, two or more pressure gauges shall be installed at locations decided by the Company representative.
- For lines containing check valves any of the following alternatives shall be adopted for pressure testing:
  - Whenever possible pressurize up-stream side of valve.
  - Replace the valve by a temporary spool and reinstall the valve after testing.
- Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by-permanent gaskets subsequently.
- For check valves in lines 1 1/2" and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper/ seat shall be refitted.
- Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Company representative.
- Piping which is spring or counter-weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.
- When testing any piping system, air or steam of approximately 2 kg/ cm<sup>2</sup>g may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.
- For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing, the core pipe and the jacket shall be tested as separate continuous systems.

## **5.2 TESTING MEDIA, TEST PRESSURE AND TEST PRESSURE GAUGES**

### **5.2.1 TESTING MEDIA**

In general, all pressure tests shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 15-20 ppm.

Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Company representative.

If operating fluid in the line is much lighter than testing fluid, the additional weight of testing fluid may render piping supports (as designed) inadequate. This will call for additional temporary supports. The typical examples are flare and vapour lines. It is preferable that hydrostatic testing is avoided in such systems and instead pneumatic testing may be specified.

Where air/ water tests are undesirable, substitute fluids such as gas oil, kerosene, methanol etc. shall be used as the testing medium, with due consideration to the hazards

involved. These test fluids shall be specified in the line list given to the contractor.

### 5.2.2 TEST PRESSURE

The hydrostatic/ pneumatic test. pressure shall be as indicated in the line list or as per the instruction of Company representative.

The selection of the piping system for one individual test shall be based on the following:

- Test pressure required as per line list. Maximum allowable pressure for the material of construction of piping.
- Depending upon the above-requirements and based on construction progress, maximum length of piping shall be included in each test.

### 5.2.3 TEST PRESSURE GAUGE

All gauges used for field; testing shall have suitable range so that the test pressure of various systems falls in 35% to 65% of gauge scale range. Pressure gage dial shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programme, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge showing an incorrect zero reading or error of more than  $\pm 2\%$  of full-scale range shall be discarded. The Company representative shall check the accuracy of master pressure gauge used for calibration. Calibration certificate shall be furnished for the pressure gauges.

## 5.3 TESTING PROCEDURE

### 5.3.1 HYDROSTATIC TEST

All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air. In all lines for pressurizing and depressurizing the system, temporary isolation valves shall be provided if valved vents, drains do not exist in the system.

Pressure shall be applied only after the system/ line is ready and approved by the Company representative.

Pressure shall be applied by means of a suitable test pump or other-pressure source which shall be isolated from the system as soon as test pressure is reached and stabilized in the system.

A pressure gauge shall be provided at the pump discharge for guidance in bringing the system to the required pressure.

The pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a



pressure test shall be retested to the specified pressure after repair. Test period shall be maintained for a minimum of four hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges.

Care shall be taken to avoid increase in the pressure due to temperature variation during the test.

### **5.3.2 PNEUMATIC TEST**

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver, after cooler and oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joints can be examined for leaks.

All other details shall be same as per hydrostatic testing procedure (specified above).

## **5.4 COMPLETION OF TESTING**

After the hydrostatic test has been completed, pressure shall be released by opening the vents, in a manner and at a rate so as not to endanger personnel or damage equipments. All vents shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines/ systems shall be dried by air. In services like dry air, ethylene etc., small traces of water can cause problem. For such lines hot air drying is to be done after hydro test.

After testing is completed the test blinds shall be removed and equipment/ piping isolated during testing shall be connected using the specified gaskets, bolts and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop/ circuit including equipments (except rotary equipments).

Pressure test shall be considered complete only after approved by the Company representative. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system/ line shall be done by the contractor at his cost.

## **5.5 TEST RECORDS**

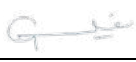
Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the Performa provided/ approved by the Company representative.



# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION FOR PAINTING

VCS – SS – PP - 2502

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| 02      | 19.02.2018 | ADE                                                                                 | RNR                                                                                 | AD                                                                                   | SK                                                                                    |
| 01      | 15.05.2017 | ADE                                                                                 | RNR                                                                                 | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                   |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                         | Revision Description                                              |
| 00              | 15.05.2017    |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                   |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |                                                                   |
| 01              | 09.02.2018    |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                   |
|                 |               | ADE                                                                                 | RNR                                                                                 | AD                                                                                   | SK                                                                                    |                                                                   |
| 02              | 10.04.2018    |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                   |
|                 |               | ADE                                                                                 | RNR                                                                                 | AD                                                                                   | SK                                                                                    |                                                                   |
| 03              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                      |                                                                                       | Format change. Doc Number Change from SS-PI-008 to VCS-SS-PP-2502 |
|                 |               | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |                                                                   |
| 04              | 30.06.2022    |  |  |  |  | VCS QMS Integration                                               |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |                                                                   |

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## 1.0 **GENERAL**

- 1.1 This technical specification shall be applicable for the work covered by the contract, and without prejudice to the provisions of various codes of practice, standard specifications etc. It is understood that contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.

Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor. Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

### 1.2 SCOPE

- 1.2.1 Scope of work covered in the specification shall include, without being limited to the following.

- 1.2.2 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

#### 1.2.3 Extent of Work

- 1.2.3.1 The following surfaces and materials shall require shop, pre-erection and field painting:

- a. All un-insulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks (both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All un-insulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.

- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping.
- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
- i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
- l. Painting of pre-erection/fabrication and Shop primer.
- m. Repair work of damaged pre-erection/fabrication and shop primer and weld joints in the field/site before and after erection as required.
- n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.

1.2.3.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials
- c. Non-ferrous materials like aluminum.

#### 1.2.4 Documents

1.2.4.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

- a. Bill of quantities for piping, equipment, machinery and structures etc.
- b. Piping Line List.
- e. Painting specifications including special civil defence requirements.

1.2.5 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

- 1.2.6 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to VCS for deviation permit.

## 2.0 **CODES & STANDARDS**

Without prejudice to the specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS: 5                    Colors for ready mixed paints and enamels.

RAL DUTCH    International Standard for colour shade (Dutch Standard)

IS: 101                Methods of test for ready mixed paints and enamels,

IS: 161                Heat resistant paints.

IS: 2074              Specifications for ready mixed paint, red oxide zinc chrome priming.

IS: 2379              Color code for identification of pipelines.

IS: 2932              Specification for enamel, synthetic, exterior (a) undercoating. (b) Finishing.

## 3.0 **CONDITIONS OF DELIVERY**

### **Packaging**

Every recipient will be fitted with a hermetically-sealed lid with an opening that is sufficiently large to allow the contents to be stirred: the outside and inside are protected against oxidation, and, the lid, are marked with a strip of color identical to the contents.

## 4.0 **COMPOSITION OF THE PAINT PRODUCTS USED**

### a)        Quality

The composition and quality of the products may not differ from batch to batch. A batch is all of the products of a specified manufacture. If the analyses of products bring to light that the composition does not conform to the specifications of the paint manufacturer, the OWNER may refuse to use this batch of products. The paint products must comply with the following conditions

- They must have the viscosity necessary for the described use and the established condition: use of the brush - paint roller (spray gun only for special cases and in the workshop)

### b)        Quality control - Sampling

While the works are in progress on the construction site, the OWNER may carry out sampling on the paint being used for the purpose of checking conformity. The paint products must be made available free of charge to the laboratory or the approved supervisory body in sufficient quantities so that all the tests can be carried out on the same batch.

If analyses reveal a non-conformity in the composition of the products used (tolerance of  $\pm 3$  % of the dosage of every component), the OWNER may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding the work, a product that does conform will be required. The only Purpose of the analysis is to reveal any nonconformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analyses concerned are not acceptance tests of the products supplied and in no way affect the obligations of the contractor specified in the contract towards the OWNER.

## 5.0 **IDENTIFICATION**

Every recipient will bear the following information:

- Name of the manufacturer
- Date and number of manufactures
- Name of the product type
- Batch no
- Net weight of the produced or the contents of the recipient
- Date of the expiry.

At the time of delivery, this packaging must bear labels in conformity with the legal stipulations in force.

### Leaving the site after work

After completion of a job a general clean-up shall be carried out by the Contractor to remove all debris, materials or irregularities that his work has brought to the site so that it is left tidy:

The restoration work includes among other things:

- The removal of abrasives.
- The removal of the different protective coverings.



- The Contractor will make the required repairs to any damage after refitting the supports.
- The removal of paint and cleaning of the stains on the floor.

## 6.0 **SURFACE PREPARATION STANDARDS**

Following latest edition of standards shall be followed for surface preparations:

1. Swedish Standard Institution- SIS-05 5900-1967/ISO 8501-1
2. Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)
3. British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS-4232.
4. National Association of Corrosion Engineers. U.S.A. (NACE).
5. IS-1477-1971 (Part-1) - Code of Practice for Painting of Ferrous metals in Buildings. (Part 1, Pre-treatment)
  - a) The contractor shall arrange, at his own cost to keep a set of latest edition of above standards and codes at site.
  - b) The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:
    - Proper storage to avoid exposure as well as extremes of temperature.
    - Surface preparation prior to painting.
    - Mixing and thinning.
    - Application of paints and the recommended limit on time intervals between coats.
  - c) Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the OWNER, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

## 7.0 **PREPARATION OF THE SURFACES**

### 7.1 General Specifications

The cases that occur in practice on building sites, with regard to painted surfaces, can be broken down as follows:

- Material of which the oxide content disappears by natural oxidation.
- Material that has already been covered with a layer of paint in the workshop.
- Material that is covered with old paint layers that show different degrees of weathering.

Good preparation of surface is the best guarantee for good anti-corrosion protection.

Paintwork may never begin until the surface to be treated is dry and is independent of the base coat and cleared of dirt, dust, rust, scale, grease, salt attack, cement powder, cement mud-scale, sand, oil, etc.

Based on the environmental conditions of coastal and saline nature, the Painting specification for station pipes defines the complete requirements like:

- Surface preparation standards like NACE etc.
- Sand blasting process
- Color Codes for piping
- Paint materials types and their DFT measurement.
- Selection and application of paints on external surfaces.

The pipeline passes through the coastal and marine environment, the **Table-4** of this specification to be followed for the painting works.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

- Bright blast-cleaning
- Mechanical or Power tool cleaning
- Manual or hand tool cleaning

The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods regardless of the form or the condition of such surfaces. The cleaning devices that might be damaged during the surface preparation shall be screened off by the Contractor.

## 7.2 Air blast cleaning with abrasive

Before beginning cleaning by blasting, the person carrying out the work will take the following measures:

- Clear the steel surface of oil and/or grease;
- Ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- Check that no blasting grains can act into the pipes during this process. Any openings not sealed off must be screened off;

- Where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again.
- Screen off all non-metal structures such as rubber where there is a filter;
- With valves, operators and other devices, care should be taken to ensure that no metal filings or paint get into the apparatus:
- The OWNER reserves the right to carry out part or all of these works himself.

To prevent rust forming quickly as the result of humidity on the blasted surface, cleaning by blasting may only be carried out when the temperature of the steel surface is at least 3°C higher than the dew-point of the ambient air.

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choice of the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted.

The abrasive to be used must conform to the local law i.e. it may contain no carbon and less than 1% free silicon dioxide. The Sa 3 will always be requested and must at least reach Sa 2½ during the initial stage of the paintwork. For blasting followed by metallization, the surface preparation degree to be achieved is always Sa 3. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard SVENSK STANDARD ISO 8501-1-1988 SIS 05.5900.

- Sa 3: surface blasted down to the bare metal; when the surface is inspected with a magnifying glass, scale, rust and foreign bodies must be completely removed and it should be possible to raise a metallic -shine on the treated surface.
- Sa 2 1/2: blasted very carefully. Scale, rust and foreign bodies must be removed in such a way that anything left behind will only be visible as nuances (shading) or strips.

The blast-cleaning will be carried out by means of compressed air free of water and oil.

After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

### 7.3 Mechanical or Power tool cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or other is technically unfeasible, mechanical de rusting can be used instead. With mechanical cleaning by means of chipping, rotating steel brushes and sanding discs, a degree of cleanliness St. 3 should be reached.

St 3 : removal of the old paint layers of which the adhesion leaves something to be desired and/or of which the paint layer no longer fulfills the requirements.

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the OWNER representative prior to the start of the works.

N.B:

St. 3 : means removal of every old paint layer. Retouching means local polishing with St. 3 or Sa 3 followed by application of the desired painting system.

After mechanical cleaning, the surface should be made dust-free with a cloth or a soft brush, washed with an organic solvent and thoroughly dried off with a dry cloth (e.g. with 1.1.1. Trichloroethane such as Solvethane, Chloroethene).

#### 7.4 Manual or Hand tool cleaning

Manual derusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation there from must be requested from the OWNER/ OWNER 's Representative.

With manual derusting, a surface preparation degree St 3 must be obtained. The length of the handles of the equipment used may not exceed 50 cm.

#### 7.5 Preparation of a surface covered with a layer of paint in the workshop.

This layer is in general applied by the manufacturer, for example, on valves, regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D 3359, method A (Standard Test Method for measuring adhesion by tape test). The adhesion should be at least.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts it in the state in which the coating is found and the guarantee remains in force. The adhesion does not have to be examined if system 63 has already been applied in the workshop on behalf of the OWNER.

The Contractor, who must provide for the protection on the construction site, must therefore obtain the information regarding the treatment of the surface and the quality of the paint that was used and must, moreover, examine the adhesion of the layer on the construction site, the percentage of damage and weathering as well as the value of the preparation of the surface in the workshop together with the thickness thereof that must be supplemented if necessary.

##### a) Galvanized surface

Galvanized surfaces, both old and new will be carefully roughened up. Every foreign body (concrete splatters, chalk marks, grease and oil stains, etc.) will be removed. Thereafter, rub the surfaces with abundant water and, if necessary, with cleaning products.

To this end, nylon brushes will be used for every kind of dirt as well as for removing zinc salt residue. Thereafter, the surfaces will be treated in accordance with system 21. Where the zinc layer is lacking, it will be derusted manually to a degree of cleanliness St 3, after which a primer coat will be applied in accordance with system 22.

b) Metallized surfaces treated with an impregnation layer

- Degrease with the desired degreasing product:
- Clean under high pressure or with a product prescribed by the paint supplier.

If the paint layer adheres well and is applied on a clean base, the painting system described may be continued. If the percentage of damage and weathering does not exceed 5 % m. retouching may be considered. These partial repairs will be carried out.

If on the other hand, the percentage of damage does exceed 5 %/m or if the layer applied in the workshop comes loose the Contractor must draw the attention of the OWNER to this and carry out the complete application system.

7.6 Preparation of surfaces covered with earlier paint layers that show different degrees of weathering.

If the surfaces do not show deep weathering limited to the spread of rust by small pitted areas or non-penetrative rust in spots, it will very often be sufficient to clean the surfaces with abrasives or with an abrasive disc, then to rub them down with steel wool, remove the dust and wash off. If thick rust appears, in spots, scale rust and active rust canker, this should be removed with needle hammers or stripped away directly by blasting, removing the dust and washing off.

7.7 Preparation of concrete or cement plaster surfaces

Remove unsound paint layers and loose components with scrapers, blades or rotating steel brushes. Thoroughly clean the entire surface with water containing ammonia. Thoroughly remove moss, algae and fungal growths. Where these growths have been removed, treat the area with a fungicide in accordance with the instructions for use.

Once the entire area is completely dry, brush off the dead residue of moss, algae and fungus with a hard brush. In the case of reinforcement steel that has been laid bare, remove as rust, dust and grease as possible and treat with a primer coat. When painting concrete surfaces, they must first be checked for cracks. Cracks larger than 0.3 mm must be repaired with an appropriate system in accordance with the type and extent of the repairs (e.g. injection with epoxy mortar). Repair damage such as cracks and bursts to concrete parts with a two-component mortar or preferably with micro-mortars. Finally check the alkalinity of the surface with the aid of litmus paper and neutralize it if necessary.

## 7.8 Use of solvents

It is sometimes necessary to use solvents when the surfaces to be painted are streaked with grease or oil. In this case a suitable organic solvent should be applied. The operation should be carried out with the aid of clean brushes or rags and clean solvent.

All the legal specifications in connection with solvents etc. must be adhered to. The OWNER/OWNER's Representative will be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to nick out any possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

## 7.9 Condition of the metal after stripping

The Contractor must call in a representative of the OWNER/OWNER's representative or of the Approved supervisory Body responsible for checking the condition of the metal during stripping and informing the OWNER/OWNER's representative immediately of any damage that he might have noticed.

- Deep corrosion of the plates - rivets - bolts
- Faulty welding
- Fittings that appear to be dangerous because of their age.

## 7.10 Removing coating from surface pipelines

The Contractor must have the equipment necessary for the removal of asphalt from the pipe without damaging the latter (scratching, impact, etc.). The Contractor undertakes to carry out the work in accordance with an approved procedure.

TABLE-1 (FOR CLAUSE 7.0)  
SURFACE PREPARATION STANDARDS

| SL. NO. | DESCRIPTION                                                                                                                                                                                                                                                      | VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT) |                 |              | REMARKS                                                                                                                                                                          |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         |                                                                                                                                                                                                                                                                  | ISO 8501-1/<br>SIS-05 59 00                  | SSPC-SP,<br>USA | NACE,<br>USA |                                                                                                                                                                                  |
| 1       | Manual or hand tool cleaning<br><br>Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen                                                                         | ST.2                                         | SSPC-SP-2       | -            | This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting. |
| 2       | Mechanical or power tool cleaning<br>Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen. | ST.3                                         | SSPC-SP-3       | -            |                                                                                                                                                                                  |
| 3       | Dry abrasive Blast cleaning<br><br>There are four common grades of blast cleaning                                                                                                                                                                                |                                              |                 |              |                                                                                                                                                                                  |

|     |                                                                                                                                                                                                 |       |            |        |                                                                                                                                                                                                                                                                |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1 | <p>White metal</p> <p>Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint &amp; foreign matter 100% cleanliness with desired surface profile.</p>         | SA 3  | SSPC-SP-5  | NACE#1 | Where extremely clean surface can be expected for prolong life of paint system.                                                                                                                                                                                |
| 3.2 | <p>Near white metal</p> <p>Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.</p> | SA 2½ | SSPC-SP-10 | NACE#2 | The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system. |
| 3.3 | <p>Commercial Blast</p> <p>Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.</p>                            | SA 2  | SSPC-SP-6  | NO.3   | For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.                                                                                                                    |
| 3.4 | <p>Brush-off Blast</p> <p>Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint &amp; foreign matter. Surface profile is not so important.</p>              | SA 1  | SSPC-SP-7  | NO.4   |                                                                                                                                                                                                                                                                |



## 8.0 **METALLISATION**

### 8.1 Applying the metallization

Metallization must be carried out in accordance with ISO 2063,

Metallization is carried out as rapidly as possible after blasting in order to limit corrosion of the pipes (max. 3 hours later). With metallization, a surface preparation degree Sa 3 is compulsory. The roughness of the blasted surfaces should be from 25 to 50µ R<sub>Max</sub>.

- The metallizing is always carried out on dry parts in good weather conditions (maximum relative humidity 80 %);
- For metallization, a wire composed of 85 % zinc and 15 % aluminum with a minimum guaranteed degree of purity of 99.5 % is used (subject to other specifications). The application thereof is always carried out in accordance with the conditions of the manufacturer and may at all times be submitted to the OWNER's representative.
- The sealant should be applied maximum 3 hours alter metallization.
- The sealant must be thinned and applied as per the present specifications. A visual inspection whereby the sealant completely covers the metallization will suffice here.
- When evaluating the metallization, a negative deviation from the minimum coating thickness, to 80 µ for 20% of the measurements will be permitted.

## 9.0 **COATING PROCEDURE AND APPLICATION**

### 9.1 Conditions for carrying out paintwork

Painting may not be carried out in unsuitable conditions.

All preparatory work and painting may only be carried out in dry weather and at a minimum temperature of 10°C, except for special cases requested by the OWNER's Representative.

Unless otherwise stipulated in the specifications of the paint supplier, application of the paint is forbidden if it is forecast that the temperature will fall to below 0°C before the paint is dry. The temperature of the surface to be painted must be at least 3°C higher than the dew point of the ambient air. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

The work must be stopped:

- If the temperature of the surface to be painted is higher than that described by the supplier.
- In rain, snow, mist or fog or when the relative humidity is higher than 80 %.

Coats that have not yet dried and have been exposed to frost, mist, snow or rain and might thereby be damaged must be removed after drying and the surfaces must be repainted at the expense of the Contractor.

Working in direct sunlight or in hot weather must be avoided,

The first coat of paint must be applied maximum 3 hours after the preparation of the surface of the relative humidity of the air is between 50% and 80%. This time span may be increased to 6 hours if the relative humidity is less than 50%. In all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2 ½ at the time of painting.

The coats of paint may only be applied on carefully cleaned surfaces that must be dry and free of grease and dust.

## 9.2 Special conditions

Painting may be carried out when the Contractor can be sure that the instructions of the paint supplier have been scrupulously followed with regard to the parameters in the following (non-exhaustive) list:

- Ambient temperature.
- Surface temperature.
- Relative humidity.
- Dew point.
- Drying times.

The Contractor must in this respect be able to produce the instructions for the paint on the site. The OWNER/CONSULTANT will guarantee 100% supervision in this regard during the execution of the work.

In addition, the paintwork may only be carried out to a minimum ambient temperature of 5°C and/or to a maximum relative degree of humidity of 85 %. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

## 10.0 PAINT MATERIAL

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Primer and finish coats shall be of class-I quality and shall conform to the following:

a) Primer (P-1)

Red oxide Zinc Chromate Primer

|                      |                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------|
| Type and Composition | Single pack, Modified phenolic alkyd medium pigmented with red oxide and zinc chromate. |
| Volume solids        | 30 - 35% (min)                                                                          |
| DFT                  | 25 microns/coat (min)                                                                   |
| Covering capacity    | 12 - 13 M <sup>2</sup> /Lit/coat                                                        |

b) Primer (P-2)

High build chlorinated rubber zinc phosphate primer

|                      |                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Type and Composition | Single pack, Air Drying Chlorinated rubber medium Plasticized with unsaponifiable plasticiser pigmented with zinc phosphate |
| Volume solids        | 35 - 40% (min)                                                                                                              |
| DFT                  | 30 - 40 microns/coat (min)                                                                                                  |
| Covering capacity    | 7 - 8 M <sup>2</sup> /Lit/Coat                                                                                              |

c) Primer (P-3)

High build zinc phosphate primer

|                      |                                                               |
|----------------------|---------------------------------------------------------------|
| Type and Composition | Single Pack, Synthetic medium, pigmented with zinc phosphate. |
| Volume solids        | 40 - 45% (min)                                                |
| DFT                  | 35 - 50 microns/coat (min)                                    |
| Covering capacity    | 10 - 12 M <sup>2</sup> /Lit/coat                              |
| Heat resistance      | Upto 80 °C (dry)                                              |

d) Primer (P-4)

Etch Primer / Wash Primer

|    |                                                |                                                                                                                    |
|----|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
|    | Type and Composition                           | Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate. |
|    | Volume solids                                  | 7 - 8% (min)                                                                                                       |
|    | DFT                                            | 8 - 10 microns/coat (min)                                                                                          |
|    | Covering capacity                              | 7 - 8 M <sup>2</sup> /lit/coat                                                                                     |
| e) | Primer (P-5)                                   |                                                                                                                    |
|    | Epoxy Zinc Chromate Primer                     |                                                                                                                    |
|    | Type and Composition                           | Two packs, Polyamide cured epoxy resin medium pigmented with zinc chromate.                                        |
|    | Volume solids                                  | 40 % (min)                                                                                                         |
|    | DFT                                            | 35 microns/coat (min)                                                                                              |
|    | Covering capacity                              | 11 - 12 M <sup>2</sup> /lit/Coat                                                                                   |
| f) | Primer (P-6)                                   |                                                                                                                    |
|    | Epoxy Zinc Phosphate Primer                    |                                                                                                                    |
|    | Type and Composition                           | Two packs, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.                                       |
|    | Volume solids                                  | 40% (min)                                                                                                          |
|    | DFT                                            | 35 - 50 microns/coat (min)                                                                                         |
|    | Covering capacity                              | 11 - 12 M <sup>2</sup> /lit/coat                                                                                   |
| g) | Primer (P-7)                                   |                                                                                                                    |
|    | Epoxy high build M10 Paint (Intermediate Coat) |                                                                                                                    |
|    | Type and composition                           | two pack Poly Polyamide cured epoxy resin medium pigmented with micaceous iron oxide. Volume solids 7- 8%          |
|    | Volume Solids                                  | 50% (min)                                                                                                          |
|    | DFT                                            | 100 microns/coat (min)                                                                                             |
|    | Covering capacity                              | 5.0 M <sup>2</sup> /lit/coat                                                                                       |
| h) | Primer (P-8)                                   |                                                                                                                    |
|    | Epoxy Red Oxide zinc phosphate primer          |                                                                                                                    |

|    |                                                                                                                                        |                                                                                                |
|----|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|    | Type and Composition                                                                                                                   | two pack. Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.             |
|    | Volume solids                                                                                                                          | 42% (min)                                                                                      |
|    | DFT                                                                                                                                    | 30 microns/coat (min)                                                                          |
|    | Covering capacity                                                                                                                      | 13 - 14 M <sup>2</sup> /lit/coat                                                               |
| i) | Primer (P-9)                                                                                                                           |                                                                                                |
|    | Epoxy based tie coat (suitable for conventional alkyd based coating prior to application of acrylic polyurethane epoxy finishing coat) |                                                                                                |
|    | Type and Composition                                                                                                                   | Two packs, Polyamide cured epoxy resin medium suitably pigmented.                              |
|    | Volume solids                                                                                                                          | 50 - 60% (min)                                                                                 |
|    | DFT                                                                                                                                    | 50 microns/coat (min)                                                                          |
|    | Covering capacity                                                                                                                      | 10 - 12 M <sup>2</sup> /Lit/Coat                                                               |
| j) | Finish Coats (F-1)                                                                                                                     |                                                                                                |
|    | Synthetic Enamel                                                                                                                       |                                                                                                |
|    | Type and Composition                                                                                                                   | Single pack, Alkyd medium pigmented with superior quality water and weather resistant pigments |
|    | Volume solids                                                                                                                          | 30 - 40% (min)                                                                                 |
|    | DFT                                                                                                                                    | 20 - 25 microns/coat                                                                           |
|    | Covering capacity                                                                                                                      | 16 - 18 M <sup>2</sup> /lit/Coat                                                               |
| k) | Finish coat (F-2)                                                                                                                      |                                                                                                |
|    | Acrylic Polyurethane paint                                                                                                             |                                                                                                |
|    | Type and Composition                                                                                                                   | Two pack, Acrylic resin and iso-cyanate hardener suitably pigmented.                           |
|    | Volume Solids                                                                                                                          | 40% (min)                                                                                      |
|    | DFT                                                                                                                                    | 30 - 40 microns / coat                                                                         |
|    | Covering Capacity                                                                                                                      | 10 - 12 M <sup>2</sup> /lit/ coat                                                              |
| l) | Finish Coat (F-3)                                                                                                                      |                                                                                                |
|    | Chlorinated Rubber Paint                                                                                                               |                                                                                                |

- |    |                                          |                                                                                                |
|----|------------------------------------------|------------------------------------------------------------------------------------------------|
|    | Type and Composition                     | Single pack, Plasticised chlorinated rubber medium with chemical & weather resistant pigments. |
|    | Volume solids                            | 40% (min)                                                                                      |
|    | DFT                                      | 30 - 40 microns/coat (min)                                                                     |
|    | Covering capacity                        | 8 - 10 M <sup>2</sup> /lit /coat                                                               |
| m) | Finish Coat (F-4)                        |                                                                                                |
|    | High build chlorinated rubber M10 paint. |                                                                                                |
|    | Type and Composition                     | Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.           |
|    | Volume solids                            | 40 - 50% (min)                                                                                 |
|    | DFT                                      | 65 - 75 microns/coat                                                                           |
|    | Covering capacity                        | 6.0 - 7.0 M <sup>2</sup> /lit/coat                                                             |
| n) | Finish coat (F-5)                        |                                                                                                |
|    | Chemical Resistant Phenolic based Enamel |                                                                                                |
|    | Type and Composition                     | Single pack phenolic medium suitably pigmented.                                                |
|    | Volume solids                            | 35 - 40% (min)                                                                                 |
|    | DFT                                      | 25 microns/ coat                                                                               |
|    | Covering capacity                        | 15.0 M <sup>2</sup> /lit/coat                                                                  |
| o) | Finish Coat (F-6)                        |                                                                                                |
|    | Epoxy High Building Coating              |                                                                                                |
|    | Type and Composition                     | Two pack. Polyamide-amine cured epoxy resin medium suitably pigmented.                         |
|    | Volume solids                            | 60 - 65% (min)                                                                                 |
|    | DFT                                      | 100 microns/coat (min)                                                                         |
|    | Covering capacity                        | 6.0 - 6.5 M <sup>2</sup> /lit/coat                                                             |
| p) | Finish Coat (F-7)                        |                                                                                                |
|    | High build Coal Tar Epoxy                |                                                                                                |

|    |                                                                       |                                                                                                                                     |
|----|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|    | Type and Composition                                                  | Two pack, Polyamine cured epoxy resin blended with Coal Tar.                                                                        |
|    | Volume solids                                                         | 65% (min)                                                                                                                           |
|    | DFT                                                                   | 100 - 125 microns/coat                                                                                                              |
|    | Covering capacity                                                     | 6.0 - 6.5 M <sup>2</sup> /lit/coat                                                                                                  |
| q) | Finish Coat (F-8)                                                     |                                                                                                                                     |
|    | Self-priming epoxy high build coating (complete rust control coating) |                                                                                                                                     |
|    | Type and Composition                                                  | Two packs. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manually prepared surface and old coatings. |
|    | Volume solids                                                         | 65 - 80% (min)                                                                                                                      |
|    | DFT                                                                   | 125 - 150 microns/coat                                                                                                              |
|    | Covering capacity                                                     | 4 - 5 M <sup>2</sup> /lit/coat                                                                                                      |
| r) | Finish Coat (F-9)                                                     |                                                                                                                                     |
|    | Inorganic Zinc Silicate coating                                       |                                                                                                                                     |
|    | Type and Composition                                                  | Two packs, self-cured solvent based inorganic zinc silicate coating.                                                                |
|    | Volume solids                                                         | 60% (min)                                                                                                                           |
|    | DFT                                                                   | 65 - 75 microns/coat                                                                                                                |
|    | Covering capacity                                                     | 8 - 9 M <sup>2</sup> /lit/coat                                                                                                      |
| s) | Finish coat (F-10)                                                    |                                                                                                                                     |
|    | High build Black                                                      |                                                                                                                                     |
|    | Type and Composition                                                  | Single pack. Reinforced bituminous composition phenol based resin.                                                                  |
|    | Volume solids                                                         | 55 - 60% (min)                                                                                                                      |
|    | DFT                                                                   | 100 microns/coat (min)                                                                                                              |
|    | Covering capacity                                                     | 5.5 - 6.0 M <sup>2</sup> /lit/coat                                                                                                  |
| t) | Finish Coat (F-11)                                                    |                                                                                                                                     |
|    | Heat Resistant Aluminium Paint Suitable up to 250°C.                  |                                                                                                                                     |

|    |                                                              |                                                                                                     |
|----|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
|    | Type and Composition                                         | Duel container (paste & medium). Heat resistant spec varnish medium combined with aluminium flakes. |
|    | Volume solids                                                | 20 - 25% (min)                                                                                      |
|    | DFT                                                          | 20 microns/coat (min)                                                                               |
|    | Covering capacity                                            | 10 - 12 M <sup>2</sup> /lit/coat                                                                    |
| u) | Finish Coat (F-12)                                           |                                                                                                     |
|    | Heat Resistant Silicon Paint suitable up to 400° C.          |                                                                                                     |
|    | Type and Composition                                         | Single pack Silicone resin based with aluminium flakes.                                             |
|    | Volume solids                                                | 20 - 25% (min)                                                                                      |
|    | DFT                                                          | 20 microns/coat (min)                                                                               |
|    | Covering capacity                                            | 10 - 12 M <sup>2</sup> /lit/coat                                                                    |
| v) | Finish Coat (F-13)                                           |                                                                                                     |
|    | Synthetic Rubber Based Aluminium Paint Suitable up to 150°C. |                                                                                                     |
|    | Type and Composition                                         | Single Pack, Synthetic medium rubber medium combined with leafing Aluminium,                        |
|    | DFT                                                          | 25 microns/coat (min)                                                                               |
|    | Covering capacity                                            | 9.5 M <sup>2</sup> /lit/coat                                                                        |

**Notes:**

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation quality and workmanship should be ensured.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,
4. All primers and finish coats should be cold cured and air-drying unless otherwise specified.



5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.
7. In case of F-6, F-9, F-1 1 & F-1 2 Finish Coats, No Primer are required.

#### MANUFACTURERS

The paints shall conform to the specifications given above and Class-I quality in their products range of any of the-following manufacturer or other approved vendors:

- i) Asian Paints (India) Ltd.
- ii) Bombay Paints
- iii) Berger Paints India Ltd.
- iv) Akzo Nobel
- v) Jenson & Nicholson
- vi) Shalimar Paints

#### STORAGE

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by OWNER/ OWNER 's Representative for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent, building.

A signboard bearing the words given below shall be clearly displayed outside:  
PAINT STORAGE No NAKED LIGHT highly -inflammable

### 12.0 COLOR CODE FOR PIPING:

- i) For identification of pipelines, the color code as per Table -1 shall be used.
- ii) The color code scheme is intended for identification of the individual group of the pipeline. The system of color coding consists of a ground color and color bands superimposed on it.
- iii) Colors (Ground) as given in Table-2 shall be applied throughout the entire length of un insulated pipes, on the metal cladding & on surfaces. Ground color coating of minimum 2m length or of adequate length not to be mistaken as color band shall be applied at places requiring color bands. Color bands shall be applied as per approved procedure.
- iv) Line coating shall meet DIN 30670 standard for external coating and API 5L RP – 2 for internal coating.

- v) The thickness for the epoxy should be 180 microns, adhesive 200 microns and balance should be PE .
- vi) The minimum coating thickness on weld seam shall be 3.2 mm and minimum coating thickness on body should be 3.2.
- vii) Minimum thickness for liquid epoxy for internal coating should be  $100 \pm 20$  microns. Max design temperature for coating should be considered  $+80^{\circ}\text{C}$ .

COLOR CODE:

- A) Ball Valve (Above Ground) : Off White
- B) Globe Valve (Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- C) Check Valve(Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- D) Launcher / Receiver : Yellow Golden
- E) Jib Crane / Trolley : Yellow Golden
- F) All underground valves shall have epoxy base coating after surface finish of SA 2:5
- G) Valves and above ground pipes need to be properly blasted to achieve surface finish of Sa 2:5 before the application of paints.

**Table 12.1 Colour Coding Scheme for Pipes and Equipment**

| SI. No | Description                                                          | Ground Color             | First Color Band | Second Color Band |
|--------|----------------------------------------------------------------------|--------------------------|------------------|-------------------|
| 1      | <b>COMPRESSED AIR</b>                                                |                          |                  |                   |
| a)     | Plant Air                                                            | Sky Blue                 | Silver Grey      | -                 |
| b)     | Instrument Air                                                       | Sea Green                | Black            | -                 |
| 2      | <b>GASES</b>                                                         |                          |                  |                   |
| a)     | Charge Gas                                                           | Canary Yellow            | Signal Red       | Smoke Grey        |
| b)     | Regeneration Gas                                                     | Canary Yellow            | White            | Dark Violet       |
| c)     | Residue Gas                                                          | Canary Yellow            | White            | French Blue       |
| d)     | LPG                                                                  | Canary Yellow            | Brilliant Green  | White             |
| e)     | Acetylene                                                            | Canary Yellow            | Dark violet      | -                 |
|        | Flare Lines                                                          | Heat resistant aluminium |                  |                   |
| f)     | Fire water and Foam & Extinguisher                                   | Post office red          |                  |                   |
| 3      | <b>ALL EQUIPMENT</b>                                                 |                          |                  |                   |
| a)     | Vessels. Columns, exchangers, etc. containing non- hazardous fluids. | Light Grey               |                  |                   |
| b)     | Base Frame/Structure                                                 | Black                    |                  |                   |
| b)     | All equipment containing hazardous fluids                            | Canary Yellow            |                  |                   |
|        |                                                                      |                          |                  |                   |

|    |                                |                                                                       |  |  |
|----|--------------------------------|-----------------------------------------------------------------------|--|--|
| c) | Pipe carrying hazardous fluids | Bar is to be replaced by Hazardous Marking as per IS:2379 Clause 7.1C |  |  |
|----|--------------------------------|-----------------------------------------------------------------------|--|--|

#### IDENTIFICATION SIGN

- i) Colors of arrows shall be black or white and in contrast to the color on which they are superimposed.
- ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by OWNER.
- iii) Size of arrow shall be either of the following:
  - a) Color Bands

Minimum width of color band shall be as per approved procedure.

- b) Whenever it is required by the OWNER to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden, yellow as per IS:2379 shall be painted on the ground color.

#### IDENTIFICATION OF EQUIPMENT

All equipment shall be stenciled in black or white on each vessels, column, equipment, and painting as per approved procedure.

#### INSPECTION AND TESTING

1. All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates Paint formulations without certificates are not acceptable.
2. The painting work shall be subject to inspection by OWNER/ OWNER's Representative at all times. In particular, following stage wise inspection will be performed and contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage.

In addition to above. record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of OWNER/ OWNER's Representative before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work. Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER.

#### PRIMER APPLICATION

- i. The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immerse conditions.

- ii. At the discretion of OWNER/ OWNER's Representative, contractor has to provide the paint manufacturers expert technical service at site as and when required. For this service, there should not be any extra cost to the OWNER.
- iii. Final Inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by OWNER/ OWNER's Representative and shall be within +10% of the dry film thickness.
- iv. The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The OWNER shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

## 18.0 PAINT SYSTEMS

The paint system should vary, with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

- a) Normal Industrial Environment, Table 18.2.
- b) Corrosive industrial Environment, Table 18.3
- c) Coastal & Marine Environment, Table 18.4

Notes 1. Primers and finish coats for any particular paint systems shall be from same manufacturer in order to ensure compatibility.

**TABLE 18.1: LIST OF PRIMERS & FINISH PAINTS**

**PRIMERS**

|     |                                                                         |
|-----|-------------------------------------------------------------------------|
| P-1 | Red oxide Zinc chromate Primer                                          |
| P-2 | Chlorinated rubber zinc Phosphate Primer                                |
| P-3 | High build Zinc phosphate Primer                                        |
| P-4 | Etch Primer/Wash Primer                                                 |
| P-5 | Epoxy Zinc Chromate Primer                                              |
| P-6 | Two component Epoxy Zinc Phosphate Primer cured with polyamine hardener |
| P-8 | Epoxy red oxide zinc phosphate primer                                   |

**FINISH COATS / PAINTS**

|      |                                                                                              |
|------|----------------------------------------------------------------------------------------------|
| F-1  | Synthetic Enamel                                                                             |
| F-2  | Two component Acrylic – Polyurethane finish paint                                            |
| F-3  | Chlorinated Rubber finish paint                                                              |
| F-5  | Chemical resistant phenolic based enamel                                                     |
| F-6  | High Build Epoxy finish coating cured with <b>polyamide</b> hardener                         |
| F-7  | High build Coal Tar Epoxy coating cured with <b>polyamine</b> hardener                       |
| F-8  | Self priming surface Tolerant High Build epoxy coating. cured with <b>polyamine</b> hardener |
| F-9  | Two component Inorganic Zinc Silicate coating                                                |
| F-10 | High build Reinforced bituminous composition phenol based resin.                             |
| F-11 | Heat resistant synthetic medium based Aluminium paint suitable for 250 deg C                 |
| F-12 | Two component Heat resistant Silicone Aluminium paint. suitable for 400 deg C                |
| F-13 | Synthetic based aluminium Paint suitable for 150 deg C                                       |
|      |                                                                                              |
|      |                                                                                              |

**Table – 18.2: Painting System for Normal Industrial Environment for Piping and Equipment (Above Ground)**

| Sl. No. | Temp. Range | Surface Preparation | Primer                                  | Finish Coat                                                                     | Total DFT | Remarks                                                                      |
|---------|-------------|---------------------|-----------------------------------------|---------------------------------------------------------------------------------|-----------|------------------------------------------------------------------------------|
| 1       | -10 to 20   | SSPC-SP-3           | One coat P-2<br>50 microns / coat (min) | One coat F-4<br>65 microns/ coat (min)<br>Two coats F-3, 30 Microns/coa t (min) | 175       | Primer and Finish coat can be applied at ambient temp.                       |
| 2       | 21 to 60    | SSPC-SP-6           | Two coats P-1, 25 microns/ coat (min.)  | Two coats of F-1, 20 microns/coa t (min)                                        | 90        | -                                                                            |
| 3       | 61 to 80    | SSPC-SP-6           | Two coats P-3, 50 microns/ coat (min)   | Two coats of F-13, 25 microns/coa t (min)                                       | 150       | -                                                                            |
| 4       | 81 to 250   | SSPC-SP-6           | -                                       | Three coats of F-11, 20 microns/ coat (min)                                     | 60        | Paint application at ambient temp. curing at elevated temp. during start-up. |
| 5       | 251 to 400  | SSPC-SP-10          | -                                       | Three coats of F-12, 20 microns/ coat (min)                                     | 60        | -do-                                                                         |

**Table – 18.3: Painting System for Corrosive Industrial Environment for Piping and Equipment (Above Ground)**

| SI. No. | Temp. Range | Surface preparation | Primer                                  | Finish Coat                                                                       | Total DFT | Remarks                                                            |
|---------|-------------|---------------------|-----------------------------------------|-----------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------|
| 1       | -14 to 80   | SSPC-SP-10          | Two coats P-6, 35 microns / coat (min.) | One coats F- 6, 100 microns coat (min.) and one coats F- 2 40 microns coat (min.) | 210       | Paint application at ambient temp.                                 |
| 2       | 81 to 250   | SSPC-SP-10          | -                                       | Three coats F- 11, 20 Microns / coat (min.)                                       | 60        | Paint application at ambient temp. and curing at 250°C for 4 hours |
| 3       | 81 to 400   | SSPC-SP-10          | -                                       | Three coats F- 12, 20 Microns / coat (min.)                                       | 60        | Paint application at ambient temp. and curing at 250°C for 4 hours |

**Table – 18.4 :Painting System for Coastal and Marine Environment for Piping and Equipment (Above Ground)**

| SI. No. | Temp. Range | Surface Preparation | Primer                                 | Finish Coat                                                                        | Total DFT | Remarks                                                             |
|---------|-------------|---------------------|----------------------------------------|------------------------------------------------------------------------------------|-----------|---------------------------------------------------------------------|
| 1       | -14 to 80   | SSPC-SP-10          | Two coats P-6. 35 Microns. coat (Min.) | Two coats F- 6, 100 microns /coat (min.) and one coats F-2 40 Microns /coat (min.) | 310       | Primer and Finish coat application at Ambient temp.                 |
| 2       | 81 to 400   | SSPC-SP-I0          | -                                      | - Three coats F- 12, 20 Microns / coat (min.)                                      | 60        | Paint application. at ambient temp, and curing at 250°C for 4 hours |
| 3       | 401 to 550  | SSPC-SP- 10         | -                                      | Three coats F- 12, 20 Microns / coat (min.)                                        | 60        | Paint application. at ambient temp, and curing at 250°C for 4 hours |

**Table – 18.5 : Painting System for External Side of Underground Tanks in all areas.**

| SI. No.                                                  | Temp. Range | Surface Preparation | Primer                           | Finish Coat                                | Total DFT | Remarks |
|----------------------------------------------------------|-------------|---------------------|----------------------------------|--------------------------------------------|-----------|---------|
| External side of un-insulated underground storage tanks: |             |                     |                                  |                                            |           |         |
| 1                                                        | -40 to 80   | SSPC-SP-10          | 1 coat of F-9 @ 65-75μ DFT/ coat | 3 coats of F-7 @ 100μ DFT/coat (3x100=300) | 365-375   |         |

## 18.2 Precautions to be taken

Neither the environment of the site nor the marking labels of devices may be covered with paint and they must be kept free of paint splashes. To this end, it is advisable to use removable masking tape.

Paint splashes, leaks, etc. on any adjacent installations such as measuring apparatus, valves, pipes. Sources of light, insulation, heat insulators, walls, concrete, etc, must immediately be wiped up and the damage repaired before the paint is dry.



Otherwise, the OWNER will be obliged to have the cleaning carried out at the expense of the Contractor. The paint recipient will only be opened at the time of use (unless otherwise specified by the manufacturer).

The product will be mixed in the recipient with the aid of suitable tools and thus homogenized.

### 18.3 Method of application

Normally, three methods of application will be used on the construction site for the paint products. i.e. with a brush, with a roller or with a spray gun.

- The brush method makes it possible to obtain good penetration of the paint over irregularities in the metal.
- Only this method will be used for application of the base coats, for retouching and for protrusions, welded areas, riveted joints or bolted joints:
- The roller method may be used on large flat surfaces for the intermediate and topcoats.
- The spray gun method must be used in accordance with the instructions of the manufacturer and carried out by qualified personnel.

The Contractor must guarantee that all safety measures have been taken for such work. The spray gun method may only be used on site for places that are difficult to reach with the brush. In this case, a request must be made to the OWNER/ OWNER's Representative for a deviation.

All paintwork will be carried out with good brushes or rollers that are suitable for the type of paint being used and for the form of the material to be painted and fitted with short handles. The maximum length of the brush and roller handles will be 50 cm; longer handles may only be used for places that are absolutely inaccessible. The maximum width of a brush will be 13 cm.

### 18.4 Application of the coating

Application of the paint will be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The OWNER or the Approved Supervisory body demands that painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

The layers of paint must have a uniform thickness. They must be spread in such a way that all concave parts are dried out and that the surface is completely covered and has a

glossy appearance without leaving brush marks and without exhibiting bubbles, foam, wrinkles, drips, craters, skins or gums that arise from weathered paint,

Each layer must have the color stipulated in the tables of the present specifications, which clearly differs from the previous layer, taking account of the Color of the top layer, all of which for the purpose of being able to identify the number of coats and their order of sequence. If the color of the coats is not mentioned in the tables the color difference in consecutive coats must, if possible, be at least 100 RAL. The color of the top layer is given in the table.

The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the OWNER or the Approved Supervisory Body.

The drying times prescribed by the paint manufacturer must be strictly observed in relation to the environmental conditions before proceeding with the application of the next layer.

The dry coating thickness indicated in the description of the paint systems are minimum thickness. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thickness specified by the supplier.

#### 18.5 Transporting treated items

In the case of works being carried out in a workshop, the metal structures will be surrounded by ventilated contraction film that prevents damage during transportation. This film may only be applied after complete polymerization of the paint.

#### 19.0 GROUND-LEVEL TRANSITION POINT

##### 19.1 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 20 cm and a depth of 40 cm. perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over the entire surface area, prepared in accordance with is Sa 3:

- 1) The primer of system 01.
- 2) Reinforced polyester  $\pm$  20 cm above the ground level marker and  $\pm$  5 cm on the asphalt cleaned beforehand (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the case of PE, in contrast to asphalt, he will apply a polygon primer to PE immediately before applying the reinforced polyester.

- 3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.
- 4) For new constructions, the polygon primer will be applied to PE and then subsequently processed as described under point 2.

## 20.0 USE OF SCAFFOLDING

Mounting, maintenance and dismantling of scaffolding for carrying out adaptation and/or paintwork to surface gas pipes or gas transport installations in use;

- The Contractor will specify the cost of scaffolding in the price list.
- The supplementary rental price for delays attributable to the Contractor will be charged to him:
- In his price quotation the Contractor should present the OWNER with diagrams of the scaffolding that he intends to install for carrying out the works of the OWNER.

## 21.0 QUALITY CONTROLS AND GUARANTEE

- 21.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications.

The Contractor should have the required calibrated monitoring apparatus for this purpose on site (with calibration certificates). The personnel who will have to use this apparatus should have the training for this purpose.

The OWNER or his representative and possibly the approved supervisory body indicated by the OWNER will maintain supervision during the works and inspect the works with random checks. A daily report will be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the OWNER or the approved supervisory body do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

## 21.2 Reference Surfaces

At the start of the works. The OWNER or the approved supervisory body will indicate a few surfaces that the Contractor will prepare and cover in accordance with the recognized method of operation under the inspection and to the satisfaction of all parties; the OWNER or his representative, the approved supervisory body, the contractor and possibly the paint manufacturer. These reference surfaces will serve as a point of comparison for the good adhesion of the paint on the installations as a whole. The parties will together

work out a system for the identification of these surfaces in order to be able to monitor the conditions of the coatings over time. If the paintwork on a section of the installations is in a worse condition than the reference surfaces, the Contractor may be obliged to treat these parts again.

### 21.3 Measures to be taken in the event of a dispute

If on delivery of the works no agreement can be reached between the Contractor and the OWNER regarding the conformity of the works to the requirements of these specifications, an Approved Supervisory Body will be Called in. The Approved Supervisory Body will then carry out inspections' on site whereby the following assessment criteria will be used:

- The Swedish standards ISO 8501-1 1988 SS 05.5900 concerning the degree of cleanliness of the areas derusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 or ASTM DI 212;
- The dry layer thickness of the film will be measured electronically, will complete statistical information. in accordance will, ISO 2808 or ASTM D 1186.
- The thickness of each layer will be measured in accordance with ISO 2808. ASTM 4138 or DIN 50986.
- Adhesion tests will be carried out in accordance with ISO 2409. ASTM 3359 or DIN 53151.
- Traction tests will be carried out in conformity with ISO 4624 or ASTM D 4541.
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer.
- Any defects in the paint film may be inspected visually by means of a magnifying glass or microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82.

The final judgment of the Approved Supervisory Body is irrevocable and binding for the Contractor and the OWNER. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by the Approved Supervisory Body shall be borne by the Contractor.

### 21.4 Guarantee

#### a) General Principles

The Contractor declares that he is aware of:

- The maximum operating temperature of the surfaces to be covered.
  - The maximum permitted degree of humidity of the bearing surface.
  - The properties of the environment to which the surfaces to be covered are: subject.
- b) Summary of the Guarantee.

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paintwork regarding, among other things:
  - The preparation of the surfaces.
  - The thickness of each layer.
  - The total thickness of the covering.
- The uniformity of the materials used.
- The repair of all defects before delivery of the works.

The Contractor will carry out the requested repair work as promptly as possible.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR ASSORTED PIPES

VCS – SS – PP - 2503

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

|                   |                         |
|-------------------|-------------------------|
| UNCONTROLLED COPY | : If printed            |
| CONTROLLED COPY   | : If in soft and signed |

## REVISION RECORD

| Rev. | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
|------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| 00   | 12.10.2019    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01   | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|      |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

## **ABBREVIATIONS:**

|         |                                                                    |
|---------|--------------------------------------------------------------------|
| ANSI    | American National Standards Institute                              |
| API     | American Petroleum Institute                                       |
| ASME    | American Society of Mechanical Engineers                           |
| ASTM    | American Society for Testing & Materials                           |
| BHN     | Brinell Hardness Number                                            |
| BIS     | Bureau of Indian Standards                                         |
| E.FS.W  | Electric Fusion Weld                                               |
| E.R.W   | Electric Resistance Weld                                           |
| HAZ     | Heat Affected Zone                                                 |
| HIC     | Hydrogen Induced Cracking                                          |
| IBR     | Indian Boiler Regulations                                          |
| IGC     | Inter Granular Corrosion                                           |
| IS      | Indian Standard                                                    |
| LT      | Low Temperature                                                    |
| MR      | Material Requisition                                               |
| NACE MR | National Association of Corrosion Engineers : Material Requirement |
| NB      | Nominal Bore                                                       |
| NPT     | Nominal Pipe Thread                                                |
| PMI     | Positive Material Identification                                   |
| PR      | Purchase Requisition                                               |
| SMYS    | Specified Minimum Yield Strength                                   |
| SS      | Stainless Steel                                                    |



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## 1. GENERAL

1.1. All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydrostatic test and other testing and marking requirements shall conform to the latest codes and standards specified in the material requisition (MR). Supplier shall strictly comply with MR/ PR stipulations and no deviations shall be permitted.

### 1.2. Testing

1.2.1. Test reports shall be supplied for all mandatory tests as per the applicable material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.10 & 1.11.

1.2.2. Material test certificates (physical property, chemical composition & heat treatment report) shall also be furnished for the pipes supplied.

1.2.3. PMI shall be performed as per the scope and procedures at supplier's work.

### 1.3. Manufacturing Processes

1.3.1. Steel made by acid Bessemer process shall not be acceptable.

1.3.2. All longitudinally welded pipes should employ only automatic welding.

1.4. Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters respectively.

1.5. a. Seamless and E.R.W. pipes shall not have any circumferential seam joint in a random length. However, in case of E.F.S.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.5 m from either end. The longitudinal seams of the two portions shall be staggered by 90°. Single random length in such cases shall be 5 to 7 m.

b. Unless otherwise mentioned in the respective material code, E.F.S.W pipes < 36" shall not have more than one longitudinal seam joint and E.F.S.W pipes ≥ 36" shall not have more than two longitudinal seam joints.

1.6. Pipe with screwed ends shall have NPT external taper pipe threads conforming to ASME/ANSI B1.20.1 up to 1.5" NB & IS 554 for 2" to 6" NB.

1.7. Pipe with beveled ends shall be in accordance with ASME B16.25. Weld contours shall be as follows

| Material                                                       | Wall Thickness        | Weld Contour    |
|----------------------------------------------------------------|-----------------------|-----------------|
| Carbon Steel Except<br>Low Temp. Carbon<br>Steel               | Up to 22 mm           | Figure 2 Type A |
|                                                                | > 22 mm               | Figure 3 Type A |
| Alloy Steel,<br>Stainless Steel &<br>Low Temp. Carbon<br>Steel | Up to 10 mm           | Figure 4        |
|                                                                | > 10 mm & Up to 25 mm | Figure 5 Type A |
|                                                                | > 25 mm               | Figure 6 Type A |

- 1.8. Galvanized pipes shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A 153.
- 1.9. All austenitic stainless steel pipes shall be supplied in solution annealed condition. All types of 321 or 347 stainless steel pipes shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking time & holding temp. for stabilizing heat treatment shall be 4 hrs & 900°C respectively.
- 1.10. **I.G.C. (Inter Granular Corrosion) Test for Stainless Steels**
- 1.10.1. For all austenitic stainless steel pipes inter-granular corrosion test shall have to be conducted as per following:  
ASTM A262 Practice "B" with acceptance criteria of "60 mils/year (max.)".  
OR  
ASTM A262 Practice E with acceptance criteria of no cracks at 20X magnification and microstructure to be observed at 250X magnification shall ensure the absence of any cracks/ fissures. When testing is conducted as per practice 'E' photograph of microstructure shall be submitted for record.
- 1.10.2. When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg.SS 309, 310, 316, 316H etc.) ASTM A262 Practice "C" with acceptance criteria of "15 mils/year (max.)" shall have to be conducted
- 1.10.3. For the IGC test as described in 1.10.1 & 1.10.2, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other set corresponding to the highest pipe thickness.
- 1.11. All welded pipes indicated as 'CRYO' & 'LT' in MR shall be impact tested per requirement & acceptance criteria of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel and carbon steel respectively unless specifically mentioned otherwise in MR.
- 1.12. **NACE/HIC Requirements**

- 1.12.1. Pipes under "NACE" category and those designated as "HIC1" shall meet the requirements given in NACE MR-0103 unless mentioned otherwise.
- 1.12.2. Pipes made from plates and designated as "HIC1" shall meet the HIC requirements of specification unless mentioned otherwise
- 1.13. Specified heat treatment for carbon steel and alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.
- 1.14. For black or galvanized pipes to IS 1239, the minimum percentage of elongation shall be 20%.
- 1.15. All 1Cr-1/2Mo and 1 ¼ Cr-1/2Mo seamless pipes shall be normalized and tempered.
- 1.16. For all welded alloy steel pipes with mandatory requirement of heat treatment and radiography, radiography shall be performed after heat treatment.
- 1.17. For Hydrogen service pipes following special requirements shall also be met:
  - 1.17.1. All carbon steel pipes having wall thickness 9.53 mm (0.375") and above shall be normalized. Cold drawn pipes shall be normalized after the final cold draw pass for all thicknesses.
  - 1.17.2. All alloy steel (Cr-Mo) pipes shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psig.
  - 1.17.3. For carbon steel Pipes, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel Pipes, hardness of weld and HAZ shall be 225 BHN (max.).
  - 1.17.4. For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. A Ferrite No.(FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post weld heat treatment.
  - 1.17.5. For all Carbon steel and Alloy steel pipes with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb).
- 1.18. For dual grades of SS where specified, chemical composition and mechanical

properties of both grades specified shall be ensured.

## 2. IBR PIPES

### 2.1. IBR Documentation

- 2.1.1. Pipes under purview of IBR shall be accompanied with IBR certificate original in Form III-A duly approved and countersigned by IBR authority/local authority empowered by the Central Boiler Board of India (Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance) or Form III-D [for well-known pipe manufacturers as per IBR] signed by Manufacturer's authorized representative. Well known pipe manufacturers, as recognized by IBR, shall submit a duly attested copy of Form XVI-G along with Form III-D.
- 2.1.2. For materials  $1\frac{1}{4}$  Cr -  $\frac{1}{2}$  Mo (ASTM A335 Gr.P11 / A691 Gr.  $1\frac{1}{4}$ Cr),  $2\frac{1}{4}$ Cr - 1Mo (ASTM A335 Gr.P22 / A691 Gr.  $2\frac{1}{4}$ Cr) & 9Cr -1Mo-V (A335 Gr.P91/A691 Gr.91), Form III-A approved by IBR shall include the tabulation of Et, Sc & Sr values for the entire temperature range given below. Et, Sc & Sr values shall be such that throughout the temperature range

$$\begin{array}{lcl} E_t/1.5 & \geq & \\ S_r/1.5 & \geq & S_A \\ S_c & \geq & \end{array}$$

where,

- $S_A$  Allowable stress at the working metal temperature.
- $E_t$  Yield point (0.2% proof stress at the working metal temperature)
- $S_c$  The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.
- $S_r$  The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature

| Temp<br>(°F)<br>Material | SA (psi) |       |       |       |       |       |       |       |      |      |      |      |
|--------------------------|----------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|
|                          | 500      | 600   | 650   | 700   | 750   | 800   | 850   | 900   | 950  | 1000 | 1050 | 1100 |
| A335<br>Gr.P11           | 17200    | 16700 | 16200 | 15600 | 15200 | 15000 | 14500 | 12800 | 9300 | 6300 | 4200 | 2800 |
| A691                     | 18900    | 18300 | 18000 | 17600 | 17300 | 16800 | 16300 | 15000 | 9900 | 6300 | 4200 | 2800 |

| Temp<br>(°F)<br>Material                 | SA (psi) |       |       |       |       |       |       |       |       |       |       |       |
|------------------------------------------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                          | 500      | 600   | 650   | 700   | 750   | 800   | 850   | 900   | 950   | 1000  | 1050  | 1100  |
| Gr. 1½<br>Cr                             |          |       |       |       |       |       |       |       |       |       |       |       |
| A335<br>Gr.P22 /<br>A691<br>Gr. 2½<br>Cr | 17900    | 17900 | 17900 | 17900 | 17900 | 17800 | 14500 | 12800 | 10800 | 7800  | 5100  | 3200  |
| A335<br>Gr.P91/<br>A691<br>Gr.91         | 28100    | 27700 | 27300 | 26700 | 25900 | 24900 | 23700 | 22300 | 20700 | 18000 | 14000 | 10300 |

Note : S<sub>A</sub> values shall be as per the latest edition prevailing.

2.2. For carbon steel pipes under IBR the chemical composition shall conform to the following:

Carbon (max) : 0.25%

Others (S, P, Mn) : As prescribed in IBR.

The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

### 3. ACCEPTABLE DEVIATIONS

3.1. Pipes to IS 3589 Gr.410 are acceptable in place of IS 3589 Gr.330.

3.2. Pipes of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316(2.5 Mo min.).

3.3. Pipes of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L(2.5Mo min.).

3.4. Seamless pipes are acceptable in place of welded pipes except in the case of welded SS321/SS321H pipes with nominal thickness greater than 9.53mm.

### 4. HYDROSTATIC TEST

4.1. All pipes shall be hydrostatically tested.

4.2. The mill test pressure shall be as follows:

4.2.1. Seamless, E.R.W. & Spiral Welded

a) Carbon Steel

| Material Std.                | Test Pressure Std. |
|------------------------------|--------------------|
| ASTM A106 Gr.B               | ASTM A530          |
| API 5L Gr.B, Seamless        | API 5L             |
| API 5L, E.R.W.               | API 5L             |
| API 5L, Spiral               | API 5L             |
| ASTM A333 Gr.3 & 6, Seamless | ASTM A530          |
| ASTM A333 Gr.3 & 6, E.R.W.   | ASTM A530          |

b) Seamless Alloy Steel

| Material Std.                          | Test Pressure Std. |
|----------------------------------------|--------------------|
| ASTM A335 Gr.P1, P12, P11, P22, P5, P9 | ASTM A530          |
| ASTM A268 TP 405, TP410                | ASTM A530          |

c) Seamless Stainless Steel

| Material Std.                                               | Test Pressure Std. |
|-------------------------------------------------------------|--------------------|
| ASTM A312 Gr.TP 304, 304L, 304H, 316, 316L, 316H, 321, 347. | ASTM A999          |

d) Seamless Nickel Alloy

| Material Std.          | Test Pressure Std. |
|------------------------|--------------------|
| ASTM B161 UNS No. 2200 | ASTM B161          |
| ASTM B165 UNS No. 4400 | ASTM B165          |
| ASTM B167 UNS No. 6600 | ASTM B167          |
| ASTM B407 UNS No. 8800 | ASTM B407          |

e) Welded Nickel Alloy

| Material Std.               | Test Pressure Std. |
|-----------------------------|--------------------|
| ASTM B725 UNS No. 2200,4400 | ASTM B725          |
| ASTM B517 UNS No. 6600      | ASTM B517          |

|                        |           |
|------------------------|-----------|
| ASTM B514 UNS No. 8800 | ASTM B514 |
|------------------------|-----------|

#### 4.2.2. Electric Fusion Weld

##### a) Carbon Steel & Alloy Steel E.FS.W (16" & above)

| Material Std                                                                                                                                                                            | Test Pressure Std.                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| API 5L Gr.B<br>ASTM A671 Gr.CC65, 70 (Cl.32)<br>ASTM A672 Gr.C60, 65, 70 (Cl.12,22)<br>ASTM A671 Gr.CF60, 65, 66, 70 (Cl.32)<br>ASTM A691 Gr. ½ Cr, 1Cr, 1¼ Cr, 2¼ Cr, 5Cr, 9Cr (Cl.42) | P = 2ST/D<br>S = 90% of SMYS<br>Except for API 5L Gr.B<br>S = 85% of SMYS<br>For API 5L Gr.B<br>T = Nominal Wall Thickness<br>D = O.D of Pipe |

##### b) Stainless Steel E.FS.W (2" to 6")

The hydrostatic test pressure in kg/cm<sup>2</sup> for the following materials shall be as given below :

**Material Gr.1** :ASTM A312 TP 304 / 304H / 316 / 316H / 321 / 347 welded.

**Material Gr.2** :ASTM A312 TP 304L / 316L welded.

| Size | Pipe Schedule : 10S |               | Pipe Schedule : 40S |               | Pipe Schedule : 80S |               |
|------|---------------------|---------------|---------------------|---------------|---------------------|---------------|
|      | Material Gr. 1      | Material Gr.2 | Material Gr.1       | Material Gr.2 | Material Gr.1       | Material Gr.2 |
| 2"   | 100                 | 80            | 155                 | 130           | 230                 | 190           |
| 3"   | 80                  | 60            | 155                 | 130           | 230                 | 190           |
| 4"   | 80                  | 50            | 155                 | 130           | 230                 | 190           |
| 6"   | 65                  | 35            | 90                  | 75            | 155                 | 130           |

##### c) Stainless Steel E.FS.W (8" and above).

| Material Std                                                              | Test Pressure Std.                                                            |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| ASTM A358 TP 304L, 304, 304H, 316L,316, 316H, 321, 347 (Classes 1, 3 & 4) | P = 2ST/D<br>S = 85% of SMYS<br>T = Nominal Wall Thickness<br>D = O.D of Pipe |



|                                                                         |                                                                               |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 2 & 5) | P = 2ST/D<br>S = 72% of SMYS<br>T = Nominal Wall Thickness<br>D = O.D of Pipe |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|

#### 4.2.3. Carbon Steel Pipe to BIS Standards

| Material Std | Test Pressure Std. |
|--------------|--------------------|
| IS 1239      | IS 1239            |
| IS 3589      | IS 3589            |

- 4.3. Hydrostatic pressure testing shall be performed using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 50 ppm.

### 5. MARKING AND DESPATCH

- 5.1. All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition the purchase order number, the item code & special conditions like "IBR", "CRYO", "NACE", "H2" etc. shall also be marked.
- 5.2. Pipes under "IBR", "CRYO", "NACE" & "H2" shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for pipe sizes less than 3" and 25mm for pipes 3" and above.
- 5.3. Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.
- 5.4. Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 5.5. Pipes shall be protected from rust & corrosion
- 5.6. Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.
- 5.7. Both ends of the pipe shall be protected with the following material:
- |              |   |                               |
|--------------|---|-------------------------------|
| Plain end    | : | Plastic cap                   |
| Bevel end    | : | Wood, Metal or plastic cover  |
| Threaded end | : | Metal or plastic threaded cap |
- 5.8. Pipes may be provided with plastic push-fit type end caps/ steel caps without belt wire.

- 5.9. Steel end protectors to be used on galvanized pipes shall be galvanized. Plastic caps can also be used as end protectors for galvanised pipe ends.

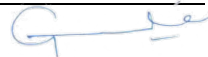


ENERGISING QUALITY

## VCS QUALITY SERVICES PVT.LTD.

### STANDARD SPECIFICATION FOR PIPELINE BALL VALVES

VCS-SS-PP-2004

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 04      | 29.04.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 03      | 07.01.2022 | SR                                                                                  | MC                                                                                  | HK                                                                                   | HK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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| REVISION RECORD |               |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                                                                      |
|-----------------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                          | Approved by                                                                         | Authorized by                                                                        | Revision Description                                                                                                                 |
| 00              | 23.06.2017    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Issued as Standard                                                                                                                   |
|                 |               | AS                                                                                  | SM                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 01              | 22.05.2019    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Revised based on API 6D 24 <sup>TH</sup> Edition.                                                                                    |
|                 |               | BS                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 02              | 28.01.2020    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Documents Formatting, numbering updated from SS-PL-004 to VPC-SS-PP-2004, vent drain Diagram updated, other Detail updated as marked |
|                 |               | MB                                                                                  | MC                                                                                  | AD                                                                                  | SK                                                                                   |                                                                                                                                      |
| 03              | 07.01.2022    |                                                                                     |                                                                                     |                                                                                     |                                                                                      | Revised as Marked                                                                                                                    |
|                 |               | SR                                                                                  | MC                                                                                  | HK                                                                                  | HK                                                                                   |                                                                                                                                      |
| 04              | 29.04.2022    |  |  |  |  | VCS QMS Integration                                                                                                                  |
|                 |               | RP                                                                                  | MC                                                                                  | HK                                                                                  | GW                                                                                   |                                                                                                                                      |

---

**ABBREVIATIONS:**

|        |                                                           |
|--------|-----------------------------------------------------------|
| ASME   | American Society of Mechanical Engineers                  |
| ASTM   | American Society for Testing and Materials                |
| API    | American Petroleum Institute                              |
| BHN    | Brinell Hardness Number                                   |
| DN     | Nominal Size                                              |
| HAZ    | Heat Affected Zone                                        |
| LC     | Lock Close (valve locked in full close position)          |
| LO     | Lock Open (valve locked in full open position)            |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| NDT    | Non Destructive Testing                                   |
| NPS    | Nominal Pipe Size                                         |
| RTJ    | Ring Type Joint                                           |
| SSPC   | Steel Structures Painting Council                         |
| MPI    | Magnetic Particle Inspection                              |
| DP     | Dye Penetrant                                             |

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## 1 SCOPE

This specification covers the minimum requirements for design, manufacture, testing and supply of carbon steel ball valves of size DN 50 mm (2") and above and ASME pressure rating Class 150# thru 900# for use in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2 REFERENCE DOCUMENTS

All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, latest edition (edition in force at the time of issue of enquiry), Specification for Pipeline and Piping Valves, with additions and modifications as indicated in the following sections of this specification.

Reference has also been made in this specification to the latest edition (edition in force at the time of issue of enquiry) of the following Codes, Standards and Specifications.

### 2.1 American Society of Mechanical Engineers (ASME)

|              |   |                                                                               |
|--------------|---|-------------------------------------------------------------------------------|
| B31.3        | : | Process Piping.                                                               |
| B31.4        | : | Pipeline Transportation System for Liquid and Slurries.                       |
| B 31.8       | : | Gas Transmission and Distribution Piping Systems.                             |
| B16.5        | : | Pipe Flanges and Flanged Fittings.                                            |
| B16.10       | : | Face to Face and End to End Dimensions of Valves.                             |
| B 16.25      | : | Butt Welding Ends.                                                            |
| B 16.34      | : | Valves-Flanged, Threaded and Welding Ends.                                    |
| B 16.47      | : | Large Diameter Steel Flanges.                                                 |
| Section VIII | : | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels. |
| Section IX   | : | Welding and Brazing Qualifications.                                           |

### 2.2 American Petroleum Institute (API)

|      |   |                                                                |
|------|---|----------------------------------------------------------------|
| 1104 | : | Specification for Welding of Pipelines and Related Facilities. |
|------|---|----------------------------------------------------------------|

### 2.3 American Society for Testing and Materials (ASTM)

|       |   |                                                                                 |
|-------|---|---------------------------------------------------------------------------------|
| A370  | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |
| B 733 | : | Auto catalytic (Electro less) Nickel - Phosphorus Coatings on Metal.            |

## 2.4 Manufacturers Standardization Society (MSS)

- SP-6 : Standard Finishes for contact faces of Pipe Flanges and Connecting – End Flanges of Valves and Fittings.
- SP-44 : Steel Pipeline Flanges.

## 2.5 Steel Structures Painting Council (SSPC)

- SSPC-VIS-I : Steel Structures Painting Council Visual Standard-Guide and Reference Photographs for Steel Surfaces prepared by Dry Abrasive Blast Cleaning.

- 2.6** In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred above, the requirements of this specification shall govern.

## 3 MATERIALS

- 3.1** The material of major components of the ball valves shall be as indicated in Valve Data Sheet. Remaining components shall be as per Manufacturer's standard (suitable for the service indicated in the data Sheet) and shall be subjected to approval by Company. In addition, the material shall also meet the requirement specified hereinafter.

All process-wetted parts, metallic and non-metallic, sealant and lubricants shall be suitable for the service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/ seawater environment, which may be used during field testing.

Non-metallic parts of the valves (including O-rings, soft seals etc.) intended for hydrocarbon gas service shall be resistant to explosive decompression.

- 3.2** Carbon steel used for the manufacture of valves shall be fully killed.
- 3.3** The carbon equivalent ( $CE_{IIV}$ ) of valve end connections which are subject to further field welding by Company shall not exceed 0.43 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE_{IIV} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

## 3.4 Charpy V-Notch Test Requirements

Charpy V-notch test on each heat of base material shall be conducted for all pressure containing parts such as Body, End Flanges, Stem and Welding Ends as well as Bolting materials for pressure containing parts.

Test procedure for Charpy V-Notch Test shall conform to ASTM A370.

For Carbon Steel, alloy steel & Stainless Steel (except Austenitic Grades) Materials, The impact test temperature shall be 0 °C or minimum design temperature indicated in valve



data sheet / MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi) / 34 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi) / 26 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi).

For Low Temperature Carbon Steel Materials, the impact test temperature shall be as per requirement of Material Standard or minimum design temperature indicated in valve data sheet/MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi) / 34 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength  $\leq 100,000$  psi) / 26 J (for materials with Specified Minimum Tensile Strength  $> 100,000$  psi).

Where the material specification requires impact values to be higher than specified in the above paragraphs, the higher values shall apply.

For duplex & super duplex stainless steel the Charpy V-Notch test values and test temperature shall be as per API 6D.

### 3.5 Hardness Test Requirements

For valves specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross section shall be taken for this purpose and the maximum hardness of the materials of valve components shall not exceed 248 HV<sub>10</sub>.

### 3.6 Electroless Nickel Plating Requirements

For all such valves where Carbon Steel/Low temperature carbon steel is used as ball material, the ball shall have 75 micrometers (0.003 inches) thick Electro less Nickel Plating (ENP) as per ASTM B 733 with following classification:

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

## 4 DESIGN AND CONSTRUCTION REQUIREMENTS

### 4.1 General

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler & Pressure Vessel Code, Section VIII, Div 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of above code. Also, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design; however, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The

manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

## 4.2 Valve Installation

Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet/ Material requisition.

## 4.3 Valve Body

4.3.1 For above ground valve, valve body design shall be either fully welded or bolted type. For buried valves, valve body design shall be fully welded type only. Valve body joints with threads are not permitted.

4.3.2 Ball mounting shall be trunnion or pivot type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable

## 4.4 Ball

Ball shall be of single piece, solid type construction.

## 4.5 Valve Bore Configuration

Valves shall be Full bore (FB) or Reduced bore (RB) as indicated in the Valve Data Sheet.

### Full Opening Valve

Full bore valves shall be suitable for the passage of all types of pipeline pigs including instrumented intelligent pigs and regular cleaning, batching and scraper pigs on regular basis without causing damage to either the valve component or the pig. The full bore, valve shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore of full bore butt-welded & flanged valves shall be in line with Connecting pipe as stated in valve data sheet or Valve MR, however in any case it shall not be less than the minimum required shown in Client Ball Valve specification & API 6D.

### Reduced Opening Valve

The bore size of reduced bore valve shall correspond to that of a full-bore valve of smaller nominal diameter as indicated in Table- 4.5 below. For sizes of a particular rating not covered in API 6D, the bore size of the reduced bore valve shall be as per manufacturer`s Standard.

| TABLE – 4.5        |                                     |                    |                                     |
|--------------------|-------------------------------------|--------------------|-------------------------------------|
| Nominal Valve Size | Nominal Valve Size for Reduced Bore | Nominal Valve Size | Nominal Valve Size for Reduced Bore |
| DN mm (NPS inches) | DN mm (NPS inches)                  | DNmm (NPSinches)   | DNmm (NPS inches)                   |
| 50 (2)             | 40 (1.5)                            | 600 (24)           | 500 (20)                            |

|          |          |           |           |
|----------|----------|-----------|-----------|
| 80 (3)   | 50 (2)   | 650 (26)  | 550 (22)  |
| 100 (4)  | 80 (3)   | 700 (28)  | 600 (24)  |
| 150 (6)  | 100 (4)  | 750 (30)  | 600 (24)  |
| 200 (8)  | 150 (6)  | 800 (32)  | 650 (26)  |
| 250 (10) | 200 (8)  | 850 (34)  | 700 (28)  |
| 300 (12) | 250 (10) | 900 (36)  | 750 (30)  |
| 350 (14) | 250 (10) | 950 (38)  | 800 (32)  |
| 400 (16) | 300 (12) | 1000 (40) | 850 (34)  |
| 450 (18) | 350 (14) | 1050 (42) | 900 (36)  |
| 500 (20) | 400 (16) | 1200 (48) | 1050 (42) |
| 550 (22) | 450 (18) |           |           |

#### **4.6 Seat Design**

The valves shall either be a soft seated valve or metal seated valve or with primary metal-to metal contact and secondary soft seats or seat design shall be as indicated in valve data sheet.

For soft seated valves, Metal seat rings may be provided with soft insert. The same shall be positively locked in position in Metal seat rings.

For valves with primary metal to metal contact and secondary soft seats, O-rings or other seals if used for drip tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation of valve at maximum differential pressure corresponding to valve class rating. The seat rings shall be so designed as to ensure sealing at low as well as high differential pressures.

**4.7** Valves shall be designed to withstand a sustained internal vacuum of at least 1 (one) mille-bar in both open and closed positions.

#### **4.8 Double Block & Bleed Design**

Valves shall have double block and bleed feature to facilitate complete flush, drain and venting of the valve body cavity. Cavity relief pressure shall be as per API 6D.

#### **4.9 Sealant Injection**

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced Bore valves of nominal valve size DN 250 mm (10") & above, shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with block valve and an internal non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Location and arrangement of sealant points shall be as per Fig 4.9.

#### **4.10 Vent & Drain**

Valves shall be provided with vent and drain connections. Location and arrangement of

vents and drains shall be as per Fig. 4.9. Body vent and drain shall be provided with valves (Ball or Plug type). Number and size shall be as per Fig. 4.9.

Valve design shall ensure repair of stem seals/ packing under full line pressure.

#### 4.11 Support Foot

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced bore valves of nominal valve size DN 250 mm (10") & above, shall be equipped with support foot and lifting lugs unless specified otherwise. Tapped holes and eyebolts shall not be used for lifting lugs. Height of support foot shall be kept minimum. The location and size of support foot/ lifting lugs shall ensure unrestrictive operation of vent/ drain valves. The design of support foot shall be such that it shall take minimum double the weight of the valve assembly.

**4.12** Valve design shall be such as to avoid bimetallic corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.

**4.13** The valve body cavity over-pressure shall be prevented by self-relieving seat rings/ assemblies. Valve Cavity relief pressure when added to the valve pressure rating shall not exceed 133% of the pressure rating of the valve at its maximum specified design temperature.

#### 4.14 Valve Ends

Valve ends shall be either flanged/ or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/ forged with the body of the valve. Face to face/ end to end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.

Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22"), as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26 inches) and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.

Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

In case of all Butt welded end valves (including soft seated valves or valves with primary metal to metal and secondary soft seats), actual yield strength of valve body shall not be less than 2/3<sup>rd</sup> of the specified minimum yield strength (SMYS) of the connecting pipe material.

For soft seated valves with Butt welded end, valves shall be provided with pup pieces on

either side of length 200 mm each for size up-to 8" & 250 mm for size 10" and above, with material as specified in valve data sheet. Length of pup piece shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. Pup piece thickness shall be calculated for the class rating. Vendor shall provide for each type (considering size, grade and thickness of the pup pieces used for all offered valves) of pup piece, test rings (500 mm long) from pup piece material for field weld procedure qualification. Valves shall be tested along-with pup piece.

**4.15** Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) is not liable to be damaged. The manufacturer shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.

#### **4.16 POSITION INDICATORS**

Valve shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions. For actuated valves, additionally mechanical means of position indicator shall be provided.

#### **4.17 STEM EXTENSIONS**

When stem extension requirement is indicated in Valve Data Sheet, the valves shall have the following provisions.

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. In case of below Ground LTCS valves, Stem extension material shall be equivalent to stem material.
- c. Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160 for carbon steel valves and ASTM A 333 Gr 6, with Sch 160 for Low temperature carbon steel valves or the material shall be as specified in valve data sheet. The material of fittings for Carbon Steel valve shall be ASTM A105/ ASTM A234 Gr. WPB and material for the fittings for low temperature carbon steel valves shall be ASTM A 350 Gr LF2 Cl 1 or the material shall be as specified in valve data sheet. The fittings and valve end shall be Socket welded ANSI class 6000# as per ASME B 16.11 (For piping class up to 600#) and BW end (For Piping Class 900#).
- d. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- e. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
- f. The Stem Extension shall be self-relieving.

#### 4.18 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes,  $DN \leq 100$  mm (4") shall be wrench operated and valve sizes,  $DN \geq 150$  mm (6") shall be gear operated. The length of wrench shall not be longer than twice the face to face or end to end dimension of the valve. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be 1.25 times the break torque required to operate the ball valve under the maximum differential pressure corresponding to the Valve Class Rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N. However, failing to meet above requirement, vendor shall offer gear operated valves. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The numbers of turn shall not exceed 250 for valves sizes up to 24" and 450 for valve size above 24".
- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

**4.19** The tolerance on internal diameter and out of roundness at the ends for welded ends valves shall be as per connected pipe specification as indicated in the Valve Data Sheet.

#### 4.20 LOCKING DEVICES

When indicated in Material Requisition/Data sheet/ Tender, valves shall have locking devices to lock the valve either in full open (LO) or full close (LC) positions. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.

#### 4.21 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

#### 4.22 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However, repair

by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein. Heat treatment and radiography shall be repeated after the weld repair.

- 4.23** No Casting is permitted for stem and stem extended material of all valve. Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division 1. For power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.
- 4.24** Wherever specified for the part of valve in valve data sheet, minimum thickness of stelliting shall be 1.6mm
- 4.25** All Soft seated valves shall be fire safe design and qualified as per API 6FA/ API 607/ ISO 10497.
- 4.26** Soft-seated valves shall have antistatic device.

## **5 INSPECTION & TESTS**

- 5.1** The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment, at his works. Such inspection and tests shall be, but not limited to, the following:
- 5.2** All valves shall be visually inspected. The internal and external surfaces of the valves shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.
- 5.3** Dimensional check on all valves shall be carried out as per the Company approved drawings.
- 5.4** Chemical composition and mechanical properties shall be checked as per this specification and relevant material standards, for each heat of steel used.
- 5.5** Non-destructive examination of individual valve material and component consisting of but not limited to castings, forgings, plates and assembly welds shall be carried out by the Manufacturer.
  - a. Body castings of all valves shall be radio graphically examined as per ASME B16.34. Procedure and acceptance criteria shall be as per ASME B 16.34. The extent of the radiography shall be as under:

| <b>Pressure Class Rating</b> | <b>Valve Size</b> | <b>Extent of Radiography</b> |
|------------------------------|-------------------|------------------------------|
| ANSI 150 # Class             | ≤ DN 600 mm (24") | Nil                          |
|                              | ≥ DN 650 mm (26") | 100%                         |



|                            |                   |      |
|----------------------------|-------------------|------|
| ANSI 300 # Class           | ≤ DN 400 mm (16") | Nil  |
|                            | ≥ DN 450 mm (18") | 100% |
| ANSI 600 # Class and above | All sizes         | 100% |

Radiography shall be performed after the final heat treatment also.

All castings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall, comply with ASME B 16.34.

- b. All valves, with body fabricated from plates or made by, forgings, shall be ultrasonically examined in accordance with the procedure and acceptance standard as per ASME B16.34.

All forgings shall be Wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall comply with ASME B16.34.

- c. Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of 5.5 (a) for cast components or 5.5 (b) for forged components and plates.

**5.6** Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8 as applicable and API 1104.

**5.7** Welds, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII , Division 1, Appendix 12 and, Appendix 6 respectively.

**5.8** All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

- a. Weld ends of all cast valves subject to welding in field shall be 100% radio graphically examined and acceptance criteria shall be as per ASME B16.34.

- b. After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

**5.9** All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material: The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes for both Shell & seat Test. No leakage is permissible during hydrostatic testing. The body cavity self-relieving feature meeting the requirements of clause 4.13 of this specification shall also be checked.

**5.10** A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried



out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

**5.11** Valves shall be subjected to Operational Torque Test as per API 6D (Annex I, Para I.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. It shall be established that the force required to operate the valve does not exceed the requirements stated in section 4.18 (C) of this specification.

**5.12** Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

Hand operator provided on the actuator shall also be checked after above testing, for satisfactory manual over-ride performance.

These tests shall be conducted on minimum one valve out of a lot of five (5) valves of the same size, rating and the actuator model/ type. In case, the tests do not meet the requirements, retesting/ rejection of the lot shall be decided by the Company's Inspector.

**5.13** Subsequent to successful testing as specified in clause 5.11 and 5.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Company Representative for cyclic testing as mentioned below:

- a. The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
- b. Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.9 and 5.10.

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of manufacturer.

Previously carried out test of similar nature shall be considered acceptable if the same has been carried out by Manufacturer in last two years. Valves of two sizes below and two sizes above the size of valve previously tested, and rating similar or one rating lower of valve tested previously, shall be qualified.

**5.14** Checks shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of clause 4.12 of this specification.

**5.15** Anti-Static testing for soft seated valves in accordance with L.5 of API 6D.

**5.16** Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's

Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his inspector shall relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

Inspection and tests performed/ witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

## 6 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN 10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection
- e. Test report on operation of valves conforming to clause 5.11, 5.12 and 5.13 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

## 7 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SA-2 ½ / SSPC-SP10. For Coastal area, painting shall be suitable for industrial marine environment. For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating.

## 8 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.

- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** The serial number of each valve indicated on its name plate shall appear on all required documentation in accordance with EN 10204 3.2.
- 8.6** Name Plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25
- 8.7** All valves shall be transported with ball in fully opened condition
- 8.8** On packages, following shall be marked legibly with suitable marking ink:
- Order Number
  - Manufacturer's Name
  - Valve size and rating
  - Tag Number
  - Serial Number

## **9 SPARES & ACCESSORIES**

- 9.1** Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2** Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

## **10 DOCUMENTATION**

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

- 10.1** At the time of bidding, Manufacturer shall submit the following documents:
- Reference list of similar ball valves manufactured and supplied in last seven years indicating all relevant details including project, year, client, location, size, rating, service etc.
  - Torque curves for the power actuated valves along with the break torque, running torque for the valve stem and maximum allowable stem torque.
  - Copy of valid API 6D Certificate.
  - Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.
  - Details of support foot including dimensions and distance from valve centreline to bottom of support foot.
  - List of recommended spares required during start-up and commissioning & 2 years of normal operation and maintenance.

10.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for Company's approval:

- a. General arrangement & detailed sectional drawings showing all parts with reference numbers and material specifications, overall dimensions and features. Number of turns of hand wheel required for operating the valve from full open to full close position for Gear Operated valves, painting/ coating scheme, Complete dimensional details of support foot (where applicable), shall be indicated in the GA.

Manufacture of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

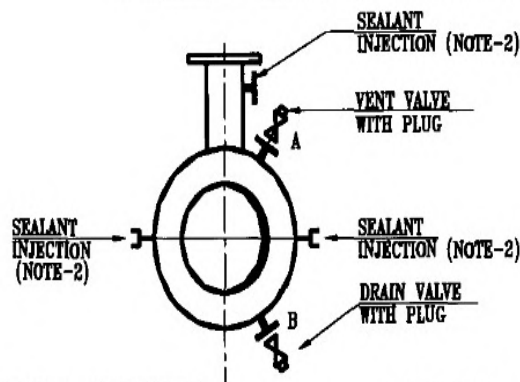
10.3 Within 30 days from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in clause 10.2 above.

10.4 Prior to shipment, Manufacturer shall submit to Company following:

- a. Test certificates as per clause 6.0 of this specification.
- b. Manual for installation, erection, maintenance and operation instructions including a list of recommended spares for the valves.

10.5 All documents shall be in English language only.

### ABOVE GROUND INSTALLATION



#### FULL BORE VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) |
|--------------------|-----------|-----------|
| 50 TO 150          | -         | 15        |
| 200 TO 600         | 15        | 25        |
| 650 & ABOVE        | 15        | 40        |

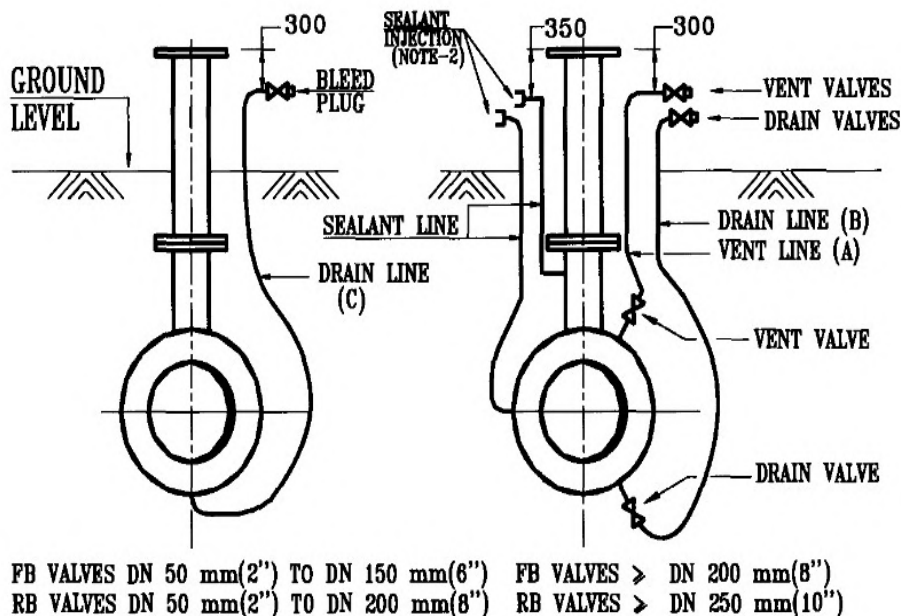
#### REDUCED BORE VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) |
|--------------------|-----------|-----------|
| 50 TO 200          | -         | 15        |
| 250 TO 750         | 15        | 25        |
| ABOVE 750          | 15        | 40        |

#### NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
- 3 ALL VENT/DRAIN CONNECTION SHALL BE WELDED WITH THE BODY.

## UNDERGROUND INSTALLATION



### FULL BORE (FB) VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) | C, DN(mm) |
|--------------------|-----------|-----------|-----------|
| 50 TO 150          | -         | -         | 15        |
| 200 TO 300         | 25        | 25        | -         |
| 350 TO 600         | 25        | 25        | -         |
| 650 & ABOVE        | 40        | 40        | -         |

### REDUCED BORE (RB) VALVES

| VALVE SIZE, DN(mm) | A, DN(mm) | B, DN(mm) | C, DN(mm) |
|--------------------|-----------|-----------|-----------|
| 50 TO 200          | -         | -         | 15        |
| 250 TO 400         | 25        | 25        | -         |
| 450 TO 750         | 25        | 25        | -         |
| 800 & ABOVE        | 40        | 40        | -         |

### NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
- 3 ALL VENT/DRAIN CONNECTION IN BURIED SECTION SHALL BE OF WELDED CONSTRUCTION. ALL PIPING INCLUDING VALVE ENDS IN BURIED PORTIONS OF VENT & DRAIN SHALL BE WELDED TYPE.

**FIGURE-4.9**



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR ERECTION OF MACHINERY AND EQUIPMENT

VCS – SS – PP – 2505

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 01      | 30.06.2022 | RP          | MC         | HK          | GW            |
| 00      | 28.01.2020 | MB          | AK         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
| 00              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01              | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
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## 1.0 SPECIFICATION FOR ERECTION OF EQUIPMENT AND MACHINERY

### 1.1 Scope:

This specification covers technical requirements for erection of all static and rotating equipment by erection contractor at site.

### 1.2 General

**1.2.1** All necessary handling equipment's, tools, tackles and precision instruments for carrying out the works as specified shall be provided by the Erection Contractor (EC) at his cost. EC must provide all tools and gauges for erection and alignment. Special tools, if any, received as part of machinery, will be given to EC for erection purposes, which shall be returned in good condition after use. Suitable deductions will be made by the Engineer-in-Charge (EIC) in case of loss or damage of the special tools. The value of such loss or damage will be decided by the EIC and EC shall be bound by such a decision.

**1.2.2** Equipment Manufacturer's recommendations regarding preservation during storage at site and detailed specifications for the installation along with layout drawings, general arrangement/equipment outline drawings and sub-assembly drawings of the various equipment and machinery will be provided to EC during the performance of work. The requirements stipulated in these shall be fulfilled by EC in addition to what is stated in this specification. Erection shall be carried out as per the instructions and supervision of Machine manufacturer's representative, wherever such supervisory services are applicable.

**1.2.3** All the items of work covered in the tender shall be carried out as per this Specification and other details to be furnished to EC. However, EIC reserves the right to give additional/alternative specifications and instructions, at any time, for execution of any particular work and EC shall execute such works in accordance with such additional/alternative specifications and instructions of the EIC. Such a step taken by the EIC shall not constitute a breach of the contract.

### 1.3 Preparation for Erection:

**1.3.1** EC shall be responsible for organising the lifting of the equipment in the proper sequence, so that orderly progress of the work is ensured and access routes for erecting the other equipment are kept open.

Rigging procedure for all the major lifts (above 10 MT) and at maximum crane capacity shall be submitted by EC for the approval of EIC. However, approval to rigging procedure proposed by EC shall not relieve EC from his responsibility in following the proper lifting/erection methods on ensuring orderly.

**1.3.2** Orientation of all foundations, elevations, length and disposition of anchor bolts and diameter of holes in the supports saddles shall be checked by EC, well in advance. Minor rectifications including chipping of foundations as the case may be, shall be carried out by EC after obtaining prior approval of EIC -. EC shall also be provided with the necessary structural drawings and piping layouts etc. wherever required for reference. EC shall crosscheck such piping and structural drawings with actual construction at site and in case of any mismatch inform the EIC before taking up the erection.

**1.3.3** During the performance of the work, EC shall keep structures, materials or equipment's adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by EC as required till the installation work is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.

**1.4 Abbreviations used:**

EC - Erection Contractor  
EIC - Engineer-in-Charge

**2.0 ERECTION OF COLUMNS, TANKS, VESSELS AND DRUMS ETC.**

**2.1 Scope of work of Erection Contractor**

- (a) Preparation of erection scheme and rigging procedure and obtaining its approval from EIC wherever necessary.
- (b) Withdrawal of equipment's from Owner's storage point, checking and reporting its conditions, transporting the same to EC's stores of work site including unloading etc.
- (c) Erection on foundations furnished by Owner including aligning, levelling and grouting including grouting wherever necessary.
- (d) Assembly and fixing of demisters, grids, internal distributors and other internal fittings in Columns, Vessels etc.
- (e) Filling of Columns, Reactors, and Vessels/Drums etc. with Raschig rings, supporting elements, sand, concrete etc. as required.
- (f) Welding of washers for equipment's, erection of pipe davit & minor welding of their parts as per specifications and instruction of EIC.
- (g) Assembly & erection of Agitator (Mixer) along with drive unit (Motor) including all accessories for vessels/drums/reactors (wherever indicated) as per specification drawings & instructions of EIC.
- (h) Flushing, cleaning and drying of Columns, Vessels/Drums etc.
- (i) Completing the equipment's in all respects for commissioning the plant as per drawings, specifications & instructions of EIC.
- (j) Any modification in the erected Columns, Reactors, Vessels/Drums to the complete satisfaction of EIC.

**2.2 General Conditions of Erection**

**2.2.1** Unless otherwise specified Columns, Vessels, Drums etc. will be generally supplied to the Erection Contractor in single piece and EC will not be required to carry out any assembly or welding. In case column is supplied in multiple pieces and erection of the equipment is not possible in single piece, EC shall be responsible for lifting the pieces, for aligning, welding and hydro test etc. in vertical position under the supervision of column Supplier (Fabricator). However, EIC shall be responsible for coordination between Erection

Contractor & Fabricator. The schedule of quantities (SOQ) for equipment erection enclosed with the tender document outlines details of each equipment such as diameter, overall height, type of support (saddle/skirt/leg/bracket), position (horizontal or vertical) and approximate erection weight etc. However the erection elevation and location of equipment shall be as per the piping layout drawing enclosed with the tender.

**2.2.2** Rigging procedures and erection schemes for all the heavy lifts weighing 10 MT & above shall be prepared by EC and got approved by EIC. Approval by EIC shall not relieve EC of his responsibilities. The details to be submitted will include the location of equipment from where it will be lifted, location of crane(s), details of crane(s) (like configuration, boom length, operating radius, boom point elevation, clearance underside the boom and the equipment, lifting capacity, counter weights to be deployed, holds on any neighbouring foundations, structures, equipment's etc.), the load chart of the crane(s), design of the lifting tackles like spreader beam, D-shackles, wire rope slings etc. Unless the erection scheme and rigging procedures are approved by EIC, erection of such equipment's shall not be undertaken in any case by EC.

**2.2.3** Before starting the erection of Columns, Vessels etc., top surface of the foundations is to be cleared/chipped, roughened to obtain proper bond, while grouting. Also the sleeves are to be cleaned before erecting the equipment's. Line (orientation) and levels are to be marked on all the foundations to facilitate checking of alignment.

EC shall also check the correct elevation and orientation of civil, structural foundations, before proceeding with the erection work. Discrepancy, if any, shall be brought to the notice of EIC. However, minor rectifications and chipping of foundations up to a thickness of 15 mm in foundation height shall be carried out at no extra cost, by the EC. EC shall be responsible for supply of levelling plates, (if required) and shall carry out levelling of equipment under the directions of EIC.

**2.2.4** While handling, transporting or erecting the equipment's, care shall be taken not to damage the nozzles, instrument connections, structural clips etc. EC shall also take care of the orientation of the nozzles and other connections of the equipment's while erecting the same and ensure compliance with the drawings and specifications supplied. Discrepancy, if any, in the number/orientation of the nozzles, cleats etc. should be brought to the notice of the EIC before actual erection is started.

**2.2.5** Verticality of the Columns, Reactors/Vessels shall be checked with theodolites. After erection the equipment shall be levelled and properly aligned with necessary shims and wedges supplied by EC, at his cost. After the level, alignment and verticality etc. are checked and approved by EIC, EC shall carry out grouting and finishing Cement for grouting shall be supplied by Owner at issue rates.

**2.2.6** EC shall produce recent test certificates of the slings which they will be using for erection work. However, retesting of the slings shall be done at site by EC at his cost, as and when required by EIC. The weights of test loads shall be as per IS-807. The test loads shall be supplied by EC at his cost. Tested slings will be punched for test loads and date of testing as directed by EIC.

**2.2.7** EC shall also carry out the assembly, erection, levelling and alignment of all types of weir plates, baffles, distributors, collectors, spray nozzles, demisters, grids and other internal fittings etc. Work shall be carried out as per manufacturer's standards/specifications which shall be made available to EC at the time of erection. Raschig rings, molecular sieves, intalax saddles packing and other types of tower packings such as sand, catalyst etc. and S.S. wire mesh shall be loaded into sections of Vessels, Columns as per specifications and drawings. Details for internals to be

installed by EC shall be as per separate schedule of quantities enclosed with the tender document. All packing's except clay and lime stone shall be washed with water before filling. Bottom layers, if required, shall be arranged as directed and random filling shall be done afterwards with equipment filled with water. Installation of packing's, shall be done only after flushing and cleaning of Columns/Vessels and completed to the satisfaction of EIC

**2.2.8** EC shall carry out minor welding for attachment of prefabricated pipe davit parts such as rain covers, handles etc. with pipe davit, during or after erection of the same as per the manufacturer's specifications, at no extra cost to the Owner.

**2.2.9** EC shall execute erection of wooden pillow for saddle support for cold horizontal vessels wherever necessary as indicated on the drawings/EI, STD 7-12-0003 and as per the instructions of EIC.

**2.2.10** EIC shall execute assembly & erection of agitator/mixer along with drive unit including all accessories as per supplier's instructions, specification drawings & instructions of EIC.

### **2.3 Flushing & Cleaning of Columns, Vessels, Drums etc.**

**2.3.1** After the erection, alignment and grouting of these equipments are complete, flushing and cleaning shall be carried out by EC as per specifications and instructions of EIC.

**2.3.2** After flushing, cleaning and draining, equipment's shall be dried by compressed air at the pressure and for duration decided by the EIC. The Vessel interior shall be thoroughly inspected to the complete satisfaction of EIC before it is finally boxed up. Boxing up of manholes and hand holes shall be leak proof. All joints which need remaking shall be remade. Compressed air for drying shall be arranged by EC.

### **2.4 Inspection and Acceptance Limits for Level and Alignment.**

**2.4.1** Co-ordinates of foundations/supporting structures/mounting holes etc. shall be checked with respect to the plot plans by EC.

**2.4.2** Before equipment's are placed on foundations, orientations shall be checked with respect to piping drawings.

**2.4.3** When equipment's are firmly bolted down but prior to grouting, verticality of all the Columns, vertical vessels etc. Shall be checked by using theodolite. Tolerances for equipment after erection shall be as per Standard. The allowable deviation from plumb line shall be 1 mm per metre height, subject to maximum of 15 mm unless otherwise stated on the drawings.

**2.4.4** Horizontal Vessels shall be checked for level across machined face of nozzle flanges with precision level.

### **2.5 Additional requirements for Underground buried vessels**

**2.5.1** Underground vessels for operating temp up to 60°C:  
The vessels shall be supplied at site with one coat of inorganic zinc silicate primer duly applied on its external surfaces as per Painting Spec. All other works such as application of coal tar enamel, as per Painting Spec. & wrapping and coating as per Painting Spec. shall be carried out by EC. This shall include necessary materials, tools and tackles to complete the Job in all respect as per the instructions of EIC.

**2.5.2** Underground Vessels for operating temp. Above 60°C and up to 300°C:

The vessels shall be supplied at site with one coat of inorganic zinc silicate primer as per Painting Spec. SS-PI-008, duly applied on its external surfaces. EC shall be required to carry out touch-up and repair of outside primer before erection of equipment.

- 2.5.3** EC shall do the necessary excavation, backfilling and removal of surplus earth at the site as per the directions of the EIC. EC's rate shall include the excavation, blast cleaning, painting, wrapping by craft paper, placing and fixing of Vessels, backfilling and removal of excess earth.

### **3.0 ERECTION OF MECHANICAL EQUIPMENT**

#### **3.1 Scope of Work of Erection Contractor**

The scope of EC shall consist of withdrawal and transportation of equipment's and accessories from Owner's stores to site, assembly of loose supplied components/parts erection of equipment on foundations, levelling, aligning and grouting, preparation of equipment's for trial runs and hand over in fit condition for the start-up of the plant as per instructions of EIC.

#### **3.2 Details of Owner Supplied Equipment's**

Equipment's to be erected shall be supplied by the owner. Equipment's may be supplied in any of the following conditions.

- Single equipment such as filter, static mixer, silencer etc.
- Skid mounted equipment, fully assembled.
- Skid mounted equipment with some items supplied loose or as subassemblies involving interconnections also.
- System comprising of many equipment's, skids with interconnected piping & hook up.

#### **3.3 Technical Requirements**

- 3.3.1** All equipment/machinery erection shall be done by experienced fitters. For this purpose EC shall employ an experienced erection supervisor and crew who have done similar jobs.
- 3.3.2** EC shall study the layout drawings, for the machineries and equipment's with their auxiliaries, controls defining scope of supply.
- 3.3.3** Equipment's shall be checked for any damages as a result of transport, handling and defects, if any, shall be reported to the EIC. Rectification of defects shall be carried out in accordance with approved procedure.
- 3.3.4** Correct procedures for handling of equipment & installation on the foundation shall be followed as given in the manufacturer's manual. In case of non-availability of such procedures, EC shall develop & submit handling procedures for all equipment weighing more than 10 metric tonnes. The handling procedure shall be approved by the EIC.
- 3.3.5** EC shall check the correctness of equipment foundations or supporting structures as per the drawings. Equipment/Skid foot print dimensions shall be verified to match with the foundation. Minor chipping of foundation, pockets if required shall be carried out by EC.
- 3.3.6** All accessories like pressure gauges, seal oil, cooling water & Lube oil headers etc., shall be tagged and separately kept in Contractor's stores till erection. All flanged connections and openings shall be kept blanked with dummies, plugs to prevent entry of foreign particles.
- 3.3.7** Equipment's shall be installed on the foundations in proper sequence. In case the



equipment's are delivered in subassemblies, EC shall do the assembly work as per manufacturer's instructions.

- 3.3.8** Equipment's shall be installed in the correct orientation and alignment.
- 3.3.9** After installation and levelling the equipment shall be grouted with the specified grouting applied to the baseplate and support.
- 3.3.10** EC shall remove all the packing and protective devices used during transport and handling from the equipment such as shock absorbent materials from machined faces, blocking of shafts or rolling bearings & restraining devices from instruments, safety devices and protective equipment's.
- 3.3.11** after the grouting is set & cured, the foundation bolts shall be checked to make sure that they are in straight and vertical position and properly tightened. Shims, if used, shall be on either side of the foundation bolts.
- 3.3.12** Desiccant, catalyst where supplied loose shall be loaded on to the respective vessels in specified quantities as per the suppliers instructions.
- 3.3.13** Internals, where supplied loose shall be assembled as per the drawings and manufacturer's instructions.
- 3.3.14** Unless otherwise specified, all the instruments such as pressure gauges, sight glasses temperature recorders etc. including instrument panels, if any, supplied along with the equipment with necessary connections, shall be installed by EC as part of Equipment erection.
- 3.3.15** Equipments shall be checked for final cleanliness before boxing up.
- 3.3.16** any interconnected piping & ducting shall be properly installed and supported. EC shall connect the gas, steam, air, utility piping, instruments, oil piping etc. as per manufacturer's drawings, specifications and instructions of the EIC.
- 3.3.17** Safety devices shall be correctly installed.
- 3.3.18** Ladders, platforms, walkways shall be correctly installed with handrails, and flooring shall be properly secured.
- 3.3.19** Field welding, where specified shall be in accordance with the specified procedures and NDT tests where specified shall be carried out. Results of NDT tests shall be recorded.
- 3.3.20** Equipment alignment & couplings shall comply with tolerances specified in manufacturer's drawings and manuals. Provisions of dowel pins or similar arrangements for retaining the alignment shall be carried out.
- 3.3.21** After the piping has been connected, the alignment shall be checked by EC again, to ensure that piping connections do not induce any undue stresses on the Equipment's. After making necessary corrections on the piping, if any, realignment shall be done by EC to ensure that no undue stresses are induced on the equipment.
- 3.3.22** Painting, insulation & fireproofing where specified shall be carried out in accordance with the applicable specifications attached in the tender document.
- 3.3.23** Any alterations, deviations made during equipment erection with respect to manufacturer's drawings or instructions shall be duly recorded and approval shall be taken



from the EIC.

**3.3.24** Any special tools, tackles supplied along with the equipment and used during installation shall be returned to the stores through the EIC.

**3.3.25** Any protection of the equipment after installation, if required shall be carried out in accordance of the instructions of the EIC.

### **3.4 Trial Runs**

**3.4.1** Wherever specified, Machinery & Equipment erected & installed by EC under the supervision of Machinery/Equipment supplier shall be subjected to trial runs in accordance with clause 5.4 of this specification. Job specific trial run procedure, if specified, supersedes the trial run procedure as described in clause 5.4.

### **3.5 System Start-up**

During this phase of work, EC shall provide as part of his work necessary skilled personnel as per requirement of EIC. Any defects noticed in the Equipment shall be made good by EC at his cost if such defects are attributable to him.

## **4.0 ERECTION OF ROTATING EQUIPMENT**

### **4.1 Scope of Work of Erection Contractor**

The scope of work shall consist of transportation of Rotating Equipment's and accessories from Owner's stores to site, assembly of sub-assemblies/ parts, erection of Rotating Equipment's on foundations, levelling, aligning and grouting, preparation of Rotating Equipment's for trial runs, carrying out no load/trial runs, return of any unused material to the owners stores and hand over in fit condition for the start- up of the Plant, as per instructions of EIC.

Defects due to EC's fault noticed during trial runs shall be rectified by him. Schedule of Quantities, indicate estimated numbers, dimensions and weights of the Rotating Equipment's. The actual data on dimensions and weights will be in the vendor data manuals.

The term 'Rotating Equipment' includes all pumps, compressors, steam & gas turbines, fans and blowers, diesel engine/steam turbine/gas turbine generator sets along with drivers accessories & auxiliary systems.

### **4.2 General Conditions of Erection**

**4.2.1** All Rotating Equipment erection shall be done by experienced fitters. For this purpose EC shall employ experienced and suitably qualified erection supervisor and crew who have done similar jobs.

**4.2.2** The Rotating Equipment manufacturer's instructions as available regarding installation and trial runs will be passed on to EC during the course of work. The requirements prescribed. Therein shall be met in addition to what is stated in this specification. Erection shall be carried out as per instructions of the Rotating Equipment manufacturer's representative and under their supervision whenever the manufacturer is present at site. In all other cases instructions of the EIC, regarding procedure/sequence of erection shall be binding on EC.

**4.2.3** For all Rotating Equipment, EC shall follow the proper sequence for assembly and erection.

For Rotating Equipment received along with driver in coupled condition, the coupling bolts shall be dismantled by EC, and alignment shall be rechecked. Realignment, if required, shall be done before recoupling.

Where drivers and couplings are provided separately, drilling and tapping of holes in the base plates for fixing drivers, fixing of couplings on shafts, after enlarging the pilot bores to the correct size with key way etc. and dowelling including provision of dowel pins, alignment screws, jack-up screws or similar arrangements for retaining the alignment shall be carried out by EC as part of erection work. Shims & wedges as required for alignment shall be supplied by EC.

- 4.2.4** Process and utility (such as cooling water, steam flushing, quenching, lubricating oil, sealing etc.) Connections connected with rotating equipment and its auxiliaries shall be fabricated and/or installed by EC from materials supplied by the Owner as per drawings, specifications and instructions of the EIC.
- 4.2.5** Piping and accessories supplied with the rotating equipment such as seal oil/Gas system, cooling water system & Lube oil system etc. shall be tagged separately and kept in EC's stores till erection. All flanged connections and openings shall be kept blanked with dummies/plugs to prevent entry of foreign matter.
- 4.2.6** The local mounted instruments such as pressure gauges, sight glasses, temperature gauges etc. and Local instrument panels, if any, with necessary connections, shall be installed by EC as part of rotating equipment erection.
- 4.2.7** After initial alignment, the Rotating Equipment's shall be properly grouted. Grouting shall be carried out as per this specification. Wherever grout holes are provided in the base plates, grout shall be filled through the also. Epoxy grout where recommended by the rotating equipment manufacturer, shall be provided by EC and shall be as specified in this standard.
- 4.2.8** Alignment between the Driver and driven equipment shall be done without connecting the equipment nozzles to respective piping. After completion of alignment, the equipment shall be connected to Piping. After the piping has been connected, the alignment shall be re-checked by EC, to ensure that piping connections do not induce any undue stresses on the Rotating Equipment's. After making necessary corrections on the piping, if any, re-alignment shall be done by EC and he will ensure that no undue stresses are induced on the Rotating Equipment.

### **4.3 Special Instructions**

EC in addition to general instructions for erection as outlined in Para 4.2 above, shall also follow the following special instructions

- 4.3.1** Depending upon the size of equipment, Pump train will be supplied for erection in any of the following modes:
  - (a) Pumps with drivers and accessories fully assembled on a common skid (Base plate).
  - (b) Pumps mounted on base plate and couplings and driver supplied loose in separate packs.
  - (c) Various major components such as pump, drivers, couplings, gear boxes & base plates auxiliary systems like lube, seal flush equipment in separate packs.

### **4.3.2 Reciprocating type Compressors**

- 4.3.2.1** Reciprocating compressors may be supplied for erection in knocked down condition in multiple packaged subassemblies such as frame assembly, distance pieces, fly wheels,



cylinder block assemblies, valve assemblies etc. and other accessories such as, drivers, couplings, gear boxes (if any), control panels, gauge boards, coolers, lube oil systems, cooling water systems, etc. would be in separate packages.

Besides the above there would be other packages for loose supplied items such as instruments, pre-fabricated piping, and piping/tubing in commercial lengths.

Lifting devices for erection shall be arranged by EC depending on the weight of packages and elevation of installation.

**4.3.2.2** In case of Rotating equipment's received in knocked down condition, the various parts shall be assembled as per instructions of the EIC and as per manufacturer's instructions. All parts of the Compressor shall be thoroughly cleaned with solvents to remove protective compounds if any, before assembly.

**4.3.2.3** The compressor, driver and other accessories shall be erected on their respective foundations and the compressor, couplings, gear box and driver shall be aligned and grouted as per the manufacturer's instructions and instructions of EIC and the manufacturers supervisor (when present). There-after all process and utility, drain & vent connections shall be completed as per the relevant drawings/instructions of EIC.

**4.3.2.4** Final alignment shall be done after all the piping connections such as water, steam, drains and connection to coolers etc. are made. Tolerances for alignment shall be maintained as specified in the Manufacturer's Instruction Manual. To ensure that piping connections do not induce any undue stresses on the Rotating Equipment, the alignment shall be checked once again by EC after the piping has been connected. Any correction necessary for proper alignment shall be done by EC.

**4.3.2.5** EC shall carefully study the vendor drawings, manuals and other data before start of the job to ensure correct erection, alignment and commissioning.

### **4.3.3 Centrifugal Compressors & Expanders**

**4.3.3.1** Centrifugal Compressors are supplied for erection in multiple packages such as,

- Compressor casings
- Drivers (Electrical motors, Steam/Gas turbines -.)
- {Steam/Gas turbines would be further supplied in multiple packages}
- Base plates (or skids)
- Lube oil/control oil systems
- Sealing systems
- Air filters (for gas turbines & compressors for air service)
- Temporary strainers
- Couplings
- Gear boxes
- Coolers
- Gauge boards
- Control panels
- Lube & Seal Oil tanks
- Fire systems (for gas turbines)
- Condenser (for steam turbines)
- Condensate systems (for steam turbines)
- Loose supply items
- Pre-fabricated & Commercial lengths piping, tubing.
- Other miscellaneous packages

**4.3.3.2** Other requirements shall be same as defined in para's 4.3.2.2 to 4.3.2.5 above.

#### **4.4 Trial Runs of Machinery**

**4.4.1** Any construction defects shall be intimated to EIC before start-up. All protective and safety guards shall be installed and rotating equipment shall be checked for free movement by manual barring over. All foundation bolts and alignment shall be checked before starting the trial runs, if damaged, rotating equipment may have to be opened and repaired as directed by EIC. Prior to carrying out the trial runs, the rotating equipment will be subjected to necessary checks by the EIC and the trial runs shall be commenced only after the approval of the EIC.

**4.4.2** Unless otherwise specified, all the rotating equipment will be subjected to trial runs for a continuous operation of 72 hours. In case of motor driven rotating equipment's, motors shall be decoupled and turned over to other agencies doing electrical work for testing and no load running of motors. After the no load runs of motors are satisfactorily completed, EC shall recouple the motors to the rotating equipment and recheck the alignment. The trial run of the rotating equipment shall be started only after the above is completed. EC shall provide, as part of his work, necessary skilled personnel (excluding the operating personnel) for conducting the trial runs round the clock during the trial runs period. The duration of trial run may be extended if it is considered necessary in the opinion of EIC and EC shall provide personnel for such extended period also. Final inspection of bearing etc. shall be carried out by EC after the Machinery had gone through the trial run and defects, if any, shall be made good for rendering the rotating equipment ready for start-up.

**4.4.3** During the trial runs, readings of bearing temperature, cooling water inlet and outlet temperatures, lube oil inlet/outlet temperature and pressure, rotating equipment discharge pressure and temperature, starting in current, no load/full load current etc. shall be recorded, wherever necessary, by EC. Trial reports shall be prepared in the approved proforma by EC containing all the above details and submitted to the EIC as part of completion documents.

**4.4.4** EC shall also provide necessary improvised fencing and watch & ward personnel as safety measures during trial runs.

#### **4.5 System Start up**

During start-up, EC shall provide necessary skilled personnel as per requirement of EIC, to rectify defects noticed in the rotating equipment, if such defects are attributed to him

### **5.0 EQUIPMENT GROUTING**

All anchor bolt sleeves/pockets and space under Base plates/machine base frames/shoe plates, etc. Shall be grouted with either free flow non shrink cementations or epoxy grout as per the following categorisation:

| Sr. No. | Type of Grout                 | Application                                                                                                                                                                                                                                                     |
|---------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Non shrink cementations grout | All static and rotating equipment's, Unless covered in 2) below, viz Static equipment's like tall columns, vertical silo, blender etc. and horizontal vessel, drum, sphere, bullets, filter, heat exchangers, coolers etc. and other similar equipment's, steel |

stack/chimney, furnace etc.

Low frequency, medium frequency, high frequency rotating machines like compressors (centrifugal, reciprocating, diaphragm, screw, gear type etc.). Induced draft fan, forced draft fan, air blowers, pumps (centrifugal, reciprocating, diaphragm, gear type etc.), expanders, turbine, generator, diesel generator, air coolers (fin fan cooler) and other similar equipment.

Machine like screen vibrator, extractor, centrifuge pulveriser, dryer, drop hammer, ball mill, crushers, bagging machine and general workshop equipment.

2 Epoxy grout

specifically if requested by the Machine Vendor.

## 5.1 Grout (Material)

All material used for grout shall be approved by EIC. EC shall submit details for prior approval of EIC. Only approved grout material shall be used.

### 5.1.1 Non-Shrink Grout

Non-shrink grout shall be premix type of cementitious (cement pre-graded fibre and additive) non-shrink, ready to use grout in dry powder form. It shall have free flow property when mixed with required quantity of water. It shall have initial setting time of 30 minutes.

It shall have the following features:

- Non corrosive to anchor bolts, base plate/saddle/frame, sliding plate.
- Not harmful to concrete and reinforcing steel.
- Non toxic
- Frost, oil and fire resistant
- Require normal curing
- Suitable to use under restraints and grout thickness required
- Expansive to counteract initial shrinkage
- Ensure high early strength without surface crack.
- Suitable for temperature of above 0 deg. C to 200 deg. C.
- Maximum flow distance is compatible to the dimensions of base plate/ saddle/frame.
- It should be resisted to the chemicals, gases etc. being handled in equipment/machinery.

It should have the following physical properties:

|                              |            |   |                       |
|------------------------------|------------|---|-----------------------|
| Minimum Compressive Strength | at 3 Days  | : | 25 kN/mm <sup>2</sup> |
|                              | at 7 Days  | : | 30 kN/mm <sup>2</sup> |
|                              | at 28 Days | : | 40 kN/mm <sup>2</sup> |

|                          |            |   |                       |
|--------------------------|------------|---|-----------------------|
| Minimum Tensile Strength | at 28 Days | : | 20 kN/mm <sup>2</sup> |
|--------------------------|------------|---|-----------------------|

|                                          |           |   |                        |
|------------------------------------------|-----------|---|------------------------|
| Minimum Bond Strength                    | at 7 Days | : | 12 kN/mm <sup>2</sup>  |
| Maximum on strained expansion in 2 Hours | :         |   | 4%                     |
| Minimum Density                          | :         |   | 2000 kg/m <sup>3</sup> |

### 5.1.2 Epoxy Grout

Epoxy grout shall consist of epoxy resin base, hardener and filler component like graded and blended aggregate. Components of epoxy grout shall be of desired grade and mixed in proportion recommended by manufacturer such that it is injectable under base plate/frame/saddle etc., has low viscosity to meet the flow distances according to dimensions of base plate saddle/frame, it is suitable for the desired thickness, it is homogenous, free from segregation, attains high early and high fall strength. It shall have minimum Pot life of 30 minutes. It shall have all the features as specified in clause 6.1.1 except for expansive properties.

It should have the following physical properties :

|                              |           |   |                       |
|------------------------------|-----------|---|-----------------------|
| Minimum Compressive Strength | at 1 Day  | : | 75 kN/mm <sup>2</sup> |
|                              | at 7 Days | : | 85 kN/mm <sup>2</sup> |
| Minimum Flexural Strength    | at 7 Days | : | 25 kN/mm <sup>2</sup> |

## 5.2 Grouting (Placement)

### 5.2.1 Surface Preparation

Prior to positioning of equipment/machine etc. Over concrete pedestal, foundation, slab, beam, etc. All laitance & loose material shall be removed by wire brushing & chipping. The bearing concrete surface shall be sufficiently levelled, hacked with flat chisels to make it rough, clean (using compressed air). Additional chipping, if required, to suit level of base plate and/or minimum thickness of grout shall also be done. In case of use of cementations grout surface shall be thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned. Any excess water shall be removed. In case of use of epoxy grout, it shall be ensured that surface/pocket to receive grout is totally dry. After erection, alignment/plumbing of equipment/machine in required level, orientation and plumb and installation of sliding plate. Forms shall be constructed around and joints made tight to prevent leakage of the grout.

### 5.2.2 Preparation of Grout

**5.2.2.1** In case of premix type of grout water shall be added in required quantity as specified by supplier and/or EIC. Any specific instruction of manufacturer will be strictly followed.

**5.2.2.2** In case of epoxy grout required quantity of all constituents shall be mixed in proportion recommended by manufacturer/supplier and/or EIC. All specific requirements of manufacturer supplier shall be strictly followed.

**5.2.2.3** Required quantity of grout shall be made considering initial setting/pot life of grout. Any grout not used within initial setting time/pot life shall be rejected and in no case used for grouting.

### 5.2.3 Placement of Grout

**5.2.3.1** Placing of grout shall be taken up only after level, orientation, alignment of equipment/machine has been approved by EIC and anchor bolts are placed in pocket.

**5.2.3.2** In case of epoxy grout EC shall give details of grouting scheme and get approval of EIC.

**5.2.3.3** The grout mixture shall be poured/injected continuously (without interruption till completion) by grouting pump/injecting gun from one side of base plat and spread uniformly with flexible steel strip and rammed with rods till the space is filled solidly and grout mixture carried to the other side of base plate and fill all pockets. Any specific requirement of manufacturer supplier shall be strictly followed. Epoxy grout shall be done by or under supervision of manufacturer/supplier and/or agency having adequate experience in this field as per direction of EIC.

Total work shall be done under supervision and direction of EIC and care shall be taken that alignment of equipment/machine is not disturbed

**5.2.3.4** Grout mixture shall be allowed to harden for a period of minimum 7 days or as required by manufacturer/supplier of grout and/or as decided by EIC. At the end of this period, the shims/edges/pack plate may be removed and anchor bolts tightened uniformly. Alignment of equipment/machine shall be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plate (if removed) must be filled up with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting is done after making appropriate correction of alignment.

**5.2.3.5** Minimum thickness of grout shall be 25mm for all types of grout and maximum thickness shall be 40mm for non-shrink grout. For epoxy grout the maximum thickness shall be as per manufacturer's recommendation and/or as specified in drawing.



## VCS QUALITY SERVICES PVT. LTD.

### DESIGN GUIDE FOR RADIOGRAPHY REQUIREMENTS

**VCS-SS-PP-2506**

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
| 00              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01              | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

---

### **Abbreviations:**

|      |   |                                          |
|------|---|------------------------------------------|
| API  | : | American Petroleum Institute             |
| ASME | : | American Society of Mechanical Engineers |
| AWS  | : | American Welding Society                 |
| BS   | : | British Standards                        |
| IQI  | : | Image Quality Indicator                  |





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|     | Radiography of welds in pipes of wall thickness below 10 mm (When X-rays are not used) |   |

## 1.0 GENERAL

Gamma-ray techniques in general are less sensitive compared to X-ray techniques for penetrated thicknesses of less than 50 mm. For the thinner material, the larger is the difference in sensitivity between radiographs taken with X-ray and Gamma-rays. The "flaw sensitivity" with use of Gamma-rays will be inferior to that of good X-ray techniques. The guidelines have been prepared to specify and implement the radiography requirements at design stage and later on, at fabrication & inspection stages.

## 2.0 SCOPE

This guide describes the radiography requirements covering the following:

- Design Requirements

- Type of Radiography film

- Material of construction for Image Quality Indicator (IQI)

- Placement of (IQI)

## 3.0 RADIOGRAPHY REQUIREMENTS

### 3.1 Design Requirements

The quality of radiographs for the job shall be as per the requirements of the design code and shall be judged by placement of the type of IQI as identified by the same code. The radiographs shall be taken with the help of X-rays source. The use of Gamma-rays (Ir-192) can be considered, wherever it is possible to get the required "Radiography Sensitivity" as per the requirements by the technique adopted for the purpose.

In order to permit the use of Gamma-rays for radiography in place of X-rays, it is necessary that the radiography procedure gives details of the following:

- Type of film

- Diameter/Thickness of the material

- Type of intensifying screens

- Source to Film Distance (SFD) and others (such as film density), which are desired in establishing the required sensitivity level as per the design code

- Type of source and source size

Radiography sensitivity is primarily influenced by factors such as:

- Film selection

- Intensifying screen selection

- Geometric Sharpness

- Film density

For critical services for effective thickness of 10 mm and below, radiography shall be carried out

with X-rays only. When X-ray is not feasible, Gamma radiography can be considered (ANNEXURE-I). The effective wall thickness shall be the actual pipe wall thickness for single wall exposure and twice the thickness for double wall exposure.

### 3.2 Type of Radiography Films

3.2.1 The type of description given regarding quality of films in different codes may not align with the description given by various film manufacturers. Therefore, for the purpose of this guide, the following is the examples of some of the film relating to various descriptions:

|                                   | Carestream<br>(Kodak) | GE<br>(Agfa Gevaert) |
|-----------------------------------|-----------------------|----------------------|
| Ultra-fine-grain<br>High contrast | Industrex DR50        | D2                   |
|                                   | Industrex MX125       | D4                   |
| Fine grain                        | Industrex AA400       | D7                   |
| High contrast                     | Industrex T200        | -                    |

3.2.2 Fuji films are also available in the Indian Market. Their equivalent can be worked out based on their literature and actual experiments.

3.2.3 When Gamma radiography is employed only ultra-fine grained high contrast film shall be used.

### 3.3 Material of Construction of IQI

In the case of low alloyed ferrous materials, IQI of low carbon steel is normally adequate. For highly alloyed ferrous materials which are usually referred to as steels, an IQI made of that particular special steel, for example stainless steel, may be used where there is extensive application of a particular alloy.

For aluminium or magnesium alloys, where there is insufficient application to justify the production of IQI from the same alloy the IQI of pure aluminium or pure magnesium respectively should be used.

For copper and its alloys, IQI of copper should be used.

Whenever it is considered impractical to get IQI of required material, the equivalent shall be established at site based on actual experiments.

In addition to the above, reference also shall be made to ASME Sec.V for selection of IQI material and its identification.

### 3.4 Placement of IQI

3.4.1 In order to judge the quality of radiography, the IQI should be placed covering the area under examination as indicated in the enclosed Fig.1 (a) and 1(b) along with other details:

Area marker

Date of radiograph

Thickness

Joint number

Welder number

Job number

And additionally, if desired, contractor mark may also be placed.

The IQI shall be so placed, that the smallest hole (wire of the lowest diameter) is towards the outer end of the film away from the centre.

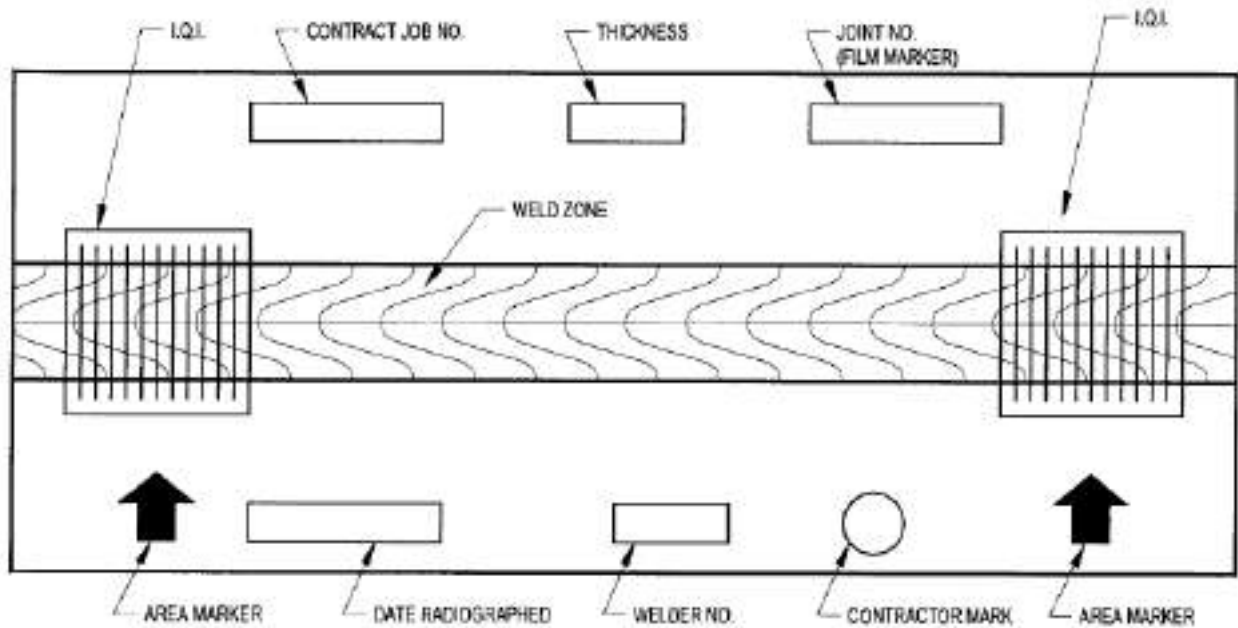


**FIG.1 (a):** FILM IDENTIFICATION AND PLACEMENT OF PENETRIMETERS

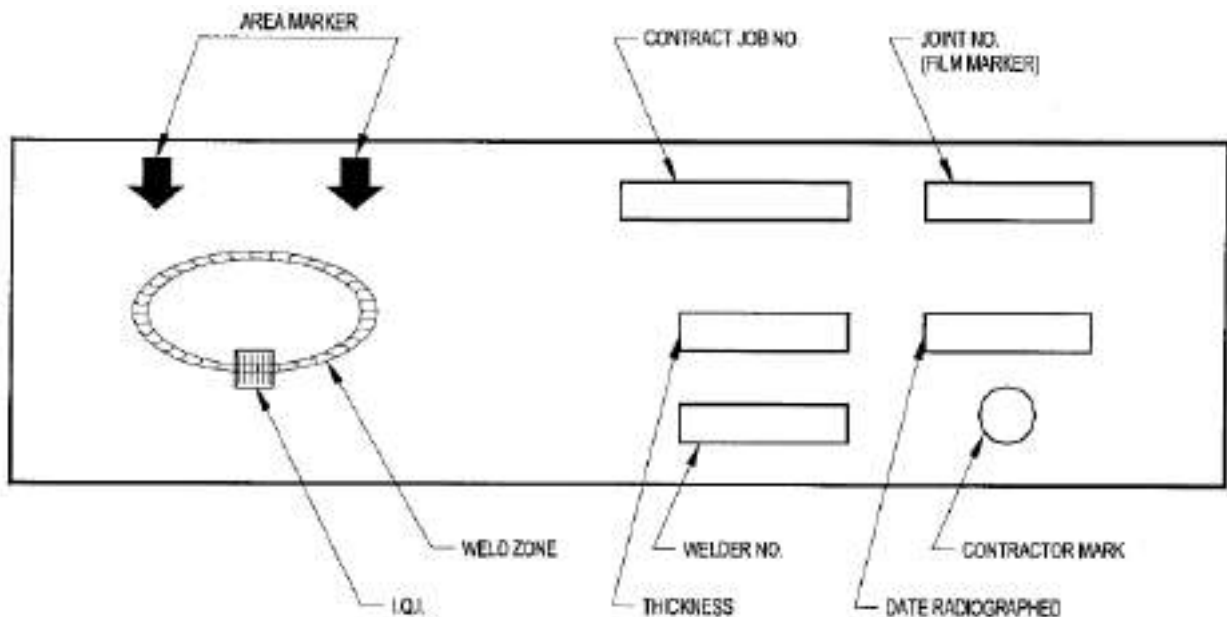


**FIG.1 (b):** FILM IDENTIFICATION AND PLACEMENT OF PENETRIMETERS  
(DOUBLE WALL DOUBLE IMAGE)

## ANNEXURE-1

### **Radiography of welds in pipes of wall thickness below 10 mm (When X-rays are not used)**

For radiography of welds in pipes of wall thicknesses below 10 mm and upto 5 mm, the guidance for this work is given below in relation to the double wall single image method.

The requirements should be followed so far as possible with the following:

- A. Only Se-75 should be used.
- B. Only ultra-fine-grain or fine-grain films may be used, preferably the former one.
- C. The source should be placed on the side of the pipe remote from the film, so that the source to film distance is approximately the same as the pipe outside diameter. The source should normally be in the plane of the weld centre line and in contact with or close to the weld. By agreement between the contracting parties, the source may be placed in some other position, after due consideration has been taken of the effects of this on the image formation.
- D. The film should be curved around the pipe so as to ensure good contact with the weld.

The details of radiography procedure so established shall be recorded by the radiography agency and duly approved by Engineer-in-Charge.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING

**VCS-SS-PP-2507**

|                                         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|-----------------------------------------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                                         |            |  |  |  |  |
| 01                                      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00                                      | 13.05.2017 | CM                                                                                  | SM                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No                                 | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |
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| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
| 00              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01              | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

**Abbreviations:**

|        |   |                                             |
|--------|---|---------------------------------------------|
| AS     | : | Alloy Steel                                 |
| ASME   | : | American Society of Mechanical Engineers    |
| CI     | : | Cast Iron                                   |
| CS     | : | Carbon Steel                                |
| HMTD   | : | Heat & Mass Transfer Division               |
| IBR    | : | Indian Boiler Regulations                   |
| LTCS   | : | Low Temperature Carbon Steel                |
| NACE   | : | National Association of Corrosion Engineers |
| NB     | : | Nominal Bore                                |
| NDT    | : | Non Destructive Testing                     |
| P & ID | : | Piping and Instrumentation Diagram          |
| PMI    | : | Positive Material Identification            |
| SS     | : | Stainless Steel                             |
| SMMS   | : | Specialist Material & Maintenance Services  |





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## 1.0 SCOPE

This specification covers general requirements of fabrication and erection of above ground and trench piping systems at site. The specification covers the scope of work of Contractor, basis of work to be carried out by Contractor and standards, specifications and normal practice to be followed during fabrication and erection by the Contractor.

## 2.0 SCOPE OF WORK OF CONTRACTOR

Generally the scope of work of Contractor shall include the following:

2.1 Transportation of required piping materials (as described in C1.2.1.1), pipe support (material as described in C1. 2.3) and all other necessary piping materials from Owner's storage point or Contractor's storage point (in case of Contractor's scope of supply) to work site/shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.

2.1.1 Piping materials include the following but not limited to the same.

- a. Pipes (All sizes and schedule)
- b. Flanges (All sizes, types & Pressure ratings).
- c. Fittings (All sizes, types and schedule)
- d. Valves (All sizes, types and Ratings)
- e. Gaskets (All sizes, types & Ratings)
- f. Bolts, Nuts or M/C Bolts (All types)
- g. Expansion Joint/Bellows (All types)
- h. Specialty items like online filters, ejectors, sample coolers, steam traps, strainers, air traps, springs, silencers, snubbers, steam and condensate manifolds, injection nozzles, MOVs, sight glass, spray nozzles, integrated steam traps, hoses, hose couplings, etc.
- i. Online instruments like control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PT/ Flow transmitter, ejectors, static mixers, flame arrestors, thermal flow switches, pre-fabricated hook-ups etc.
- j. Shutdown Valves with and without fire box.

2.2 Shop & field fabrication and erection of piping in accordance with documents listed under C1.3.0 i.e. 'BASIS OF WORK' including erection of all piping materials enumerated above.

2.3 Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, tum-buckles, supporting fixtures, bracket cantilevers, struts, tee-posts including erection of spring supports, sway braces, dummy pipes, corrosion pads/protection shields, low friction pads, clamps, special support, expansion bellows, steam and condensate manifolds supports etc. Corrosion Pads/Protection shields, stiffeners and stiffening rings, if not covered in the specifications/standards, shall be of the same material as of parent pipes.

## 2.4 Site fabrication of Piping items

Site fabrication of Piping items shall include but not be limited to the following



- 2.4.1 Fabrication of piping specials like special radius bends, reducers, mitres etc.
- 2.4.2 Fabrication of plain and threaded nipples from pipes as required during erection.
- 2.4.3 Fabrication of swage nipples as and when required.
- 2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90°/45° elbows as and when required.
- 2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.
- 2.4.6 Fabrication of stub-in connection with or without reinforcement.
- 2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven/different thickness wherever required.
- 2.4.8 Fabrication of circular pipe for steam rings, fire water lines, utility lines.
- 2.4.9 Threading of all small bore piping as per piping material specifications.
- 2.4.10 Drilling on blind flange for inserting / joining small bore lines.
- 2.4.11 Fabrication and welding of reinforcement pads at branch pipe locations wherever required.
- 2.4.12 Equipment nozzle reinforcement with pads, jacket & stiffeners wherever required.
- 2.4.13 Fabrication of injection nozzles as per details provided wherever required.
- 2.4.14 Fabrication of chain operation arrangement for valves, wherever required. All material required for this modification shall be supplied by Contractor.
- 2.4.15 Fabrication and erection in position of funnels required for OWS/ SS/ Condensate blow down system as per direction of Engineer-in-charge.
- 2.4.16 Grinding & finishing of uneven surfaces/ joints after welding. Internal grinding of welds of orifice flanges to render smooth surface.
- 2.4.17 Tapping and drilling of holes in flanges, blind flanges, piping connections for jack screw, if required.
- 2.4.18 Providing bird screens at the outlet of lines open to atmosphere.
- 2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 2.6 Piping isometrics for main process/utility lines shall be provided to the Contractor.  
  
Preparation of miscellaneous small bore isometrics with bill of materials for process and utility lines (up to 1½" size) like instruments & pump flushing / cooling, sample connection, purging, pump casing vents & drains, pump base plate drains, control valve drains / vent to flare, instrument drains & vents, steam tracing (non-IBR) from steam supply stations up to condensate recovery station, and lines specified as field routed within the Unit battery limit as and when required are in Contractor's scope of work. Approval for these isometrics prepared by the Contractor shall be taken from Engineer-in-charge before erection.  
  
Small bore piping isometrics given by Owner shall be rechecked by Contractor before erection and installation.
- 2.7 Obtaining approval for drawings prepared by Contractor from statutory authority, if required.
- 2.8 Spun concrete lining of the inside of pipes 3" NB & above including fittings and flanges as

required in accordance with specification.

- 2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 2.11 Performing PMI using alloy analysers as per Standard Specification for Positive Material Identification at Construction Sites, VCS-SS-PP-2502.
- 2.12 Casting of concrete pedestals and Fabrication and erection of small structures/ platforms for pipe supports and valve operation / attending some instruments, spectacle blinds etc., providing brackets, modification / extension of platforms, providing additional platforms / ladders for improving / providing accessibility.
- 2.13 Providing insert plates with anchor fasteners in concrete structures / paved floors and repair of platform gratings around pipe openings and providing suitable members for support under the platform grating.
- 2.14 Making material reconciliation statement and return of Owner's supply left over materials to Owner's storage.
- 2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems (Specification No. 6-44-0013). The accessories required for blinding the line like flange, blind flange, gasket (all sizes, type and rating), stud-bolts, flexible hoses etc. are to be arranged by the Contractor. During flushing the discharged water / air shall be drained / routed as directed by the Engineer - In Charge.
- 2.16 Contractor shall prepare welding specifications for all weld joints where dissimilar welding will be performed, and obtain approval from VCS.
- 2.17 Contractor to ensure meeting all requirements for carrying out work in shutdown/running plant.
- 2.18 Pickling (as and when applicable) as per Job specification(s) for chemical cleaning of CS suction piping of compressors, SS Piping, Weldment etc., as applicable.
- 2.19 Chemical Cleaning/ Hydro jet cleaning as per marked-up P&IDs with supply of chemicals, consumables, DM water, equipment's, boilers, coupons, tools & tackles and other testing equipment's required for the same.

### **3.0 BASIS FOR WORK**

- 3.1 The complete piping work shall be carried out in accordance with the following:
  - 3.1.1 "Approved for Construction" drawings and sketches issued by VCS to the Contractor - Plans and/or Isometrics.
  - 3.1.2 "Approved for Construction" drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.
  - 3.1.3 Approved Process Licensors standards and specifications.
  - 3.1.4 Drawings, sketches and documents prepared by Contractor duly approved by Engineer-in-Charge (such as isometrics of small bore piping and offsite piping etc.).
  - 3.1.5 VCS specifications / documents as below:

- a. Process and Instrument Diagram.
- b. Job Piping Materials Specification (\*\*\*\*-6-44-0005). \*\*\*\* denotes job number.
- c. Piping support, engineering standards.
- d. Line list
- e. Piping support indices (only in offsite), if supports are not shown in plan.
- f. Job specification of Non-destructive Requirement of Piping (VCS-SS-PP-0036)
- g. Job Welding specification for fabrication of piping (VCS-SS-PP-0040).
- h. Any other VCS or OTHER specifications attached with Piping Material Specification or special condition of contract (such as standard for cement lining of pipe, standard of jacketed piping, standard for steam tracing, Dimensional Tolerances etc.)
- i. Standard specification for positive material identification (PMI) at construction sites, 6-82-0002
- j. Standard Spec for application of torque & hydraulic bolt tension for flange joints (6-76-0002) and its addendum, if any.

#### 3.1.6 Following codes, standards and regulations

- |    |                 |   |                                                                                                                |
|----|-----------------|---|----------------------------------------------------------------------------------------------------------------|
| a. | ASME B 31.3     | : | Process Piping                                                                                                 |
| b. | ASME Sec. VIII  | : | Code for unfired pressure vessel.                                                                              |
| c. | IBR Regulations |   |                                                                                                                |
| d. | ASME Sec. IX    | : | Qualification standard for welding and brazing procedures, welders, brazers and welding and brazing operators. |
| e. | NACE Std.       | : | Code for Sour Services material requirements MR-0175/MR0103/Job spec(NACE), as applicable                      |

**Note:** All codes referred shall be latest edition, at the time of award of contract.

### 3.2 Deviations

Where a deviation from the "Basis of Work" and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of Engineer-in-Charge and the work carried out only after obtaining written approval from him in each case.

## 4.0 FABRICATION

### 4.1 Piping Material

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping Material Specification" for the "Pipe Class" specified for that system. To ensure the above requirement, all piping material supplied by the Owner / Contractor shall have proper identification marks as per relevant standards / VCS specifications / Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated / erected. Material-

traceability is to be maintained for A.S., S.S., NACE, L TCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

For the purpose of common understanding the construction job procedure, to be submitted by the Contractor, shall include proposal for

Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.

Positive material identification, handling, storage & preservation.

## 4.2 Dimensional Tolerances

The Contractor shall be responsible for working to the dimensions shown on the drawings. However, the Contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipment's, inserts, structures etc. To take care of these variations "Field Welds" shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. In any case no extra claims will be entertained from the Contractor on this account. Wherever errors / omissions occur in drawings and Bills of Materials it shall be the Contractor's responsibility to notify the Engineer-in-Charge prior to fabrication or erection.

## 4.3 IBR Piping

- 4.3.1 Contractor shall obtain approval for the piping systems falling under purview of IBR from the statutory Indian Boiler Regulations (IBR) authority of the state where the plant is situated. The Owner shall provide documentation for the IBR System. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper IBR forms.
- 4.3.2 IBR Package for residual, field routed and site modified steam lines shall be prepared by the Contractor. IBR approval for the same shall be in Contractor's scope, at his own cost.

## 4.4 Pipe Joints

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2" and above in process and utility piping shall be accomplished by butt- welds. Joining of lines 1-1/2" and below shall be by socket welding/butt welding/threaded joints as specified in "Piping Material Specifications". However, in piping 1-1/2" and below where socket welding/ threaded joints are specified butt - welds may be used with the approval of Engineer-in-Charge for pipe to pipe joining in long runs of piping. This is only applicable for non-galvanized piping without lining.

Flange joints shall be used at connections to Vessels, Equipment's, Valves and where required for ease of erection and maintenance as indicated in drawings.

#### 4.5 Butt Welded and Socket Welded Piping

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the Job welding specification (VCS-SS-PP-0040) and NDT specification (VCS-SS-PP-0036).

#### 4.6 Screwed Piping

In general, Galvanized piping shall have threads as per IS:554 or ANSI B2.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B2.1, tapered unless specified otherwise.

Threads shall be clean cut, without any burrs or stripping and the ends shall be reamed. Threading of pipes shall be done preferably after bending, forging or heat treating operations. If this is not possible, threads shall be gauge checked and chased after welding heat treatment etc.

During assembly of threaded joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leak-proof joint. Threaded joints to be seal-welded shall be cleaned of all foreign matter, including sealant and made up to full thread engagement before seal welding.

#### 4.7 Flange Connections

All flange facings shall be true and perpendicular to the axis of pipe to which they are attached. Flanged bolt holes shall straddle the normal centrelines unless different orientation is shown in the drawing.

Wherever jack screws are to be provided, drilling and tapping for the jack screws in the flange, shall be done as per VCS Standard before welding it to the pipe.

#### 4.8 Branch Connections

Branch connections shall be as indicated in the piping material specifications. For end preparation, alignment, spacing, fit-up and welding of branch connections refer welding specifications. Templates shall be used wherever required to ensure accurate cutting and proper fit-up.

For all branch connections accomplished either by pipe to pipe connections or by using forged tees the rates quoted for piping shall be inclusive of this work.

Reinforcement pads shall be provided wherever indicated in drawings / specifications etc.

#### 4.9 Bending

Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used.

Cold bends for lines 1-1/2" and below, with a bend radius of 5 times the nominal diameter shall be used as required in place of elbows wherever allowed by piping specifications. Bending of pipes 2" and above may be required in some cases like that for headers around heaters, reactors etc.

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any



cross-section, shall not exceed 8% and 3% of the nominal outside diameter, for internal and external pressure respectively.

#### **4.10 Forging and Forming**

Forging and forming of small bore fittings, like reducing nipples for piping 1-1/2" and below, shall be as per ASME B 31.3.

#### **4.11 Mitre Bends and Fabricated Reducers**

The specific application of welded mitre bends and fabricated reducers shall be governed by the Piping Material Specifications. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

#### **4.12 Cutting and Trimming of Standard Fittings & Pipes**

Components like pipes, elbows, couplings, half-couplings etc. shall be cut / trimmed / edge prepared wherever required to meet fabrication and erection requirements, as per drawings and instructions of Engineer-in-Charge. Nipples as required shall be prepared from straight length piping.

#### **4.13 Galvanized Piping**

Galvanized carbon steel piping shall be completely cold worked, so as not to damage galvanized surfaces. This piping involves only threaded joints and additional external threading on pipes may be required to be done as per requirement.

#### **4.14 Jacketed Piping**

The Jacketing shall be done in accordance with VCS Specification or Licensors specification as suggested in material specification or special condition of contract.

Pre-assembly of jacketed elements to the maximum extent possible shall be accomplished at shop by Contractor. Position of jump-over and nozzles on the jacket pipes, fittings etc. shall be marked according to pipe disposition and those shall be prefabricated to avoid damaging of inner pipe and obstruction of jacket space. However, valves, flow glasses, in line instruments or even fittings shall be supplied as jacketed.

#### **4.15 Shop Fabrication / Prefabrication**

The purpose of shop fabrication or pre-fabrication is to minimize work during erection to the extent possible. Piping spool, after fabrication, shall be stacked with proper identification marks, so as facilitate their withdrawal at any time during erection. During this period all flange (gasket contact faces) and threads shall be adequately fabricated by coating with removable rust preventive. Care shall also be taken to avoid any physical damage to flange faces and threads.

#### **4.16 Miscellaneous**

4.16.1 Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like tum-buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Engineer-in-Charge.

4.16.2 Spun Concrete Lining



The work of inside spun concrete lining of pipes and specials of diameter 3" and above shall be done as per material specifications and special condition contract.

#### 4.16.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications and the actual Piping Material Specification.

### 5.0 ERECTION

#### 5.1 Cleaning of Piping before Erection

Before erection all pre-fabricated spool pieces, pipes, fittings etc. shall be cleaned inside and outside by suitable means. The cleaning process shall include removal of all foreign matter such as scale, sand, weld spatter chips etc. by wire brushes, cleaning tools etc. and blowing with compressed air/or flushing out with water. Special cleaning requirements for some services, if any, shall be as specified in the piping material specification or isometric or line list. S.S jacketed piping requiring pickling shall be pickled to remove oxidation and discoloring due to welding.

#### 5.2 Piping Routing

No deviations from the piping route indicated in drawings shall be permitted without the consent of Engineer-in-Charge.

Pipe to pipe, pipe to structure / equipment's distances / clearances as shown in the drawings shall be strictly followed as these clearances may be required for the free expansion of piping / equipment. No deviations from these clearances shall be permissible without the approval of Engineer-in-Charge.

In case of fouling of a line with other piping, structure, equipment etc. the matter shall be brought to the notice of Engineer-in-Charge and corrective action shall be taken as per his instructions.

#### 5.3 Cold Pull

Wherever cold pull is specified, the Contractor shall maintain the necessary gap, as indicated in the drawing. Confirmation in writing shall be obtained by the Contractor from the Engineer-in-Charge, certifying that the gap between the pipes is as indicated in the drawing, before drawing the cold pull. Stress relieving shall be performed before removing the gadgets for cold pulling.

#### 5.4 Slopes

Slopes specified for various lines in the drawings / P&ID shall be maintained by the Contractor. Corrective action shall be taken by the Contractor in consultation with Engineer-in-Charge wherever the Contractor is not able to maintain the specified slope.

#### 5.5 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

- 5.5.1. All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.
- 5.5.2. a. Upon receipt, the Contractor shall remove the Expansion Joints / Bellows from the case(s) and check for any damage occurred during transit.

- b. The Contractor shall bring to the notice of the Engineer-in- Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges/ weld ends etc.
  - c. Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.
- 5.5.3. a. For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations/ external shrouds, tie / rods, angles.
- b. An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.
- 5.5.4. a. All Expansion Joints shall be delivered to the Contractor at "Installation length", maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.
- b. Expansion Joints stop blocks shall be carefully removed after hydrostatic testing. Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.
- 5.5.5. a. The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.
- b. The pipe ends / flanges shall be spaced at a distance specified in the drawings.
- 5.5.6. The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.
- 5.5.7. Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.
- 5.5.8. After the Expansion Joint is installed the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.
- 5.5.9. The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.
- 5.5.10. Precautions
- a. For carrying out welding, earthing lead shall not be attached with the Expansion Joint.
  - b. The Expansion bellow shall be protected from arc weld spot and welding spatter.
  - c. Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in position. These lugs shall be removed after testing and certification IS over.

## 5.6 Flange Connections

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled together, without inducing any stresses in the pipes and the equipment nozzles. Extra care shall be taken for flange connections to pumps, turbines, compressors, cold boxes, air coolers etc. The flange connections to these equipment's shall be checked for misalignment, excessive gap etc. after the final alignment of the equipment is over. The joint shall be made up after obtaining

approval of Engineer-in-Charge.

Hydraulic bolt tensioning & torque tensioning shall be performed on flange joints as per the requirements specified in "standard Specification for application of Torque & bolt Tension for flange joints,VCS-SS-PP-0041 and its addendum, if any.

Temporary protective covers shall be retained on all flange connections of pumps, turbines, compressors and other similar equipment's, until the piping is finally connected, so as to avoid any foreign material from entering these equipment's.

The assembly of a flange joint shall be done in such a way that the gasket between these flange faces is uniformly compressed. To achieve this, the bolts shall be tightened in a proper sequence. All bolts shall extend completely through their nuts but not more than 1/4".

Steel to C.I. flange joints, if any, shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

## 5.7 Vents and Drains

High point vents and low point drains shall be provided as per the instructions of Engineer-in-Charge, even if these are not shown in the drawings. The details of vents and drains shall be as per piping material specifications / job standards.

## 5.8 Valves

Valves shall be installed with spindle / actuator orientation / position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation / position is not shown in the drawings, the Engineer-in-Charge shall be consulted and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves, and other uni- directional valves are installed with the "Flow direction arrow "on the valve body points in the correct direction. If the direction of the arrow is not marked on such valves, this shall be done in the presence of Engineer-in-Charge before installation.

Fabrication of stem extensions, locking arrangements and interlocking arrangements of valves (if called for), shall be carried out as per drawings / instructions of Engineer-in-Charge.

## 5.9 Instruments

Installation of in-line instruments such as control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PTI Flow transmitter, ejectors, etc. and Shut Down Valves with fireboxes shall form a part of piping erection work.

Fabrication and erection of piping upto first block valve / nozzle / flange for installation of offline Instruments for measurement of level, pressure, temperature, flow etc. shall also form part of piping construction work. The limits of piping and instrumentation work will be shown in drawings / standards / specifications. Orientations / locations of take-offs for temperature, pressure, flow, level connections etc. shown in drawings shall be maintained.

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping (VCS Spec.

VCS-SS-PI-0007). Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

### **5.10 Line Mounted Equipment's / Items**

Installation of line mounted items like filters, strainers, steam traps, air traps, de-super heaters, ejectors, samples coolers, mixers, flame arrestors, sight glasses etc., including their supporting arrangements shall form part of piping erection work.

### **5.11 Bolts and Nuts**

The Contractor shall apply molycoat grease mixed with graphite powder (unless otherwise specified in piping classes) all bolts and nuts during storage, after erection and wherever flange connections are broken and made-up for any purpose whatsoever. The grease and graphite powder shall be supplied by the Contractor within the rates for piping work.

### **5.12 Pipe Supports**

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 2" NB & above. For lines 1½"NB & below Contractor shall locate and design pipe supports in line with VCS Std's. In case of IBR Lines 1½"NB & below only indicative supporting shall be provided & detailing of such supports is in Contractor's scope. Contractor shall obtain approval of Engineer - in - Charge on drawings prepared by Contractor, before erection. However, any extra supports desired by Engineer- in-Charge shall also be installed.

No pipe shoe / cradle shall be offset unless specifically shown in the drawings.

Hanger rods shall be installed inclined in a direction opposite to the direction in which the pipe move during expansion.

Pre-set pins of all spring supports shall be removed only after hydrostatic testing and insulation is over. Springs shall be checked for the range of movement and adjusted if necessary to obtain the correct positioning in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with the Engineer-in-Charge and necessary confirmation in writing obtained certifying that:

All restraints have been installed correctly.

Clearances have been maintained as per support drawings.

Insulation does not restrict thermal expansion.

All temporary tack welds provided during erection have been fully removed.

All welded supports have been fully welded.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR NON-DESTRUCTIVE EXAMINATION REQUIREMENTS OF PIPING

VCS – SS – PP - 2508

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
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|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
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**STANDARD SPECIFICATION  
FOR NON-DESTRUCTIVE EXAMINATION  
REQUIREMENTS OF PIPING**

**DOCNO: VCS-SS-PP-2508  
Rev No : 02**

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**Abbreviations:**

|       |   |                                          |
|-------|---|------------------------------------------|
| AS    | : | Alloy Steel                              |
| ASME  | : | American Society of Mechanical Engineers |
| ASTM  | : | American Society for Testing & Materials |
| CS    | : | Carbon Steel                             |
| DP/LP | : | Dye/Liquid Penetrant                     |
| IBR   | : | Indian Boiler Regulations                |
| MP    | : | Magnetic Particle                        |
| PMS   | : | Piping Material Specification            |
| SS    | : | Stainless Steel                          |



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## 1.0 GENERAL

### 1.1 Scope

This specification covers the general requirements for non-destructive examination of shop & field fabricated piping.

### 1.2 Related Codes & Engineering Standards

Referred codes/ standards are as follows. Latest editions of the Codes/Standards referred to shall be followed.

- a) ASME Boiler & Pressure Vessel Codes, Section V & VIII (Div.1) including addenda.
- b) ASME B31.3
- c) ASME B16.5
- d) ASME B16.34
- e) Standard Piping Material Specification; XXXX-XX-XX-XXX
- f) Standard Specification for Fabrication & Erection of Piping; VCS-SS-PP-2507
- g) ASTM E10
- h) Design Guide for Radiography Requirements; VCS-SS-PP-2506
- i) Indian Boiler Regulations (IBR)

## 2.0 VISUAL EXAMINATION

2.1 Weld shall be visually inspected wherever accessible in accordance with the following requirements:

- |                                                                                              |                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a) Internal misalignment                                                                     | 1.5 mm or less                                                                                                                                                                                                  |
| b) Cracks or lack of fusion                                                                  | not permitted                                                                                                                                                                                                   |
| c) Incomplete penetration                                                                    | Depth shall not exceed the lesser of 0.8mm or 0.2 times thickness of thinner component joined by butt-weld. The total length of such imperfections shall not exceed 38 mm in any 150 mm of weld length.         |
| d) Surface porosity and exposed slag inclusions<br>(For nom. wall thickness 4.7 mm and less) | not permitted                                                                                                                                                                                                   |
| e) Concave root surface (Suck up)                                                            | For single sided welded joints, concavity of the root surface shall not reduce the total thickness of joint, including reinforcement, to less than the thickness of the thinner of the components being joined. |
| f) Weld ripples irregularities                                                               | 2.5 mm or less.                                                                                                                                                                                                 |

- g) Lack of uniformity in bead width 2.5 mm or less.
- h) Lack of uniformity of leg length 2.5 mm or less.
- i) Unevenness of bead 2.0 mm or less
- j) Weld undercutting 0.8 mm or 1/4 thickness of thinner components joined by butt weld, whichever is less. (shall be smooth finished)
- k) Overlap 1.5mm or less
- l) Bead deflection 2.5 mm or less

- m) External weld reinforcement and internal weld protrusion (when backing rings are not used) shall be fused with and shall merge smoothly into the component surfaces. The height of the lesser projection of external weld reinforcement or internal weld protrusion from the adjacent Base material surface shall not exceed the following limits:

| Wall thickness of thinner component joined by butt Weld (mm) | Weld reinforcement or internal protrusion (mm) max |
|--------------------------------------------------------------|----------------------------------------------------|
| 6.4 and under                                                | 1.6                                                |
| Over 6.4 -12.7                                               | 1.2                                                |
| Over 12.7 -25.4                                              | 4.0                                                |
| Over 25.4                                                    | 4.8                                                |

- n) Throat thickness of fillet welds:

Nominal thickness of the thinner component x 0.7 or more.

- o) Flattening

Flattening of a bend, as measured by difference between the nominal outside diameter and minimum or maximum diameter at any cross section shall not exceed 5 % of the nominal outside diameter of pipe.

- p) Reduction of wall thickness

Reduction of wall thickness of a bend, as measured by difference between the nominal thickness and minimum thickness shall not exceed 10 % of the nominal wall thickness of pipe.

2.2 Welds having any of imperfections which exceed the limitations specified in various clauses of 2.1 shall be repaired by welding, grinding or overlaying etc. Number of times of repair welding for the same weld, however shall conform to applicable notes to Table 1- Note 6(b) b.5.

### 3.0 NON-DESTRUCTIVE EXAMINATION

- 3.1 The type and extent of weld examination shall be in accordance with Table-1. A11 visual and supplementary methods of girth weld examination shall be in accordance with ASME B31.3 & the requirements of this standard specification.
- 3.2 Welds between dissimilar materials shall be examined by method & to the extent required for the material having the more stringent examination.

## 4.0 TABLE-1 (with applicable notes)

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: II

| INSP<br>N.<br>CLA<br>SS | SERVICE                                                                                                             | MATERI<br>AL<br>(NOTE 3) | P.NO<br>. | TEMP<br>.<br>DEG.<br>C | PRESS.<br>CLASS<br>B16.5/<br>B16.34 | APPLICA-<br>BLE<br>PIPING<br>CLASS | TYPE OF<br>EXAMINATION                                                                                 | TYPE OF WELD EXAMINED |                               |                              |                                       |                                              |
|-------------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------|-----------|------------------------|-------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|------------------------------|---------------------------------------|----------------------------------------------|
|                         |                                                                                                                     |                          |           |                        |                                     |                                    |                                                                                                        | GIRTH<br>BUTT<br>WELD | SOCKET<br>WELD<br>(NOTE<br>2) | ATTAC-<br>HMENT<br>T<br>WELD | FAB.<br>BRANCH<br>WELD<br>(NOTE<br>1) | FAB.<br>WELDS<br>OF<br>MITRES<br>/<br>REDUC. |
| 1                       | 2                                                                                                                   | 3                        | 4         | 5                      | 6                                   | 7                                  | 8                                                                                                      | 9                     | 10                            | 11                           | 12                                    | 13                                           |
| II                      | a) ALL SERVICES COVERED UNDER INSPECTIONCLASS-1, BUT, EXCEEDING CATEGORY 'D' PR/T EMP LIMITATIONS.                  | CARBON<br>STEEL          | 1         | -29<br>TO<br>427       | 150# TO<br>60#                      | 15HC,<br>30HC,<br>60HC             | a)<br>VISUAL<br>b)<br>RADIOGRAPHY<br>(NOTE 5,6)<br>c)<br>MP / LP (NOTE<br>4,6,10,11)<br>d)<br>HARDNESS | 100%                  | 100%                          | 100%                         | 100%                                  | 100%                                         |
|                         | b) ALL SERVICES OTHER THAN COVERED UNDER INSPECTIONCLASS-1, BUT NON-TOXIC, NOT SUBJECT TO SEVERE CYCLIC CONDITIONS. |                          |           |                        |                                     |                                    |                                                                                                        | 5%                    | ---                           | ---                          | ---                                   | 20%                                          |
|                         | c) TOXIC, NON-LETHAL & FLAMMABLE                                                                                    |                          |           |                        |                                     |                                    |                                                                                                        | ---                   | 5%                            | ---                          | 5%                                    | 20%                                          |
|                         | d) FLAMMABLE/NON FLAMMABLE & TOXIC/NON-TOXIC; NOT SUBJECT TO SEVERE CYCLIC CONDITIONS                               |                          |           |                        |                                     |                                    |                                                                                                        | NOTE-7                | NOTE-7                        | NOTE-7                       | NOTE-7                                | NOTE-7                                       |
|                         |                                                                                                                     | LTCS                     |           | -45<br>TO<br>204       |                                     | 15HLT,<br>30HLT,<br>60HLT          |                                                                                                        |                       |                               |                              |                                       |                                              |

### REMARKS FOR ABOVE TABLE:

- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- NOTE- 7 FOR HARDNESS IS NOT VALID FOR P. NO. 8.

### Applicable Notes to Table-1

1. Branch welds shall consist of the welds between the pipe & reinforcing element (if any), nozzles & reinforcing element and the pipe & nozzle under the reinforcing element. Reinforcing element to be interpreted as pads, saddles, weldolets, sockolets etc.
2. Seal welds of threaded joints shall be given the same examination as socket welds.
3. Unless specifically stated, all materials shall be for "Non-IBR" service.
4. Magnetic Particle & the Liquid Penetrant method of examination shall be in accordance with Section V of the ASME Boiler and Pressure Vessel Code, Article VII and VI respectively. The entire area of the accessible finished weld surface shall be examined. Selected root runs, subject to a maximum of 10%, before finished weld, may also be examined, at the discretion of the engineer-in-charge.
  - a) Wherever MP / LP testing is specified, either MP or LP test may be used. But wherever only MP test is specified, LP method of examination may be used only if MP examination is impracticable in the field as concurred by PMC/ Company site-in charge.
  - b) "Random 5%" of Liquid Penetrant / Magnetic Particle test shall mean testing, by applicable test, one weld for each twenty welds or less made by the same welding procedure. "Random 10%" shall mean testing, by applicable test, one weld for each ten welds or less made by the same welding procedure. Similarly "Random 20%" shall mean testing, by applicable test, one weld for each five welds or less made by the same welding procedure.
  - c) When Liquid Penetrant examination is specified, the surface shall be free of peened discontinuities.
  - d) Inspection shall be performed in the welds excluding those for which radiography has been done.
  - e) Girth weld, branch weld, attachment weld & socket weld of 3-1/2% Ni steel shall be Liquid Penetrant tested only when welded with austenitic material where MP test has been specified.
5. Radiography:
  - a) "Random 5%, 10% or 20% radiography" shall mean examining not less than one from each 20 welds or less in case of "Random 5% radiography", 10 welds or less in case of "Random 10% radiography", one from each five welds or less in case of "Random 20% radiography" made by the same welding procedure. Irrespective of percentage, no. of welds to be radiographed shall be minimum 1. However first two welds made by each welder shall also be radiographed in case of "Random radiography". Welds selected for examination shall not include flange welds and shall be radiographed for their entire length. However, where it is impossible or impracticable to examine the entire weld length of field welds for either random or 100% radiography, and if the same impossibility is agreeable to site-in-charge, then a single 120 deg. exposure of the weld length may be given a Magnetic Particle test or Liquid Penetrant test.

However in such cases for ferro-magnetic materials, only MP test shall be acceptable for classes higher than 600#.

- b) In-process examination shall not be substituted for any required radiographic examination.
- c) Number of radiography per one circumferential weld shall be as per ASME Sec.V Articles 2 and 22.

6. When radiography or other non-destructive inspection is specified, acceptance criteria for repairs or defects shall be as follows:

- a) In case of 100% examination, any unacceptable weld shall be repaired and re inspected.
- b) If required random examination reveals a defect requiring repair, then:
  - i. Two additional examinations of same type shall be made of the same kind of item (if welded joint, then by the same welding procedure or operator or both).
  - ii. If the group of items examined as required by b.1 above is acceptable, the items requiring repair shall be repaired or replaced and re-examined as required and all items represented by this additional examination shall be accepted.
  - iii. If any of the items examined as required by b.1 above reveals a defect requiring repair, two further comparable items shall be examined for each defective item found by examination.
  - iv. If all the items examined as required by b.3 are acceptable, the items requiring repair shall be repaired or replaced and re-examined as required, and all items represented by this further examination shall be accepted.
  - v. Number of times repair welding could be done for the same weld before acceptance shall be as follows:

| <b>Material</b>    | <b>No. of times repair welding is allowed</b> |
|--------------------|-----------------------------------------------|
| C.S. up to 300#    | 3 or less                                     |
| C.S. above 300#    | 2 or less                                     |
| Killed steel       | 2 or less                                     |
| Low alloy steel    | 2 or less                                     |
| Austenitic S.S.    | 2 or less                                     |
| 3.5 Ni steel       | 2 or less                                     |
| Al & Al base alloy | 2 or less                                     |

Cu & Cu base alloy 2 or less

Others 2 or less

vi. Welds not found acceptable for allowed number of times of repair as per b.5 above shall be replaced and re-examined.

vii. If any of the items examined as required by b.4 above reveals a defect requiring repair, all items represented by these examinations shall be either :

- Repaired or replaced and re-examined as required.
- Fully examined and repaired or replaced as necessary, and re-examined as necessary.

## 7. Hardness Test:

- a) Hardness test shall be in accordance with ASTM specification E10. Hardness tests of the heat affected zone shall be made at a point as near as practicable to the edge of the weld. One test per weld shall be performed.
- b) Hardness test where specifically called out in Table-1 of this specification or in PMS, shall be carried out irrespective of thickness and to the extent (%age) as mentioned therein.
- c) All welds which are given heat treatment shall be hardness tested. Hardness test shall be performed after final heat treatment.
- d) A minimum of 10% of welds, hot bends, and hot formed components in each furnace heat treated batch and 100% of those which are locally heat treated shall be hardness tested.
- e) Hardness test requirement not covered in this specification shall be as per ASME B31.3.
- f) The hardness limit applies to the weld and heat affected zone. Following hardness values shall be maintained:

| <b>Base Metal Group</b>                   | <b>Maximum Hardness (BHN/RC)</b> |
|-------------------------------------------|----------------------------------|
| CS                                        | 238BHN/RC22                      |
| CS (NACE), Caustic, Amine, H <sub>2</sub> | 200BHN                           |
| Cr Up to 2%                               | 225BHN                           |
| Cr 2.25%-10%                              | 241BHN                           |
| 18/8 SS (NACE)                            | RC22                             |

8. For IBR service lines, following IBR requirements shall apply in addition to the notes 4, 5, 6, 7, 12 and Table 1. In case of conflict between above notes and these requirements, the more stringent ones shall apply. IBR piping shall be erected of IBR inspector approved

material and construction procedure. Erected piping shall be hydro tested, inspected and approved by IBR inspector.

a) Piping over 102 mm (4") bore:

10% of welds made by each welder on a pipeline with a minimum of two welds per welder, selected at random, shall be subjected to radiography.

b) Piping 102 mm (4") bore and under, but not less than 38 mm (1-1/2") bore:

Two percent of welds made by each welder on a pipeline with a minimum of one weld per welder, selected at random, shall be subjected to radiography or may be cut for visual examination and tests.

c) Piping less than 38 mm (1.5") bore:

Special tests are not normally required but 2% of welds by each welder on a pipe line may be cut out from the pipeline for the visual examination and bend tests.

d) Retests:

If any test specimen is unsatisfactory, two further weld specimens for retests shall be selected from the production welds and subjected to tests. In the event of failure of any retest specimens, the production welds carried out by this welder subsequent to the previous test shall be given special consideration.

9. For fabricated fittings LP test shall be done on the final pass of welding only, in addition to visual examination.
10. For mitres and fabricated reducers, LP / MP test shall be done on root pass in addition to radiography applicable to circumferential joint of respective piping class.
11. For branch connections, LP/MP test shall be done on root pass and final pass.
12. 10% of the butt weld joints shall be radiographed, however, 50% of these butt weld joints shall be field weld joints.
13. For lined specs, testing (MP/LP/Radiography etc.) shall be performed before lining.





## VCS QUALITY SERVICES PVT. LTD.

### WELDING SPECIFICATION FOR FABRICATION OF PIPING

VCS-SS-PP-2509

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
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**WELDING SPECIFICATION FOR FABRICATION OF  
PIPING**

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|                 |               | RP                                                                                | MC                                                                                | Hk                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

## **Abbreviations:**

|             |   |                                          |
|-------------|---|------------------------------------------|
| ASME        | : | American Society of Mechanical Engineers |
| ASNT        | : | American Society for Non-destructive     |
| Testing AWS | : | American Welding Society                 |
| BPVC        | : | Boiler & Pressure Vessel Code            |
| CFH         | : | Cubic Feet per Hour                      |
| DWDI        | : | Double Wall Double Image                 |
| DWSI        | : | Double Wall Single Image                 |
| GTA         | : | Gas Tungsten Arc                         |
| GTAW        | : | Gas Tungsten Arc Welding                 |
| IBR         | : | Indian Boiler Regulations                |
| IQI         | : | Image Quality Indicator                  |
| NDT         | : | Non Destructive Testing                  |
| PQR         | : | Procedure Qualification Record           |
| RT          | : | Radiographic Testing                     |
| SMAW        | : | Shielded Metal Arc Welding               |
| SWSI        | : | Single Wall Single Image                 |
| UTS         | : | Ultimate Tensile Strength                |

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(This specification shall be used in conjunction with Welding Specification Charts).

## **1.0 GENERAL**

This specification shall be followed for the fabrication of all types to welded joints of piping system within the battery limits of the plant.

The welded pipe joints shall include the following:

- a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.
- b) Attachments of forgings, flanges and other supports to pipes.
- c) Welded manifold headers and other sub-assemblies.
- d) Welded branch connections with or without reinforcing pads.
- e) Joints in welded/fabricated piping components.
- f) The attachments of smaller connections for vents drain drips and other instrument tapping's.

Any approval granted by the Engineer-in-Charge or Owner's inspector, shall not relieve the Contractor of his responsibilities and guarantee.

This specification shall not be applicable for welding of pipelines for transportation of liquid petroleum, gas and other similar products in onshore and off shore.

## **2.0 APPLICABLE CODES & STANDARDS**

All welding work, equipment's for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures unless otherwise specified in the Welding Specification Chart and the Technical Notes attached thereof. In the case of conflicting requirements, the requirements mentioned in Welding Specification Chart/Technical Notes shall be applicable.

- i. ASME Code for Pressure Piping - ASME B31.3
- ii. ASME Boiler & Pressure Vessel Code, Sec II Part C, Material Specifications: Welding Rods, Electrodes and Filler metals.
- iii. ASME Boiler & Pressure Vessel Code, Section V, Non-destructive examination.
- iv. ASME Boiler & Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
- v. ASME Boiler & Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- vi. The Indian Boiler Regulations - I.B.R.

In the event of any differences due to the additional requirements mentioned in this specification, over and above those obligatory as per codes, this specification shall be binding.

## **3.0 BASE METAL**

**3.1** In general, use of carbon steel, alloy steel and stainless steel is envisaged. The details of the material specifications are given in the Welding Specification Chart.

**3.2** The Contractor shall provide the manufacturer's test certificates for every heat of the materials

supplied by him.

#### **4.0 WELDING CONSUMABLES**

- 4.1** The Contractor shall provide, at his own expense, all the welding consumables necessary for the execution of the job such as electrodes, filler wires, argon etc. and these should bear the approval of the Engineer-in-Charge.
- 4.2** The welding electrodes and filler wires supplied by the Contractor shall conform to the class specified in the Welding Specification Chart. The materials shall be of the make approved by the Engineer-in-Charge.
- 4.3** Electrode qualification test records should be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the Contractor, for obtaining the approval of the Engineer-in-Charge.
- 4.4** The Contractor shall submit batch test certificates, from the electrode manufacturers, giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.
- 4.5** All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by the electrode manufacturer. "Out of the oven time" or electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering.
- 4.6** All low hydrogen type of electrodes shall be rebaked at 350°C for 1 hour minimum and stored in ovens kept at 80-100°C before use. Recommendations of the electrode manufacturer shall be followed, if available.
- 4.7** The electrodes, filler wires and flux used shall be free from rust, oil, grease, earth and other foreign matter which affect the quality of welding.
- 4.8** Tungsten electrodes used shall conform to ASME Sec. II C SFA 5.12 specification. Thoriated Tungsten electrodes shall not be permitted due to possible radiation hazard. Instead, ceriated Tungsten Electrodes (EWCe-2 or equivalent) shall be used for GTA Welding.

#### **5.0 SHIELDING & PURGING GAS**

- 5.1** Argon gas used in GTA welding for shielding purposes shall be 99.995% pure. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests. Normally this rate may be 12-20 CFH.
- 5.2** Argon gas with a purity level of 99.995% shall be used for purging.
- 5.3** When GTAW process alone or a combination of GTAW and SMAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in Welding Specification Chart.
- 5.4** Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.

**5.5** After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails. For systems, which have a small volume (up to 1/2 cubic foot) to be purged, a gas flow rate of 6-CFH is usually adequate. Systems of larger volume may require higher flow rates and these should be established during procedure qualification tests.

**5.6** Gas backing (purging) is not required for socket type of welded joints.

**5.7** Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding, use of water-soluble dams should be made.

## **6.0 EQUIPMENTS & ACCESSORIES**

**6.1** The Contractor should have the arrangement of sufficient number of welding and cutting equipment's, auxiliaries, and accessories of sufficient capacities so as to meet the target/schedule.

**6.2** All the equipment's for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders (with suitable calibration arrangement etc.) shall be provided by the Contractor at his own expenses and these should bear the approval of the Engineer-in-Charge.

**6.3** Contractor shall make arrangements at his own expense, for providing the radiographic equipment's radiographic films, processing equipment all other darkroom facilities and all the equipment's/aterials required for carrying out the dye-penetrant/magnetic particle test/ultrasonic testing for satisfactory and timely completion of the job.

**6.4** Redoing of any work, necessitated by faulty equipment's or operation used by the Contractor, will be done at his own expense.

## **7.0 WELDING PROCESS**

**7.1** Welding of various materials under this specification shall be carried out using one or more of the following processes with the approval of the Engineer-in-Charge.

- Shielded Metal Arc Welding Process (SMAW)
- Gas Tungsten Arc Welding Process (GTAW)

**7.2** The welding processes to be employed are given in the Welding Specification Chart. Any deviation desired by the Contractor shall be obtained through the express consent of the Engineer-in-Charge.

**7.3** Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-Charge. The welding procedure adopted and consumables used shall be specifically approved.

**7.4** A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of Engineer-in-Charge.

## **8.0 EDGE PREPARATION**

### **8.1 General**

The edges to be welded shall be prepared to meet the joint design requirements by any of the following methods recommended:

a) Carbon Steel

Gas cutting, machining or grinding methods shall be used. After gas cutting, oxides shall be removed by chipping or grinding.

b) Low Alloy Steels (containing up to 5% Chromium).

Gas cutting, machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

c) High alloy steel (> 5% Chromium) and stainless steels, nickel alloys:

Plasma cutting, machining or grinding methods shall be used. After plasma cutting, cut surfaces shall be machined or ground smooth.

## **8.2 Cleaning**

a) The ends to be welded shall be properly cleaned to remove paint, oil, grease, rust, oxides, sand, earth and other foreign matter. The ends shall be completely dry before the welding commences.

b) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling. Wire brushes used for cleaning stainless steel joints shall have stainless steel wires and the grinding wheels used for grinding stainless steel shall be of a suitable type. Separate grinding wheels and wire brushes should be used for carbon steels and stainless steels.

## **9.0 ALIGNMENT & SPACING**

**9.1** Components to be welded shall be aligned and spaced as per the requirements laid down in applicable code. Special care must be taken to ensure proper fitting and alignment when the welding is performed by GTAW process. Flame heating for adjustment and correction of ends is not permitted unless specifically approved by the Engineer-in-Charge.

**9.2** A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

**9.3** For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and 'C' clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer-in-Charge.

**9.4** Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

**9.5** Tacks should be equally spaced. Minimum number of tacks shall be:

- |         |   |                                   |
|---------|---|-----------------------------------|
| 3 tacks | - | for 2 1/2" and smaller dia. pipes |
| 4 tacks | - | for 3" to 12" dia. pipes          |
| 6 tacks | - | for 14" and larger dia. pipes     |

**9.6** Welding shall commence only after approval of fit-up by the Engineer-In-Charge.



## **10.0 WEATHER CONDITIONS**

- 10.1** The parts being welded and the welding personnel should be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out.
- 10.2** During field welding using GTAW process, particular care shall be exercised to prevent any air current affecting the welding process.

## **11.0 WELDING TECHNIQUE**

### **11.1 Root Pass**

- a) Root pass shall be made with electrodes/filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5 mm diameter (12 SWG) but in any case not greater than 3.25 mm (10 SWG).
- b) Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.
- c) The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited 3mm max. When the applicable code does not place any restriction.
- d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer-in-Charge.
- e) Welding shall be uninterrupted.
- f) While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.
- g) Peening shall not be used.

### **11.2 Joint Completion**

- a) Joint shall be completed using the class of electrodes, recommended in the Welding Specification Chart. Size of the electrode shall not exceed 4 mm in diameter for stainless steels and alloy steels used for low temperature applications.
- b) Two weld beads shall not be started at the same point in different layers.
- c) Butt joints shall be completed with a cover layer that would affect good fusion at the joint edges and a gradual notch free surface.
- d) Each weld joint shall have a workmanship like finish. Weld identification work shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.
- e) Rust preventive/protective painting shall be done after the weld joint has been approved.

### **11.3 Dissimilar Welds**

Where welds are to be produced between carbon steels and alloy steels preheat and post weld heat treatment requirements shall be those specified for corresponding alloy steels and filler

wire/electrodes shall correspond to ER 70 S-G or AWS E-7016/7018 type. For welds between two dissimilar Cr-Mo low alloy steels, preheat and post weld heat treatments shall be those specified for higher alloy steel and electrodes used shall correspond to those specified for steel of lower alloy content. For carbon steel or alloy steel to stainless welds, use of filler wire/electrodes EIER-309/E-310/E NiCr Fe-3 shall be made. The welding procedure, electrodes/filler wires to be used shall be approved by the Engineer-in-Charge.

## **12.0 HEAT TREATMENT**

### **12.1 Preheating**

- a) No welding shall be performed without preheating the joint to 10°C (50°F) when the ambient temperature is below 10 degree.
- b) Preheating requirements for the various materials shall be as per the Welding Specification Chart attached.
- c) Preheating shall be performed using resistance or induction heating methods. Preheating by gas burners, utilizing oxy-acetylene or oxy-propane gas mixtures, with neutral flame may also be carried when permitted by the Engineer-in-Charge.
- d) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- e) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature recorders shall be provided by the Contractor to record the temperature.

### **12.2 Post Heating**

In case of alloy steel materials such as Cr-Mo steels, if the post weld heat treatment is not performed immediately after welding, the weld joint and adjacent portion of pipe, at least 50 mm on either side of weld, shall be uniformly heated to 300°C. This temperature shall be maintained for half an hour minimum, and then wrapped with mineral wool before allowing it to cool to room temperature. If the Post Heating temperature specified in the Welding Specification Charts exceeds 300°C, the same shall be followed. Similarly, if the welding specification chart specifies post-heat time, the same shall be applicable. Post weld heat treatment as specified in the Welding Specification Chart shall be carried out later on.

### **12.3 Post Weld Heat Treatment (PWHT)**

- a) Post weld heat treatment, wherever required for joints between pipes, pipes and fittings, pipe body and supports shall be carried out as per the welding specification chart, applicable codes standards and the instructions of the Engineer-in-Charge. In this regard procedure qualification to be done before carrying out PWHT in production welds.
- b) The Contractor shall submit for the approval of the Engineer-in-Charge, well before carrying out actual heat treatment, the details of the post weld heat treatment procedure as per Exhibit B attached, that he proposes to adopt for each of the materials/assembly/part involved.
- c) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction-heating equipment, as decided by the Engineer-in-Charge.
- d) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat- treated. Care shall be taken to ensure that width of heated band over which specified post weld

heat treatment temperature attained is at least that specified in the relevant applicable standards/codes. Control of temperature shall be done using microprocessor/computer controlled system. The desired time-temperature cycle shall be entered into the microprocessor/computer.

- e) Throughout the cycle of heat treatment, the portion outside the heated. band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose temperature at the exposed surface should not be allowed to exceed 50% of the peak temperature.
- f) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples should be attached to the pipe directly at equally spaced location along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 1 up to 6" dia., 2 up to 10" dia. and 3 for 12" dia. and above. However, the Engineer-in-Charge can increase the required number of thermocouples to be attached if found necessary.
- g) Automatic temperature recorders, which have been suitably calibrated, shall be employed for measuring & recording temperature. Both, the actual time-temperature graph and the designed time temperature graph shall be available on every chart. The time-temp graph shall be submitted to Engineer-in-Charge immediately on completion of Stress Relieving Cycle the calibration record of each recorder should be submitted to the Engineer-in-Charge prior to starting the heat treatment operations and his approval should be obtained.
- h) Manufacturer's test certificate shall be submitted for the thermocouples materials and record shall be maintained by the Contractor.
- i) Immediately on completion of the Heat Treatment, the Post Weld Heat Treatment charts/records along with the hardness test results on the weld points, wherever required as per the Welding Specification Chart, shall be submitted to Engineer-in- Charge for his approval.
- j) Each weld joint shall bear a unique identification number, which shall be maintained in the piping sketch to be prepared by the Contractor. The weld joint identification number should appear on the corresponding post weld heat treatment charts. The chart containing the identification numbers and piping sketch shall be submitted to the Engineer-in-Charge in suitable folders.

### **13.0 CLEANING OF THE WELD JOINT**

All weld joints shall be free from adherent weld spatters slag, sward, dirt or foreign matter. This can be achieved by brushing. For stainless steels, brushes with only stainless steel bristles shall be used.

### **14.0 INSPECTION AND TESTING**

#### **14.1 General**

- a) The Owner's inspector shall have free access to all concerned areas, where the actual work is being performed. The contractor shall also accord the Owner's Inspector all means and facilities necessary to carry out inspection.
- b) The Owner is entitled to depute his own inspector to the shop or field where prefabrication and erection of pipe lines is in progress for (but not limited to) the following objectives:

- i. To check the conformance to relevant standards and suitability of various welding equipment's and the welding performance.
  - ii. To witness the welding procedure qualification.
  - iii. To witness the welder performance qualification.
  - iv. To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in piping construction.
- c) Contractor shall intimate sufficiently in advance the commencement of qualification tests, welding works and acceptance tests, to enable the Owner's inspector to be present to supervise them, as decided by the Engineer-In-Charge.

#### **14.2 Welding Procedure Qualification**

Welding procedure qualification shall be carried out in accordance with the applicable requirements of ASME Sec. IX latest edition and/or other applicable codes and the job requirements. The contractor shall submit the welding procedure specification in format as per Exhibit-C (attached) immediately after the receipt of the order. Owner's inspector will review, check and approve the welding procedure submitted and shall release the procedure for qualification tests. The procedure qualification test shall be carried out by the Contractor at his own expense. A complete set of test results in the format as per Exhibit-D attached) shall be submitted to the Owner's inspector for his approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard test as specified in the code shall be carried out in all cases. In addition to these tests, other tests like macro/micro examination, hardness tests, dye penetrant examination, charpy V-notch, Corrosion tests, impact tests etc. shall be carried out on specimens depending upon the type of base material, operating conditions and requirements laid down in the detailed drawings and specifications. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the Owner's inspector.

#### **14.3 Welder's Qualification**

- a) Welders shall be qualified in accordance with the ASME Section-IX or other applicable codes. The Owners inspector reserves the right to witness the test and certify/approve the qualification of each welder separately. Only those welders who have been approved by the Owner's Inspector shall be employed for welding. Contractor shall submit the welder qualification test reports in the format as per Exhibit-E (attached) and obtain express approval before commencement of work. It shall be the responsibility of Contractor to carry out qualification tests of welders. For welding of the steam piping, falling under the purview of Indian Boiler Regulations, only those welders with IBR Certification, qualified by Boiler Inspectorate, and acceptable to the local Boiler Inspector authority shall be employed.
- b) The welders shall always have in their possession; an identification card containing information contained in Exhibit-G and shall produce it on demand by the Engineer-In-Charge or his representative. It shall be the responsibility of the Contractor to issue the identify cards after it has been duly certified by the, owner's Inspector.
- c) No welder shall be permitted to work without the possession of the identify card.
- d) If a welder is found to perform a type of welding or in a position for which he is not

qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the Contractor.

#### **14.4 Visual Examination**

Visual Examination of all welds shall be carried out as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage cracks, inadequate penetration, unrepaired burn-through, under cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

#### **14.5 Radiographic Examination**

- a) Contractor shall appoint agency for carrying out the radiography works at site from the list of agency enclosed in the bid document or separately supplied by owner/ VCS.
- b) The Radiographic Examination procedures to be adopted shall be submitted by the contractor as per Exhibit-F and shall be got approved from the Owner's Inspector prior to employment. A person qualified to ASNT Level-II or ASNT Level-III in Radiographic testing shall prepare the procedure. The Radiography Procedure shall be established to demonstrate that the required sensitivity can be consistently achieved under the most unfavorable parameters (e.g. source to film distance, geometric unsharpness, thickness etc.). The radiographic technique and procedure adopted shall conform of the requirements mentioned in Article 2 as well as Article 22 of ASME Sec. V. The IQI sensitivity obtained shall be equal to or better than the requirements mentioned in Article 2 of ASME Sec. V. Source side penetrameter shall be used in establishing radiographic procedure/ technique. The acceptance criteria shall be as per the relevant codes of Fabrication and overriding requirements if mentioned elsewhere in the technical specifications of the contract. The Contractor shall be responsible for carrying out Radiography; rectification of defects and re-radiography of welds repaired/rectified at his cost.
- c) The extent of Radiography shall be as per specifications to be supplied to the Contractor. For welds between dissimilar materials, the extent of Radiographic Examination shall be the more stringent of the two recommended for the materials being welded. Wherever random Radiography is called for, in a particular piping class, the dissimilar materials weld joints shall essentially be included.
- d) Type of Radiation source and film to be used shall be as per Exhibit-H for carrying out radiographic examination. However if specifications (as given elsewhere in the contract) for some critical material require usage of X-Radiation, then Radiography shall be done using X-Rays only.
- e) The Contractor shall fulfill all the statutory and owner's safety requirements while handling X-ray and Gamma-ray equipment's.
- f) In case of random radiography, the joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person qualified to ASNT

Level-II in Radiographic testing, in line with Article 2 of ASME Sec. V. The certificate of ASNT/ISNT Level II qualification of the NDT personnel shall be submitted to owner's inspector for his approval prior to start of job.

- g) The Contractor shall provide the Owner's Inspector, all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable for varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler, marking pencils etc. to enable him to review the radiographs.
- h) Where random radiography is specified, the first weld of each welder shall be completely radiographed. In the case of pipe of size 6" and below, the first two welds shall be completely radiographed.
- i) For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and the of two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.
- j) The Contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the Contractor shall promptly arrange for Radiographic Examination so that there is no accumulation of defective joints.
- k) Contractor shall quote rates for X-ray as well as Gamma Ray for joints indicated to be radiographed by X-ray in Table of Exhibit-H.

#### **14.5.1 Check shots**

- a) Owner / Engineer - in - charge or his representative shall select 5% of the total joints radiographed on a day for check shots. Contractor shall carry out check shots as directed.
- b) Weld profiles of check shots shall be compared with weld profile observed in the earlier Radiographs. In the event of anyone variation in the check shots and earlier Radiographs, contractor shall re-shoot the entire lot of joints radiographed by particular Radiography agency on the particular date. All the re-shot films shall be compared with the originally submitted films.

#### **14.6 Liquid Penetrant and Magnetic Particle Examination**

- a) Whenever such tests are specified, the tests shall be carried out on joints chosen by the Owner's inspector, as per ASME Section V article 6 and 7 respectively. The tests are to be performed by a person possessing a valid ASNT/ISNT Level-II qualification in the method being used.
- b) For austenitic stainless steels and other nonmagnetic materials, liquid (dye) penetrant test shall be carried out. For carrying out this test, the materials shall be brought within a temperature limit of 15°to 50°C.

#### **14.7 Hardness Test**

Hardness requirements for welds shall be as per the Welding Specification Chart Non Destructive Examination Specification attached elsewhere in the contract. Hardness testing shall be carried out by Vickers Hardness Tester during welding procedure qualification and shall be cross sectional. For production welds, hardness testing shall be carried out by portable



digital hardness testers. Poldi hardness tester shall not be permitted. Contractor shall produce documentary evidence/calibration certificate to the Owner's Inspector and obtain approval of the hardness testing equipment.

#### **14.8 Proof Tests**

Hydrostatic and pneumatic tests shall be performed as per the requirements laid down by respective flushing and Testing specification/applicable codes to demonstrate the soundness of the welds. The tests shall be conducted after fulfilling the requirement of visual examinations radiography etc. and after the entire work has been certified by the Owner's inspector to be fit for being subjected to such tests.

#### **15.0 REPAIRS OF WELDS**

- a) Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding.
- b) When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The re-welded joint shall again be examined following standard practices.
- c) No repair shall be carried out without prior permission of the Owner's inspector.
- d) Repairs and/or work of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

#### **16.0 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)**

- a) Electrode and Welding Consumable Qualification Records as per Exhibit-A, for the Welding Consumables tested and approved for the work.
- b) Batch Test Certificates, for the Electrodes used, obtained from the Electrode Manufacturers.
- c) Proposed Heat Treatment Procedure as per Exhibit-B
- d) Heat Treatment Charts.
- e) Weld joint hardness test results.
- f) Welding Procedure Specifications as per Exhibit-C immediately after receipt of the order.
- g) Welding Procedure Qualification records as per Exhibit-D.
- h) Welder Performance Qualification records as per Exhibit-E immediately after conducting Welder Qualification Tests.
- i) Radiography Procedure as per Exhibit-F and other NDT procedures.
- j) Radiographic test Report along with Radiographs and other NDT reports.
- k) Piping Sketch (Isometric) giving all the details regarding the pipe specifications, welded joints, joints radiographed magnetic particle, tested, ultrasonic tested, penetrant tested, joints heat treated, WPS used, welders identification number, etc.

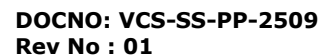




EXHIBIT-A

Sheet 2 of 3

C) Impact Test Results

Test Temperature : Notch in :  
Type of Specimens (Charpy) : Size of Specimens :

| Specimen No. | Impact Value | Average |
|--------------|--------------|---------|
| 1.           |              |         |
| 2.           |              |         |
| 3.           |              |         |
| 4.           |              |         |
| 5.           |              |         |

D) Chemical Analysis Results

Electrode Size Result :  
Batch No. :

| %C | %S | %P | %Si | %Mn | %Cr | %Ni | %Mn | Other |
|----|----|----|-----|-----|-----|-----|-----|-------|
|    |    |    |     |     |     |     |     |       |

E) Fillet Weld Test Results :

Welding Positions :

Base Materials :

Size of electrode used :

Visual Inspection Results :

1)

2)

3)

EXHIBIT-A

Sheet 3 of3

Macro Test Results :  
Fracture Test Results :  
Remarks :

F) Other Test Results

1. Transverse tensile test :

In combination with :  
Base material used :  
Position of welding :  
Preheat temperature :  
Post weld heat treatment :  
Radiography :

|                    |       |             |         |
|--------------------|-------|-------------|---------|
| Identification No. | U.T.S | Fracture in | Remarks |
|--------------------|-------|-------------|---------|

2. Guided Bend Test :

| Position | Identification No. | Root, Face or Side Bend | Remarks |
|----------|--------------------|-------------------------|---------|
|          | 1.                 |                         |         |
|          | 2.                 |                         |         |
|          | 3.                 |                         |         |
|          | 4.                 |                         |         |
|          | 5.                 |                         |         |

G) Any other tests :

H) Conclusions :

.....  
PREPARED BY  
(CONTRACTOR)

.....  
REVIEWD  
(CONTRACTOR)

.....  
APPROVED BY  
(VCS/OWNER)



EXHIBIT-B

Sheet 1 of 1

**STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION**

Contractor : \_\_\_\_\_

Name of the Heat treater : \_\_\_\_\_

Name of the Project : \_\_\_\_\_ Specification

Reference No. \_\_\_\_\_

1. General Details \_\_\_\_\_ Other Details

Name of the

Equipment: \_\_\_\_\_

Type of Heating: Elec. Res. / Induction

(Tick mark applicable method) Maximum  
Permissible Temp at Uncovered Parent  
Metal \_\_\_\_\_

Width of heated band \_\_\_\_\_

Width of Insulation \_\_\_\_\_

2. Material: \_\_\_\_\_

No. of Thermocouples (Dia wise)

Type of Thermo couples \_\_\_\_\_

3. Heat Treatment Cycle Details

Charging temp °C \_\_\_\_\_

Rate of heating ° C /Hr. \_\_\_\_\_

Soaking Temperature, °C \_\_\_\_\_

Soaking Time, Hrs. \_\_\_\_\_

Rate of Cooling ° C/Hr. \_\_\_\_\_

Method of Cooling \_\_\_\_\_

4. Other details, if any \_\_\_\_\_

EXHIBIT -C  
SHEET 1 OF 3

**FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)**

Company Name \_\_\_\_\_ by \_\_\_\_\_

Welding Procedure Specification No. \_\_\_\_\_ Date \_\_\_\_\_

Welding Process (es) \_\_\_\_\_ Type (s) \_\_\_\_\_

(Automatic, Manual, Machines or Semi Auto)

**JOINTS**

Joint Design \_\_\_\_\_

Backing (Yes) \_\_\_\_\_ (No) \_\_\_\_\_

Backing Material (Type) \_\_\_\_\_

Sketches Production Drawings. Weld Symbols Written

Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Manufacturer sketches may be attached to illustrate joint design weld layers and bead sequence e.g. for notch toughness procedures, for multiple process procedures, etc.)

**BASE METALS**

P.No. \_\_\_\_\_ Group No. \_\_\_\_\_ to P. No. \_\_\_\_\_ Group No. \_\_\_\_\_  
OR

Specification type and grade \_\_\_\_\_  
to Specification type and grade \_\_\_\_\_

OR

Chem. Analysis and Mech. Prop. \_\_\_\_\_  
to Chem. Analysis and Mech. Prop. \_\_\_\_\_

Thickness Range:

Base Metal: Groove \_\_\_\_\_ Fillet \_\_\_\_\_

Deposited Weld Metal: Groove \_\_\_\_\_ Fillet \_\_\_\_\_

Pipe Dia Range: Groove: \_\_\_\_\_ Fillet \_\_\_\_\_

Other \_\_\_\_\_



EXHIBIT -C  
SHEET 2 OF 3

**FILLER  
METALS**

F.No. \_\_\_\_\_ Other \_\_\_\_\_  
A.No. \_\_\_\_\_ Other \_\_\_\_\_  
Spec. No. (SFA) \_\_\_\_\_  
AWS No.(Class) \_\_\_\_\_  
Size of filler metals \_\_\_\_\_

**(Electrodes, Cold Wire, Hot Wire etc.)**

Electrode-Flux (Class) \_\_\_\_\_  
Flux Trade Name \_\_\_\_\_  
Consumable Inset \_\_\_\_\_  
Each base metal/filler metal combination should be recorded individually.  
WPSNO \_\_\_\_\_ Rev. \_\_\_\_\_

|                                                                                                                           |                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>POSITIONS:</b><br>Position(s) of Groove _____<br>Welding Progression: UP _____ Down _____<br>Positions of fillet _____ | <b>POSTWELDED HEAT TREATMENT</b><br>Temperature Range _____<br>Time Range _____                                                                                    |
| <b>PREHEAT</b><br>Preheat Temp. Mon. _____<br>Interpass Temp. Max. _____<br>Preheat Maintenance _____                     | <b>GAS</b><br>Shielding Gas (es) _____<br>Percent Composition (mixtures) _____<br>Flow Rate _____<br>Gas Backing _____<br>Trailing Shielding Gas Composition _____ |

**ELECTRICAL CHARACTERISTICS**

Current AC or DC \_\_\_\_\_ Polarity \_\_\_\_\_  
Amps (Range) \_\_\_\_\_ Volts (Range) \_\_\_\_\_  
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc.  
This information may be listed in a tabular form similar to that shown below).  
Tungsten Electrode Size and Type \_\_\_\_\_  
(Pure Tungsten, 2% Ceriated, etc.)  
Mode of Metal Transfer for GMA W \_\_\_\_\_  
(Spray arc, short circuiting arc, etc.)  
Electrode Wire feed speed range \_\_\_\_\_

EXHIBIT-C  
SHEET 3 OF 3

**TECHNIQUE**

String or Weave Bead \_\_\_\_\_

Orifice or Gas Cup Size \_\_\_\_\_

Initial and Interpass Cleaning (Brushing, Grinding, etc.) \_\_\_\_\_

Method of Back Gouging \_\_\_\_\_

Oscillation \_\_\_\_\_

Contact Tube to Work Distance \_\_\_\_\_

Multiple or Single Pass (per side) \_\_\_\_\_

Multiple or Single Electrodes \_\_\_\_\_

Travel Speed (Range) \_\_\_\_\_

Peening \_\_\_\_\_

Other \_\_\_\_\_

| Weld Layer(s) | Process | Filler metal |      | Current       |            | Volt Range | Travel Speed Range | Other                                                                                              |
|---------------|---------|--------------|------|---------------|------------|------------|--------------------|----------------------------------------------------------------------------------------------------|
|               |         | Class.       | Dia. | Type polarity | Amp. Range |            |                    |                                                                                                    |
|               |         |              |      |               |            |            |                    | <b>e.g.</b><br>Remarks,<br>Comments,<br>Hot wire<br>Addition,<br>Technique<br>Torch<br>Angle, etc. |



**FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)**  
**RECORD ACTUAL CONDITIONS USED TO WELD TEST**  
**COUPON**

Company Name \_\_\_\_\_  
Procedure Qualification Record No. \_\_\_\_\_ Date \_\_\_\_\_  
WPS No. \_\_\_\_\_  
Welding Process (es) \_\_\_\_\_  
Types (Manual, Automatic, Semi-Auto) \_\_\_\_\_

**JOINTS**

**Groove Design of Test Coupon**

(For combination qualification the deposited weld metal thickness shall be recorded for each Filler metal or process weld)

|                                                                                                                                                                                        |                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BASE METALS</b><br>Material Spec. _____<br>Type of Grade _____<br>P.No. _____ to P.No. _____<br>Thickness of Test Coupon _____<br>Diameter of Test Coupon _____<br>Other _____      | <b>POSTWELD HEAT TREATMENT</b><br>Temperature _____<br>Time _____<br>Other _____<br>_____<br>_____                                          |
| <b>FILLER METALS</b><br>Weld Metal Analysis A No _____<br>Size of Filler Metal _____<br>Filler Metal E.No. _____<br>SFA Specification _____<br>AWS Classification _____<br>Other _____ | <b>GAS</b><br>Type of Gas on Gases _____<br>Composition of Gas Mixture _____<br>Other _____<br>_____<br>_____                               |
| <b>POSITION</b><br>Position of Groove _____<br>Weld Progression (Uphill, Downhill) _____<br>Other _____<br>_____                                                                       | <b>ELECTRICAL CHARACTERISTICS</b><br>Current _____<br>Polarity _____<br>Amps _____<br>Tungsten Electrode Size _____<br>Other _____<br>_____ |



**WELDING SPECIFICATION FOR FABRICATION OF  
PIPING**

**DOCNO: VCS-SS-PP-2509  
Rev No : 01**

| PREHEAT                | TECHNIQUE                                  |
|------------------------|--------------------------------------------|
| Preheat Temp. _____    | Travel Speed _____                         |
| Inter pass Temp. _____ | String or Weave Bead _____                 |
|                        | Oscillation _____                          |
|                        | Multi pass or Single Pass (per side) _____ |
|                        | Single or Multiple Electrodes _____        |
|                        | Other _____                                |



EXHIBIT-D

SHEET 2 OF 2

**GUIDED BEND TESTS**

| Type of Figure No | Result |
|-------------------|--------|
|                   |        |
|                   |        |
|                   |        |

**TOUGHNESS TESTS**

| Specimen No. | Notch Location | Notch Type | Test Temp. | Impact Value | Lateral Exp. |      | Drop Weight |          |
|--------------|----------------|------------|------------|--------------|--------------|------|-------------|----------|
|              |                |            |            |              | % Shear      | Mils | Break       | No Break |
|              |                |            |            |              |              |      |             |          |
|              |                |            |            |              |              |      |             |          |
|              |                |            |            |              |              |      |             |          |

**FILLET WELD TEST**

Result – Satisfactory: Yes \_\_\_\_ No \_\_\_\_ Penetration into Parent Metal: Yes \_\_\_\_ No \_\_\_\_

Macro – Results \_\_\_\_\_

**OTHER TESTS**

Type of Test \_\_\_\_\_

Deposit Analysis \_\_\_\_\_

Other \_\_\_\_\_

Welder's Name \_\_\_\_\_ Clock No. \_\_\_\_\_ Stamp No. \_\_\_\_\_

Test Conducted by \_\_\_\_\_ Laboratory Test No. \_\_\_\_\_

We certified that the statements in this record are correct and test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date \_\_\_\_\_ Manufacturer \_\_\_\_\_

By \_\_\_\_\_

(Detail of record of tests are illustrative only and may be molded to conform to the type and number of tests required by codes and specifications).



EXHIBIT-E

SHEET 1 OF 2

FORMAT FOR MANUFACTURER'S RECORD FOR WELDER OR WELDING OPERATOR  
QUALIFICATION TESTS

Welder Name \_\_\_\_\_ Check No. \_\_\_\_\_ Stamp No. \_\_\_\_\_

Using WPS No. \_\_\_\_\_ Rev. \_\_\_\_\_

The above welder is qualified for the following ranges

| <u>Variable</u>                             | <u>Record Actual Values<br/>Used in Qualification</u> | <u>Qualification Range</u> |
|---------------------------------------------|-------------------------------------------------------|----------------------------|
| Process                                     | _____                                                 | _____                      |
| Process Type                                | _____                                                 | _____                      |
| Backing (metal,<br>Weld metal, flux, etc.,) | _____                                                 | _____                      |
| Material Spec.                              | _____ to _____                                        | _____ to _____             |
| Thickness                                   |                                                       |                            |
| Groove                                      | _____                                                 | _____                      |
| Filler                                      | _____                                                 | _____                      |
| Diameter                                    |                                                       |                            |
| Groove                                      | _____                                                 | _____                      |
| Filler                                      | _____                                                 | _____                      |
| Filler Metal                                |                                                       |                            |
| Spec. No.                                   | _____                                                 | _____                      |
| Class                                       | _____                                                 | _____                      |
| F. No.                                      | _____                                                 | _____                      |
| Position                                    | _____                                                 | =====                      |
| Weld Progression                            | _____                                                 | _____                      |
| Gas Type                                    | _____                                                 | _____                      |
| Electrical Characteristics                  |                                                       | _____                      |
| Current                                     | _____                                                 | _____                      |
| Polarity                                    | _____                                                 | _____                      |



EXHIBIT-E

SHEET 2 OF 2

### Guided Bend Test Results

| Type and Fig.No. | Result |
|------------------|--------|
|                  |        |
|                  |        |
|                  |        |
|                  |        |

### Radiographic Test Results

For alternative qualification of groove welds by radiography

Radiographic Results \_\_\_\_\_

### Fillet Weld Test Results

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen \_\_\_\_\_  
Length and Per Cent of Defects \_\_\_\_\_ inches \_\_\_\_\_ %  
Macro Test – Fusion \_\_\_\_\_  
Appearance - Fillet Size (ing) \_\_\_\_\_ x \_\_\_\_\_ Convexity or Concavity \_\_\_\_\_

Test Conducted by \_\_\_\_\_ Laboratory - Test No. \_\_\_\_\_

We certify that the statements in this record are correct and that the test welds were prepared.  
Welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date \_\_\_\_\_ Organization \_\_\_\_\_

By \_\_\_\_\_

(Details of record tests are illustrative only and may be modified to conformation to the type & number of tests required by the Code).

**Note:** Any essential variables in addition to those above shall be recorded

EXHIBIT – F

**RADIOGRAPHIC PROCEDURE QUALIFICATION RECORD FOR PIPE**

**WELDING**

1. Location
2. Date of Testing
3. Name of the Contractor/Agency
4. Material: Carbon steel/Alloy Steel/Stainless
4. Technique: DWSIISWSI/DWDI
5. Diameter & Thickness
6. Type of Weld Joint
7. Radiation Source
8. Intensifying Screens/Lead Screens
9. Geometric Relationship:
10. Limit of Film Coverage:
11. Film Type and Make:
12. Exposure Time:
13. Processing:
14. Density:
15. Sensitivity:
- 16.\* Type of penetrameter:  
(Source side)
- 17.\* Type of penetrameter:  
(Film side)

Signature of Contractor/Agency with Seal

Approval of VCS's Inspector

Ref. Para regarding recommended practice on placement of penetrameters Article 22, SE 142, ASME Sec. V.

For "Random Radiography" lines placement of penetrameters as per Article 2, ASME, Sec. V is permitted.

EXHIBIT - G

**WELDER'S IDENTIFICATION CARD**

1. Name
2. Identification
3. Date of Testing
4. Process
5. Thickness Range
6. Diameter Range
7. F. No.
8. Date of approval of welding
9. Position(s)

Photograph

Approved by:

Employer's Signature with Seal

EXHIBIT - H

**Type of Source and Films to be used for RADIOGRAPHY**

| NOMINAL WALL THICKNESS(T) IN<br>mm |                                                               | SHOP WELDED JOINTS |                  | IN-SITU WELDS                                                                                                                                                                                                                                     |                  |
|------------------------------------|---------------------------------------------------------------|--------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
|                                    |                                                               | SOURCE             | FILM : CEN Class | SOURCE                                                                                                                                                                                                                                            | FILM : CEN Class |
| $T \geq 19$                        | All Materials                                                 | Gamma Ray          | C5               | Gamma ray                                                                                                                                                                                                                                         | C5               |
| $8 \leq T < 19$                    | Carbon steel                                                  | Gamma ray          | C4               | Gamma ray                                                                                                                                                                                                                                         | C4               |
| $< 8$                              | All other materials                                           | Gamma ray          | C3               | Gamma ray                                                                                                                                                                                                                                         | C3               |
|                                    | Carbon Steel Other than Inspection Class IV *                 | Gamma ray          | C3               | Gamma ray                                                                                                                                                                                                                                         | C3/C1            |
|                                    | All Other Materials and Carbon Steel of Inspection Class IV * | X-Ray              | C4               | X-ray with C4 or Equivalent to be used. Gamma Ray (Se 75 Source only) with C3/C2 Equivalent may be allowed only if in the assessment of owner's inspector, Joints are in accessible for X-ray equipment and radiographic sensitivity is achieved. |                  |

**Note:** Integral to above table

- 1) Films slower than the above may have to be used, if required radiographic sensitivity is not achieved consistently.

COMPARISION OF FILM FROM DIFFERENT MANUFACTURERS.

| CEN Classification | KODAK | AGFA | FUJI  |
|--------------------|-------|------|-------|
| ---                | CX    | D8   | ---   |
| C5                 | AA400 | D7   | IX100 |
| C4                 | T200  | D5   | IX80  |
| C3                 | MX125 | D4   | IX50  |
| C2                 | M100  | D3   | ---   |
| C1                 | DR50  | D2   | IX25  |
| ---                | SR**  | ---  | ---   |

**\*\*Special films, extremely fine grain & very high resolution**



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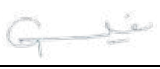
### TECHINICAL NOTES FOR BOLTS AND NUTS

VCS-SS-PP-2510

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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## REVISION RECORD

| Rev. | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                        | Authorized by                                                                       | Revision Description |
|------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| 00   | 28.01.2020    |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
|      |               | MB                                                                                | AK                                                                                | AD                                                                                 | SK                                                                                  |                      |
| 01   | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|      |               | RP                                                                                | MC                                                                                | HK                                                                                 | GW                                                                                  |                      |
|      |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                      |





---

## Abbreviations:

|      |                                                |
|------|------------------------------------------------|
| ASME | The American Society of Mechanical Engineers   |
| ASTM | The American Society for Testing and Materials |
| MR   | Material Requisition                           |
| SS   | Stainless Steel                                |



## CONTENTS

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| 1.0 | GENERAL.....                | 5 |
| 2.0 | ACCEPTABLE DEVIATIONS ..... | 6 |



## 1.0 GENERAL

**1.1** The process of manufacture, heat treatment, chemical & mechanical requirements and marking for all stud bolts, m/c bolts, jack screws & nuts shall be in accordance with the codes/standards and specifications given in the requisition. The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut. Supplier shall strictly comply with MRIPR stipulations and no deviation shall be permitted.

## 1.2 Testing

1.2.1. Test reports shall be supplied for all mandatory tests as per the relevant material specifications.

1.2.2. Material test certificate shall also be furnished. (Heat Analysis, Product Analysis and Mechanical Requirement)

1.2.3. Stress Rupture Test as detailed in ASTM A453 shall be carried out for all ASTM A453 bolting material irrespective of the temperature.

1.2.4. Refer Specification no VCS-PL-ITP-0012 for 'Inspection & Test Plan for Bolting Material'.

**1.3** All bolting shall be as per ASME B 18.2.1 for studs, M/c bolts and jackscrews and ASME B 18.2.2 for nuts.

**1.4** Threads shall be unified (UNC for up to 1" dia and 8UN for > 1" dia) as per ASME B1.1 with class 2A fit for studs, M/c bolts and jackscrews and class 2B fit for nuts.

**1.5** Stud bolts shall be threaded full length with two heavy hexagonal nuts unless otherwise specified. Length tolerance shall be in accordance with the requirement of Table D2 of Annexure-D of ASME B 16.5.

**1.6** The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.

**1.7** Heads of jackscrews and m/c bolts shall be heavy hexagonal type. Jackscrew end shall be rounded.

**1.8** Each size of studs & m/c bolts with nuts and jackscrews shall be supplied in separate containers marked with size and material specifications. 'CRYO' shall be marked additionally in case 'CRYO' is specified in the requisition.

**1.9** All items shall be inspected and approved (stage-wise) by VCS.

**1.10** The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.

**1.11** All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.

**1.12** Any additional requirements specified in the requisition shall be fully complied with.

**1.13** Stud bolts, nuts & jackscrews shall be impact tested wherever specified in the material specification and also where the material specification is indicated as "CRYO". For S.S. nuts and bolts minimum impact energy absorption shall be 27 Joules and test temperature shall be -196DC unless mentioned otherwise. For other materials impact energy and test shall be as per respective code.

**1.14** Bolts/nuts of material of construction B7M/2HM shall be 100% Hardness tested as per supplementary requirement S3 of ASTM A193.

- 1.15** When specified as galvanized, the studs, M/C bolts and nuts shall be 'hot dip zinc coated' in accordance with requirements of 'class C' of ASTM A 153'. As an alternative, electro-galvanizing as per IS 1573, 'Service Grade Number 2' is also acceptable.
- 1.16** All Stud Bolts of Bolt diameter size 1" and above shall be provided with three nuts irrespective of whatever has been specified elsewhere in the MR.
- 1.17** Bolting shall be protected by non-corrosive oil or grease before dispatch to prevent rusting.
- 1.18** For stud bolt diameters not covered in ASTM A320, mechanical properties shall match the values specified for the matching grades and stud bolt diameters in ASTM A 193.
- 1.19** In cases where the lengths of Stud/Machine bolts specified in the MR are not multiples of 0.25", the length supplied shall be equal to the specified length rounded up to the next higher 0.25".
- 1.20** All Specialties mentioned in item description like "IBR", "L T", "H2", etc. other than **"CRYO"** & **"NACE"** shall be ignored.
- 2.0 ACCEPTABLE DEVIATIONS**
- 2.1** Nuts to ASTM A194Gr.7 are acceptable in place of ASTM A194Gr 4.
- 2.2** Stud Bolts to ASTM A453 Gr.660 C1.B are acceptable in lieu of ASTM A453 Gr.660C1.A and vice versa



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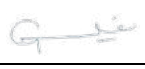
### TECHINICAL NOTES FOR GASKETS

VCS-SS-PP-2511

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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## REVISION RECORD

| Rev. | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
|------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| 00   | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01   | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|      |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|      |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

---

## Abbreviations:

|      |                                  |
|------|----------------------------------|
| AARH | Average Arithmetic Root Height   |
| BHN  | Brinell Hardness Number          |
| CS   | Carbon Steel                     |
| MR   | Material Requisition             |
| PMI  | Positive Material Identification |
| RTJ  | Ring Type Joint                  |



CONTENTS

1.0 GENERAL..... 5



## 1.0 GENERAL

- 1.1** All gaskets shall conform to the codes/standards and specifications given in the requisition. Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted.
- 1.2** Process of manufacture, dimensions and tolerances not specified in requisition shall be in accordance with the requirements of the manufacturer's standards.
- 1.3 Testing**
- 1.3.1. Test reports shall be supplied for all mandatory tests for gaskets as per the standards specified in the requisition.
- 1.3.2. Chemical composition and hardness of RTJ gaskets shall also be furnished in the form of test reports on samples.
- 1.3.3. For Spiral wound material following shall be furnished:
- Manufacturer's test certificate for filler material and spiral material as per the relevant material specifications.
  - Manufacturer's test certificate for raw materials and tests for compressibility! seal- ability & recovery as per the relevant material specifications.
- 1.3.4. Refer Specification no VCS-PL-ITP-0013 for 'Inspection & Test Plan for Gaskets'.
- 1.4** Full face gaskets shall have bolt holes punched out.
- 1.5** Filler material for spiral wound gaskets shall not have any colour or dye.
- 1.6** All spiral wound gaskets shall be supplied with Outer ring. Material of the outer ring shall be CS unless otherwise specified in the MR.
- 1.7** For spiral wound gaskets, material of Inner Compression ring shall be same as Spiral Strip material. Inner rings shall be provided for all Spiral Wound Gaskets.
- 1.8** Hardness of metallic RTJ gaskets shall not exceed the values specified below unless otherwise specified in MR:

| Ring Gasket Material           | Maximum Hardness (BHN) |
|--------------------------------|------------------------|
| Soft Iron                      | 90                     |
| Carbon steel                   | 120                    |
| 5 Cr. $\frac{1}{2}$ Mo         | 130                    |
| Type 304, 316, 321, 347        | 140                    |
| Type 304L, 316L                | 120                    |
| Inconel UNS N06625             | 200                    |
| Incoloy UNS N08825             | 190                    |
| Duplex SS UNS N032205, N031803 | 230                    |

- 1.3.5. Face finish of metallic RTJ gaskets shall be 32 to 63 AARH.

- 1.3.6. Gaskets of different types and sizes shall be placed in separate shipping containers and each container clearly marked with the size, rating, material specification and item code.
- 1.3.7. All items shall be inspected and approved by VCS.
- 1.3.8. Any additional requirements specified in the requisition, shall be fully complied with.
- 1.3.9. Non-metallic ring gaskets as per ASME B 16.21 shall match flanges to ASME B 16.5 upto 24" and to ASME B 16.47B above 24" unless specified otherwise.
- 1.3.10. Spiral wound gasket as per ASME B 16.20 shall match flanges to ASME B 16.5 upto 24" and to ASME B 16.47B above 24" unless specifically mentioned otherwise.
- 1.3.11. The following abbreviations have been used in the Material Requisition for Spiral Wound Gaskets:
- |        |   |                |
|--------|---|----------------|
| (I)    | : | Inner Ring     |
| (O)    | : | Outer Ring     |
| GRAFJL | : | Grafoil Filler |
- 1.3.12. Specialties mentioned in item description like "IBR", "LT", "HICI", "H2", etc. shall be ignored.



## VCS QUALITY SERVICES PVT. LTD.

### STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION AT CONSTRUCTION SITES

**VCS-SS-PP-2520**

|         |            |                                                                                     |                                                                                     |                                                                                      |                                                                                       |
|---------|------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |            |  |  |  |  |
| 01      | 30.06.2022 | RP                                                                                  | MC                                                                                  | HK                                                                                   | GW                                                                                    |
| 00      | 28.01.2020 | MB                                                                                  | AK                                                                                  | AD                                                                                   | SK                                                                                    |
| Rev. No | Date       | Prepared By                                                                         | Checked By                                                                          | Approved By                                                                          | Authorized By                                                                         |

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**STANDARD SPECIFICATION  
FOR POSITIVE MATERIAL IDENTIFICATION AT  
CONSTRUCTION SITES**

**DOCNO: VCS-SS-PP-2520  
Rev No : 01**

| REVISION RECORD |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|-----------------|---------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|
| Rev.            | Revision Date | Prepared by                                                                       | Checked by                                                                        | Approved by                                                                       | Authorized by                                                                       | Revision Description |
| 00              | 28.01.2020    |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               | MB                                                                                | AK                                                                                | AD                                                                                | SK                                                                                  |                      |
| 01              | 30.06.2022    |  |  |  |  | VCS QMS Integration  |
|                 |               | RP                                                                                | MC                                                                                | HK                                                                                | GW                                                                                  |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |
|                 |               |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                      |

---

### **Abbreviations:**

|      |                                            |
|------|--------------------------------------------|
| API  | American Petroleum Institute               |
| ASM  | American Society for Metals                |
| ASME | American Society of Mechanical Engineers   |
| ASTM | American Society for Testing and Materials |
| PMI  | Positive Material Identification           |
| RTJ  | Ring Type Jacket                           |
| TPI  | Third Party Inspection                     |



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## **1.0 SCOPE**

- 1.1 This specification applies to metallic alloy materials used in piping, heater coils, storage tanks, vessels etc. at construction sites. Positive Material Identification (PMI) is to be carried out on Owner supplied material as well on materials purchased by the contractor.
- 1.2 Any deviation from this specification must be approved by Owner/VCS in the prescribed format.
- 1.3 Carbon steels are excluded from the scope of this specification.

## **2.0 DEFINITIONS**

### **2.1 POSITIVE MATERIAL IDENTIFICATION (PMI)**

The term Positive Material Identification (PMI) refers to determination/verification of alloy type or its composition using portable or mobile spectrometer/alloy analyzer.

Chemical spot checking, resistivity testing, eddy current testing, electromagnetic alloy sorting, thermoelectric testing shall not be considered as PMI for the purpose of this specification.

## **3.0 SPECIFIC APPLICABILITY**

- 3.1 The following items require PMI unless specifically exempted through a Concession/ Deviation permit by Owner/VCS.
  - 3.1.1 All pressure containing piping components including, thermo wells instrument manifolds, RTJ gaskets, fasteners etc.
  - 3.1.2 Tubular products used in the fabrication of heaters.
  - 3.1.3 Pressure - containing instrument housings (e.g. gauge glass housings, orifice meter tubes).
  - 3.1.4 Internal metallic linings/cladding, and weld overlay, done at site, used for protection against corrosive environments.
  - 3.1.5 Tubing
  - 3.1.6 Stud, bolts and nuts
  - 3.1.7 Plates
  - 3.1.8 All pressure containing welds.
  - 3.1.9 Any other components or materials specifically designated for PMI on the purchase order/contract.

### **3.2 EXCLUSIONS**

The following items are exempted unless specifically designated for PMI in the purchase order/contract:

- 3.2.1 Gaskets (spiral wound or carbon steel only).
- 3.2.2 Internal instrument parts.
- 3.2.3 Internal machinery parts.
- 3.2.4 Internal non pressure containing baffles, trays, tray clips, supports, pall-rings, support rings, etc.
- 3.2.5 Electrical components.



3.2.6 Internal valve components.

3.2.7 Compression-type ferrules and fittings for use with 3/4 inch (19mm) outside diameter and smaller tubing.

#### **4.0 REFERENCES**

American Society of Mechanical Engineers (ASME) BPV Code Section-II Part A, B, C and D ASME B 31.3

American Society for Testing and Materials (ASTM): As applicable

Material Verification Program for New and Existing Alloy Piping Systems: API RP 578

Any other material specification referenced by the Purchase Order/Contract.

#### **5.0 GENERAL REQUIREMENTS**

5.1 The test methods outlined in this specification are intended to identify the nominal composition of alloy materials. These test methods are not intended to establish the conformance of a material to a particular alloy specification.

5.2 PMI shall not be considered as a substitute for required mill test reports listing chemical composition. In addition, mill test reports shall not be considered as confirming alloy verification.

5.3 The PMI activity shall be included in the overall quality plan and Inspection & Test Plan for warehouse and fabrication/erection. The contractor shall submit to VCS/Owner, a procedure for PMI to comply with the requirements of this specification. Approval of PMI procedure shall be obtained from Owner/VCS prior to commencement of fabrication/erection as the case may be.

5.4 A copy of daily PMI records shall be submitted to Owner/ VCS.

5.5 After installation, but prior to hydrostatic testing/painting/insulation, the contractor shall examine all components requiring PMI for proper compliance to this specification. A record of this final check, as specified below, shall be submitted to VCS/Owner and made part of the permanent inspection records.

5.5.1 Owner supplied material:

Records signed by contractor and duly certified by VCS/Owner.

5.5.2 Contractor supplied material:

Records signed by contractor and certified by an approved third party inspection agency.

5.6 After acceptance, all components shall be marked with a suitable paint mark. Markings must be permanent and readily visible. These markings are in addition to markings required by other codes/specifications/Technical Notes.

5.7 Controls shall be established to keep the non-conforming items identified till proper resolution of non-conformity.

5.8 VCS/Owner shall have the right to witness the performance of any PMI test.

#### **6.0 EXTENT OF PMI**

PMI shall be done on each component (100 percent PMI inspection) including welds, unless specifically exempted by Owner/VCS.





All non- pressure parts such as pipe supports shall require 10% PMI (i.e. out of 10 such components). For each non conformity detected, the extent of PMI shall double.

One stud & nut assembly for each flange joint shall require PMI. If any non-conformity is detected, all studs & nuts in the particular piping loop shall require PMI.

## 7.0 PMI IN WAREHOUSE

PMI testing to be performed as part of the receiving inspection at warehouse.

The extent of PMI shall be as specified in 6.0. However, if PMI testing has been carried out at vendor/manufacturer's shop and relevant certified records and correlation with incoming material is available, PMI testing at warehouse need not be done.

PMI testing done as a part of receiving Inspection shall not be regarded as an alternative to PMI testing of the installed system.

## 8.0 PMI OF PIPING AND HEATER COIL COMPONENTS

PMI testing (irrespective of PMI done at earlier stages) shall be carried out when piping loops/heater coils have been cleared for hydrostatic testing by VCS/Owner. Hydrostatic Testing shall be carried out only when non-conforming components have been replaced with conforming components and subsequent Non Destructive Testing, Post Weld Heat-Treatment, Hardness checking etc., as required by specifications have been completed. PMI records shall form a part of piping/heater inspection records. Contractor shall demonstrate to Owner/ VCS that each & every component of the piping system and heater coils has been subjected to PMI by providing line wise records of PMI.

## 9.0 TESTING METHODOLOGY

In general, portable X-Ray Fluorescence (XRF) type alloy analyzers such as Oxford Instruments X-Met 3000 TX, X-Met 2000 Metal Master, NITON's XLt or NITON II or similar analyzer shall be used for carrying out PMI. Identification of characteristic alloying elements (see 10.0 for examples), which distinguishes the material from other materials, will be sufficient. Generally, 5 to 10 seconds exposure (Id-mode) is sufficient for this purpose. However, in case of doubt, Owner/VCS may insist on complete analysis.

The surface of the component to be subjected to PMI shall be free from grease, oil, paint or oxides. Testing shall be done after proper surface cleaning and other requirements as outlined by the manufacturer of the portable alloy analyzer. Modification, if any, of these procedures must be approved by Owner/VCS.

## 10.0 CHARACTERISTIC ELEMENTS

| Material Specification |        | Characteristic Elements |
|------------------------|--------|-------------------------|
| ASTM A 335             | Gr P11 | Cr, Mo                  |
|                        | Gr P5  |                         |
|                        | Gr P22 |                         |
|                        | Gr P9  |                         |

|            |          |                             |
|------------|----------|-----------------------------|
| ASTM A 312 | Type 304 | Cr, Ni                      |
|            | Type 316 | Cr, Ni, Mo                  |
|            | Type 321 | Cr, Ni, Ti                  |
|            | Type 347 | Cr, Ni, Columbium, Tantalum |

Characteristic elements for materials not listed above shall be proposed by the contractor for approval of the Owner/VCS.

## **11.0 CALIBRATION**

- 11.1 Instruments used for PMI shall have the sensitivity to detect the alloying elements in the specified ranges. Instruments or methods used for examination shall be of the type that will provide quantitative, recordable, elemental composition results for positive identification of the alloy elements present.
- 11.2 Each alloy analyzer shall be calibrated using known alloy standards for intended materials to be checked by PMI. A calibration certification from the Manufacturer or his authorized agency shall be submitted to VCS/Owner for records. As such, calibration at site is not envisaged.
- 11.3 VCS/Owner shall review the procedure and qualification and witness sample alloy verification tests to confirm that the procedures, equipment and personnel are capable of providing consistent and accurate results.

## **12.0 SITE VERIFICATION OF ANALYZER**

Verification using Standard samples supplied by institutes such as ASM (American Society of Metals) for the intended materials type and grade shall be performed each day before using the analyzer. Such a verification shall be done again if PMI test is to be performed on different grade or type of material.

## **13.0 PERSONNEL QUALIFICATION**

The persons performing the PMI test should be knowledgeable about properties of material, all aspects of operation of PMI equipment including the method of testing. Qualification/experience documents of the person performing the PMI test including his training and experience shall be submitted to VCS/Owner for review and approval.

## **14.0 ACCEPTANCE CRITERIA**

### **14.1 BASE METAL**

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

### **14.2 DEPOSITED WELD METAL**

For deposited weld metal between base metals of the same specification using matching consumables, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the welding consumables specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be

acceptable.

## 15.0 REJECTION CRITERIA

15.1 If the PMI test results fall outside the acceptable range as given in 14.0 above, the contractor shall obtain a quantitative check analysis performed by a laboratory acceptable to VCS/Owner for a complete chemical analysis. Results of this analysis shall be submitted to VCS/Owner, with contractor's recommendation, for final decision.

Decision of VCS/Owner shall be final in this regard.

15.2 If any material component or weld is found unacceptable, all other represented materials (e.g. in case of fasteners, supports) or welds shall be considered suspect. In such cases, the contractor has the following options:

15.2.1 Scrapping all those represented materials or components and replacing with new components or welds.

15.2.2 Performing 100% examination of the remainder of the represented materials/ components and replacing each item that fails the PMI check.

15.2.3 If the performance of any verification activity is unacceptable to VCS/Owner or if any material has been incorrectly identified, all further tests shall be subject to VCS/Owner approval until the problem is corrected.

## 16.0 DOCUMENTATION

16.1 Print out from alloy analyzer, in original, duly certified by the contractor/ PMI agency.

16.2 Basis and action for resolving and documenting PMI non conformances.

16.3 Contractor shall demonstrate to VCS/Owner that all components requiring PMI have been subjected to PMI testing and accepted.





ENERGISING QUALITY

## VCS PROJECT CONSULTANTS PVT. LTD.

### STANDARD SPECIFICATION FOR HEALTH, SAFETY & ENVIRONMENT

**VPC – SS – PP - 2021**

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---

**ABBREVIATIONS:**

|      |                               |
|------|-------------------------------|
| TPIA | THIRD PARTY INSPECTION AGENCY |
| QA   | Quality Assurance             |
| QC   | Quality Control               |
| LOI  | Letter of Indent              |
| QAP  | Quality Assurance Procedure   |
| ISS  | International Standard Space  |
| UPS  | Uninterruptible Power Supply  |

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## 1.0 SCOPE

This specification establishes the Health, safety and Environment (HSE) aspects to be complied with by the contractor during construction at site.

## 2.0 REFERENCES

This document should be read in conjunction with following.

- General Condition of Contract (GCC)
- Special Condition of Contract (SCC)
- Job Specifications
- Relevant IS codes
- Reporting Formats

## 3.0 RESPONSIBILITY & ORGANISATION

Safety activities at site shall be under control of contractor's RCM. He shall be responsible for implementation of HSE provisions. The nominated or designated safety engineer/ officer shall assist and perform day to day HSE work as per his advice.

## 4.0 GENERAL REQUIREMENT

**4.1** The contractor should follow HSE policy of owner as applicable to construction site.

**4.2** The contractor shall deploy a full time HSE engineer / officer to coordinate the site.

The HSE officer shall be duly qualified in Industrial Health & Safety management with an experience of 4 -5 years.

**4.3** The contractor shall ensure that HSE requirements are clearly understood & faithfully implemented at all level, at each site.

**4.4** The contractor shall organize safety awareness programs regularly.

**4.5** The contractor shall ensure his participation in the every HSE meeting called by owner/owner representative.

**4.6** The contractor's shall conduct daily tool box talk.

**4.7** The contractor shall submit Monthly HSE reports (Form attached in ANNEXURES).

**4.8** The contractor shall provide all help and support to the injured person got injury at site during construction work and arrange compensation as per insurance policy / Act.

**4.9** The contractor shall adhere consistently to all provisions of HSE. In case of non-compliance or continuous failure the owner/ owner representative may impose stoppage of work without any cost time implication to owner. A penalty amount of Rs 1000/- shall be imposed on the contractor for the serious HSE violation.

- 4.10** Three times of this penalty may count as a serious violation of contractor in line with HSE. This may affect to new work assignment/award of contractor.

## **5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING**

### **Accident**

Unintended occurrence arising out of and in the course of employment of a person, which results in to injury with or without damage to plant/equipment/materials.

### **Incident**

means an unplanned and uncontrolled event which results in damage to plant or equipment or loss of material without causing any injury to persons, like fire, spill, leak, property damage etc.

### **Near-miss**

An unexpected, unwanted event not causing loss, injury or illness but which under slightly altered conditions can lead to an accident.

can be defined as "Any event which under slightly un favorable circumstances, may have resulted in any of the following:

- Injury, fatal or otherwise or ill health to people
- Loss of property, damage to plant or materials
- Damage to the environment
- A business interruption"

Accident, Incident and Near miss reporting form listed in ANNEXURES

## **6.0 HSE REQUIREMENTS AT SITE**

### **6.1 Personnel Protective Equipment's**

The contractors shall provide sufficient numbers of following personal protective equipment's (PPEs) to workmen and supervisors/engineers to use them properly at work site.

Following five numbers of Personnel protective equipment's are identified as MANDATORY for all.

- Safety Helmet
- Coverall
- Safety shoes/footwear
- Safety Glasses
- Hand Gloves (as per job requirement)

Other PPEs are depending upon nature of job like

Arc Welding – Welding face shield

Grinding – Grinding face shield

Height work – Full Body harness (above 2 meters)

Ask site supervisor for proper use and selection of protective clothing / equipment for specialized jobs

## **6.2 Welding**

- Ensure that welding machine is in order and approved by site engineer.
- Ensure that welding cables are in order.
- Ensure that welding machine is properly earthed.
- Remove all combustible material from welding area to avoid fire
- Place a fire extinguisher nearby welding premises.
- Ensure welding holder, cable and its lugs in good condition and use only industrial power socket and plugs (3 Pin) to avoid electricity risk.
- Make sure that welding machine is provided with ON/OFF switch and is earthed/grounding.
- Do not over load electrical appliances and cable, Shocked pin etc,
- Ground the work piece separately from the welding return connection only.

## **6.3 Gas Cutting**

- Check the cylinder and its valve or leakage and move out any leaking cylinder immediately.
- Ensure that flash back arresters are installed with torch and NRV (Non-return valve) on the gas cylinders side.
- Ensure cylinders in vertical position (Cylinder trolley) and far away from fall of sparks and hot metal.
- Check the regulator and torches that they are inspected prior to every use.
- Check for leaks around regulators, hoses/fittings & nozzle with soap solution.
- Check the entire hose length if it is cracked or worn out cut that length of hose or replace the hose.
- Check that flash back arrester used for the purpose is of approved make/specification only.
- Place a fire extinguisher nearby welding premises.

## **6.4 Grinding Operation**

- Grinding wheels should be stored in dry place.
- After expiry date, grinding wheel must be condemned, broken in to pieces.
- Power supply cable of adequate current carrying capacity shall be used and it should be in good workable condition without abrasions, cuts or puncture in outer insulation.
- Socket pin provided at supply end and on/off switch in working condition.
- Proper earthing of the body in case of metallic body.
- Wheel guard properly fitted in position.

- Machine body without any damage like crack etc.
- Moving part (wheel) must be properly fixed to the machine with the help of spanner.
- Grinding wheel must be of suitable size as per the speed of grinding machine.
- Grinding wheel without manufacturer's sticker showing size, speed and expiry date must be condemned.
- Don't use portable grinding machine as bench grinder.
- Don't fit over size wheel than recommended size by machine/wheel manufacturer.
- Don't grind small, unstable object without fixing it in the vice.
- Don't over press the grinding wheel against the job for fast removal of metal.
- Put OFF the main switch, while machine is not in use (tea break etc.)
- Don't chip off grinding/cutting wheel for achieving fast cutting rate.

**PPEs:**

- Use of helmet, face shield or safety goggles (where face shield is not possible.) and hand gloves.

## **6.5 Use of Power Tools and Cables**

- All electrical equipment and tools used by the contractors and their employees shall be properly checked by contractor's supervisor before use.
- All power tools must have proper guard at all time.
- Leads /cables must be placed so that they do not create a tripping hazard.

## **6.6 Material Handling and storage**

The Contractor will only use crane/Hydra and lifting equipment that has been tested and certified as fit for purpose by 3rd Party. All crane operators and riggers will be adequately trained and certified. The Contractor will keep records of tests and certification of all lifting equipment crane employed on the Works. Maintenance records shall be routinely inspected by the Contractor and made available for Safety audits.

**LIFTING GEAR:** Lifting machine, chains, ropes and lifting tackles used at site shall conform to the following:

- All parts shall be good construction, sound material and adequate strength and free from defects.
- Shall be properly maintained, thoroughly examined, load tested by competent person.
- No lifting machine and no chain, rope or lifting tackle shall except for purpose of test be loaded beyond safe working load must be plainly marked on the gear concerned.
- All material must be properly stacked and secured to prevent sliding, falling or collapse.
- Stairs and passage ways must be kept clear at all time.

## **6.7 Trenches and Excavation**

Before commencing any excavation work the Site in charge will ensure that the proposed works have been adequately assessed and planned to ensure that they are executed safely and without risks to Health and safety. The factors to be assessed and planned will include: -

- The nature and stability of the material being excavated and the need for any support of walls.
- The effect of excavation on nearby area.
- The foreseeable presence of hazardous contaminants.
- The proximity of mobile plant.
- The provision of edge protection (fall prevention of people and materials)
- Access and egress

## **6.8 Pipe Transportation and lowering**

- All drivers shall hold a valid driving license for the class of vehicle.
- Securing of the load shall be according to established and approved methods.
- All overhangs shall be made clearly visible and restricted to acceptable limits.
- Load shall be checked before moving off and after traveling a suitable distance.
- All vehicles used by Contractors shall be in worthy condition and in conformance to the Land Transport requirement.
- Use of certified side booms after 3rd Party inspection.
- Effective communication should be done among all involved personals.
- Signaling shall be done by authorized foreman only.
- Ensure appropriate measures are taken for overhead hazards.
- Persons are not allowed towards trench side / under the boom at the time of lowering.
- Co-ordination of lowering in by a single man only.
- Inspection of equipment before use.
- All personnel should stay clear of moving equipment.
- Use of certified lifting tools and tackles.

## **6.9 Pressure / Leak Testing**

### **Hydraulic and Pneumatic Test**

Access to the test area shall be limited to essential personnel only. before the test commences compliance is required with the following points:

- Persons supervising pressure or leak tests must have sufficient knowledge and experience of testing to fully understand the hazards of the activity and the precaution, which must be taken.
- Effective communication, including formal procedures, must be established between sites whenever the test envelope extends beyond one site, for example, pipelines.
- The area shall be cordoned off (using tape, shields or barriers, etc) at an adequate

- distance from the equipment to be tested, as specified on the Permit to Work
- Warning signs shall be posted at access ways, at other strategic positions, and on the equipment to be tested (including the doors of test workshops or other designated areas
  - Pressuring equipment shall be provided with suitably calibrated pressure control / regulator devices.
  - Pressuring equipment shall not be left unattended at any time during the test.
  - Pressuring equipment shall be isolated from the equipment under test and where practicable disconnected, when the test pressure has been reached.
  - Care must be taken to ensure that materials of construction have the required ductility at the test temperature to prevent brittle fracture.
  - A safety valve should be fitted to the equipment/system being tested, set to relieve at a pressure that will prevent over pressurization
  - Sufficient venting / draining points shall be provided in order to prevent trapping of pressurizing medium behind non-return valves, check valves, between isolation valves, or within dead legs of the pressure envelope
  - The equipment/plant to be pressure tested must be subjected to thorough examination prior to testing. It may be necessary to 100% inspect all welds using visual, radiographic or other NDT techniques
  - The gas supply must be isolated when test pressure has been achieved
  - The pressure envelope must contain sufficient vents, to a safe location.
  - De-pressurization after pneumatic testing must be gradual

#### **6.10 Scaffolding and Ladder**

- All working platform must be constructed with the specific requirement of job.
- All portable ladders must be in good condition as per the site norms.
- If the working platform is not permanent then safety belt must be used.
- There shall be firm foundation for all scaffoldings. All scaffolding shall be made of sound material.
- Scaffolding material shall be inspected and used, only if found in good condition.
- Provide metal base plate is used under all upright or standard scaffoldings. Correct type of couplers shall be used for all connections.
- Plumb and level scaffoldings as erection proceeds, so that braces will fit without forcing. Fasten all braces securely.
- Working platforms shall be provided with guards. This should consist of top rail, mid rail, and toe board. The toe board shall be of minimum height 100 mm, while the mid rail and top rail shall be at heights of 600 mm and 1200 mm respectively.
- Do not use ladders or makeshift devices on top of scaffoldings to increase the height.

- Shall be placed at least 75 deg. to the floor.
- Ladder shall extend 3" to 4" above the point of Landing and topmost 3 rungs shall not be used.
- Ladder is checked visually for defects before every use.
- Ladders shall not be used in a horizontal position as runways or scaffoldings.
- Ladders shall not be placed in front of a door that opens toward the ladder unless the door is locked, blocked or guarded.
- Fall arrestor to be used where ever applicable.

#### **6.11 Work Permit Procedure**

- For working at more than 10' height the permission must be obtained from site in-charge.
- For doing any Hot work in the fire risk areas the permission must be obtained from site in charge or safety officer.
- For any Excavation work it must be ensured that there are no under group utilities like cables, Water pipeline etc.
- For any work inside confined space, entry permit must be obtained from site engineer.

#### **6.12 Barricades and Warning Signs**

- Area where work is being carried out above man height or below 1' ground depth must be barricaded.
- Follow the instruction of all types of warning signs like "NO SMOKING" "NO ENTRY" "DANGER" "Work at height"

#### **6.13 Emergency Plan and Procedures**

- All Contractor's employees should be aware of site Emergency control plan
- Periodic drill to train employees for their awareness & information should be followed.

#### **6.14 Road Safety Norms**

- For roadside working site to be barricaded as per approved barricading norms Penalty clause for road safety & barricading shall be applicable as per relevant clause of commercial part of tender.
- Only eligible driver can drive required vehicle inside site
- Speed limit norms of site must be followed
- No riding or travelling on the back of open-end vehicle, fork lift or trailers should be done.

#### **6.15 Labour Welfare & Legal Requirement**

- All mandatory provisions with regard to safety as prescribed under contract Labour (Abolition & Regulation) Act 1970 and Rules made there under are applicable.
- Workmen compensation insurance and registration under ESI should be maintained.
- Time to time, all rules and regulations suggested by safety committee of site must be

followed and implemented

## ANNEXURE – A

### RELEVANT IS-CODES FOR PERSONNEL PROTECTION

|                                   |   |                                                                    |
|-----------------------------------|---|--------------------------------------------------------------------|
| IS : 2925 – 1984                  | : | Industrial Safety Helmets.                                         |
| IS : 4770 – 1968                  | : | Rubber gloves for electrical purposes                              |
| IS : 6994 – 1973 (Part – I)       | : | Industrial Safety Gloves (Leather & Cotton)                        |
| IS : 1989 – 1986 (Part – I & III) | : | Leather safety boots and shoes                                     |
| IS : 3738 – 1975                  | : | Rubber knee boots                                                  |
| IS : 5557 – 1969                  | : | Industrial and Safety rubber knee boots                            |
| IS : 6519 – 1971                  | : | Code of practice for selection, care and repair of Safety footwear |
| IS : 11226 – 1985                 | : | Leather Safety footwear having direct moulding sole                |
| IS : 5983 – 1978                  | : | Eye protectors                                                     |
| IS : 9167 – 1979                  | : | Ear protectors.                                                    |
| IS : 3521 – 1983                  | : | Industrial Safety belts and harness                                |



---

**ANNEXURE – B**

FORMAT - 1.0

**1.0: HEALTHY, SAFETY & ENVIRONMENT (HSE) PLAN**

Project: -----

Contractor: -----

Date: -----

Owner: .....

(To be prepared & submitted by each Construction Agency)

| Activity<br>Description | Procedure/<br>W.I./ Guidelines | Code of<br>Conformance | Performing Function |         |          | Audit Function                         |
|-------------------------|--------------------------------|------------------------|---------------------|---------|----------|----------------------------------------|
|                         |                                |                        | Performance         | Checker | Approver | Customer Review/<br>Audit Requirements |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |
|                         |                                |                        |                     |         |          |                                        |

PREPARED BY

REVIEWED

APPROVED BY

## 2.0 MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (1/6)

Project: \_\_\_\_\_ Contractor : \_\_\_\_\_  
Date: \_\_\_\_\_ Owner : \_\_\_\_\_  
Inspection By: \_\_\_\_\_

**Note: write 'NC' (Not Concern) wherever any of the items are not applicable**

| Item                                             | Yes | No | Remarks | Action |
|--------------------------------------------------|-----|----|---------|--------|
| <b>HOUSEKEEPING</b>                              |     |    |         |        |
| Waste containers provided and used               |     |    |         |        |
| Sanitary facilities adequate and Clean           |     |    |         |        |
| Passageways and Walkways Clear                   |     |    |         |        |
| General neatness of working areas                |     |    |         |        |
| Proper Material Storage                          |     |    |         |        |
| Wooden Boards properly stacked and nails removed |     |    |         |        |
| Cords, leads out of walk and traffic ways        |     |    |         |        |
| Scraps removed from the work site                |     |    |         |        |
| Other                                            |     |    |         |        |
| <b>PERSONNEL PROTECTIVE EQUIPMENT</b>            |     |    |         |        |
| Goggles: Shields                                 |     |    |         |        |
| Face protection                                  |     |    |         |        |
| Hearing protection                               |     |    |         |        |
| Safety Shoes provided                            |     |    |         |        |
| Hand protection                                  |     |    |         |        |
| Respiratory Masks etc.                           |     |    |         |        |
| Safety Belts                                     |     |    |         |        |
| Safety Helmets                                   |     |    |         |        |
| Other                                            |     |    |         |        |
| <b>EXCAVATIONS / OPENINGS</b>                    |     |    |         |        |
| Excavation permit                                |     |    |         |        |
| Excavated earth kept away from edge              |     |    |         |        |
| Dewatering pump kept away from edge              |     |    |         |        |
| Safe access into excavated area                  |     |    |         |        |
| Opening properly covered or barricaded           |     |    |         |        |
| Excavations shored                               |     |    |         |        |
| Excavations barricaded                           |     |    |         |        |
| Overnight lighting provided                      |     |    |         |        |
| Other                                            |     |    |         |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (2/6)**

| Item                                                       | Yes | No | Remark | Action |
|------------------------------------------------------------|-----|----|--------|--------|
| Welding Cutting                                            |     |    |        |        |
| Valid not work permit                                      |     |    |        |        |
| Flashback arrester provided for cylinders                  |     |    |        |        |
| Power cable not crossing the welding cable                 |     |    |        |        |
| Adequate earthing provided                                 |     |    |        |        |
| No combustible materials kept near welding & cutting works |     |    |        |        |
| Gas cylinder chained upright & kept in trolleys            |     |    |        |        |
| Cables and hoses not obstructing                           |     |    |        |        |
| Screens or shields used                                    |     |    |        |        |
| Flammable materials protected                              |     |    |        |        |
| Fire extinguisher (s) accessible                           |     |    |        |        |
| Other                                                      |     |    |        |        |
| SCAFFOLDING                                                |     |    |        |        |
| Fully decked platform                                      |     |    |        |        |
| Guard and intermediate rails in place                      |     |    |        |        |
| Toe boards in place & tied properly                        |     |    |        |        |
| Adequate shoring                                           |     |    |        |        |
| Adequate access                                            |     |    |        |        |
| Other                                                      |     |    |        |        |
| LADDERS                                                    |     |    |        |        |
| Extension side rails I'm above                             |     |    |        |        |
| Top of landing                                             |     |    |        |        |
| Properly secured at top & bottom                           |     |    |        |        |
| Angle $\pm 70^\circ$ from horizontal                       |     |    |        |        |
| Other                                                      |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (3/6)**

| Item                                           | Yes | No | Remark | Action |
|------------------------------------------------|-----|----|--------|--------|
| <b>HOISTS, CRANES AND DERRICKS</b>             |     |    |        |        |
| Condition of cables and sheaves OK             |     |    |        |        |
| Condition of slings, chains, hooks and eyes OK |     |    |        |        |
| Inspection and maintenance logs maintained     |     |    |        |        |
| Outriggers used                                |     |    |        |        |
| Singh/ barricades provided                     |     |    |        |        |
| Signals observed and understood                |     |    |        |        |
| Qualified operators                            |     |    |        |        |
| Other                                          |     |    |        |        |
| <b>MACHINERY, TOOLS AND EQUIPMENT</b>          |     |    |        |        |
| Proper instruction                             |     |    |        |        |
| Safety devices                                 |     |    |        |        |
| Proper cords                                   |     |    |        |        |
| Inspections and maintenance                    |     |    |        |        |
| Other                                          |     |    |        |        |
| <b>VEHICLE AND TRAFFIC</b>                     |     |    |        |        |
| Rules and regulations observed                 |     |    |        |        |
| Inspection and maintenance                     |     |    |        |        |
| Licensed drivers                               |     |    |        |        |
| Others                                         |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (4/6)**

| Item                                       | Yes | No | Remark | Action |
|--------------------------------------------|-----|----|--------|--------|
| TEMPORARY FACILITIES                       |     |    |        |        |
| Emergency instruction posted               |     |    |        |        |
| Fire extinguishers provided                |     |    |        |        |
| Fire-aid equipment                         |     |    |        |        |
| Secured against storm damage               |     |    |        |        |
| General nemeses                            |     |    |        |        |
| In accordance with electrical requirements |     |    |        |        |
| Other                                      |     |    |        |        |
| Fire Prevention                            |     |    |        |        |
| Personnel instructed                       |     |    |        |        |
| Fire extinguishers checked                 |     |    |        |        |
| No smoking in prohibited areas             |     |    |        |        |
| Hydrants clear                             |     |    |        |        |
| Other                                      |     |    |        |        |
| ELECTRICAL                                 |     |    |        |        |
| Proper wiring & earthing                   |     |    |        |        |
| ELCB's provided                            |     |    |        |        |
| Ground fault circuit interrupters          |     |    |        |        |
| Protection against damage                  |     |    |        |        |
| Prevention of tripping hazards             |     |    |        |        |
| Proper electrical cable joints             |     |    |        |        |
| Light poles secured                        |     |    |        |        |
| Clear way to power distribution board      |     |    |        |        |
| Proper rating of fuses                     |     |    |        |        |
|                                            |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (5/6)**

| Item                                                                                             | Yes | No | Remark | Action |
|--------------------------------------------------------------------------------------------------|-----|----|--------|--------|
| <b>HANDLING AND STORAGE OF MATERIALS</b>                                                         |     |    |        |        |
| Properly stored or stacked                                                                       |     |    |        |        |
| Passageways clear                                                                                |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>FLAMMABLE GASES AND LIQUIDS</b>                                                               |     |    |        |        |
| Containers clearly identified                                                                    |     |    |        |        |
| Proper storage                                                                                   |     |    |        |        |
| Fire extinguishers nearby                                                                        |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>WORKING AT HEIGHT</b>                                                                         |     |    |        |        |
| Erection plan                                                                                    |     |    |        |        |
| Safety nets                                                                                      |     |    |        |        |
| Safety belts tied properly                                                                       |     |    |        |        |
| Illumination                                                                                     |     |    |        |        |
| No loose material at height                                                                      |     |    |        |        |
| No body under working area                                                                       |     |    |        |        |
| All openings covered                                                                             |     |    |        |        |
| Other                                                                                            |     |    |        |        |
| <b>ENVIRONMENT</b>                                                                               |     |    |        |        |
| Chemical and other Effluents properly disposed                                                   |     |    |        |        |
| Cleaning liquid of pipes disposed of properly                                                    |     |    |        |        |
| Seawater used for hydrotesting disposed off as per agreed proceeding                             |     |    |        |        |
| Lubricant Waste/ Engine oils properly disposed                                                   |     |    |        |        |
| Waster from Canteen office, sanitation etc. disposed properly                                    |     |    |        |        |
| Disposal of surplus earth stripping materials, Oily rags and combustible materials done properly |     |    |        |        |
| Green belt protection.                                                                           |     |    |        |        |

**MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (6/6)**

| Item                                                        | Yes | No | Remark | Action |
|-------------------------------------------------------------|-----|----|--------|--------|
| HEALTH CHECK                                                |     |    |        |        |
| Hygienic conditions at labour camps OL                      |     |    |        |        |
| Availability of First Aid facilities                        |     |    |        |        |
| Proper sanitation at site, office and labour camps          |     |    |        |        |
| Arrangements of medical facility                            |     |    |        |        |
| Measures for dealing with illness                           |     |    |        |        |
| Availability of potable drinking waters for workmen & staff |     |    |        |        |
| Provision of cretches for children                          |     |    |        |        |
| ERECTION                                                    |     |    |        |        |
| Slings/ D'shakle checked                                    |     |    |        |        |
| Signal Man                                                  |     |    |        |        |
| Tag line for guiding the load                               |     |    |        |        |
| Protecting the slings from sharp edges                      |     |    |        |        |
| No loose materials at height                                |     |    |        |        |
| Ladder & platform welding inspected                         |     |    |        |        |
| No one under the suspended load                             |     |    |        |        |
| Stay rope                                                   |     |    |        |        |
| SWL                                                         |     |    |        |        |

-----  
Signature of Resident  
Engineer with Seal

**Monthly Health, Safety & Environmental (HSE) Report  
(To be submitted by each Contractor)**

Actual work start date: \_\_\_\_\_

For the month of: \_\_\_\_\_

Project: \_\_\_\_\_

Report No.: \_\_\_\_\_

Name of the Contractor: \_\_\_\_\_

Status as on: \_\_\_\_\_

Name of Work: \_\_\_\_\_

Name of Safety officer: \_\_\_\_\_

| Item                                                 | This Month | Cumulative |
|------------------------------------------------------|------------|------------|
| Total strength (Staff – Workmen)                     |            |            |
| Number of HSE meeting organised at site              |            |            |
| Number of HSE awareness programmes conducted at site |            |            |
| Whether workmen compensation policy taken            | Y/N        |            |
| Whether workmen compensation policy valid            | Y/N        |            |
| Whether workmen registered under ESI Act             | Y/N        |            |
| Number of Fatal Accident                             |            |            |
| Number of Loss Time Accident (Other than Fatal)      |            |            |
| Other accident (non loss time)                       |            |            |
| Total No. of accident                                |            |            |
| Total man-hours worked                               |            |            |
| Man-hour loss due to fire and accident               |            |            |
| Compensation cases raised with insurance             |            |            |
| Compensation cases resolved and paid to workmen      |            |            |

Remark

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Safety Officer/RCM

(Signature and name)

To: OWNER..... 1 COPY

RCM/SITE-IN-CHARGE 1 COPY





**SUPPLEMENTARY ACCIDENT, INCIDENT&NEAR MISS REPORT**

Project: \_\_\_\_\_ Supplementary to Report No.: \_\_\_\_\_

(Copy enclosed)

Site: \_\_\_\_\_ Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

NAME OF THE INJURED.....  
FATHER'S NAME.....  
SUB-CONTRACTOR M/S.....  
DATE & TIME OF ACCIDENT.....  
LOCATION.....

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT

NATURE OF INJURY / DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICITIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER 1 COPY  
: RCM/SITE-IN-CHARGE 1 COPY



**ACCIDENT REPORT**

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No. \_\_\_\_\_

Date: \_\_\_\_\_

Name of Site: \_\_\_\_\_

COTRACTOR \_\_\_\_\_

NAME OF THE INJURED .....

FATHER'S NAME.....

SUB-CONTRACTOR M/S.....

DATE & TIME OF ACCIDENT.....

LOCATION.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER  
: RCM/SITE-IN-CHARGE

1 COPY  
1 COPY



TS – HDPE CASING FOR MDPE  
PIPE

## TS – HDPE CASING FOR MDPE PIPE

|                                                                                  |                                   |  |
|----------------------------------------------------------------------------------|-----------------------------------|--|
|  | TS – HDPE CASING FOR MDPE<br>PIPE |  |
|----------------------------------------------------------------------------------|-----------------------------------|--|

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## TS – HDPE CASING FOR MDPE PIPE

### 1.0 INTENT OF SPECIFICATIONS

The intent of this specification is to establish minimum requirements to manufacture and supply of HDPE pipes used for casing purpose of carrier pipe, supplying natural gas.

### 2.0 SCOPE OF WORK

The scope of the tendered will include manufacture/ supply, inspection / testing / marking / packaging / handling and despatch of HDPE Pipes of ratings and grades as indicated in the Material Requisition & Schedule of Rates.

Purchaser reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms and conditions in the original order.

### 3.0 REFERENCE DOCUMENTS

Unless otherwise specified, this document requires to the latest standards of the following:

|         |                                                  |
|---------|--------------------------------------------------|
| IS 4984 | High Density Polyethylene Pipes for water supply |
|---------|--------------------------------------------------|

### 4.0 TECHNICAL SPECIFICATION

#### 4.1 Raw Material: -

- 4.1.1 The material used for manufacture of pipes should not constitute toxic hazard, should not support microbial growth and should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. The pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material.
- 4.1.2 High density polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS 7328: 1992. HDPE conforming to designation PEEWA-45-T-012 of IS 7328: 1992 may also be used with the exception that melt flow rating (MFR) shall not exceed 1.10 g/10 minutes. In addition, the material shall also conform to 5.6.2 of IS 7328: 1992 (see A-I).
- The specified base density shall be between 940.5 kg/m<sup>3</sup> and 946.4 kg/m<sup>3</sup> (both inclusive) at 27°C according to procedure prescribed in Annex A of IS 7328:1992. The value of the density shall also not differ from the nominal value by more than 3kg/m<sup>3</sup> as per 5.2.1.1 of IS 7328: 1992
  - The Material Flow Rate (MFR) of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in 7 of IS 2530 :1963. The MFR of the material shall also be within  $\pm 20$  percent of the value declared by the manufacturer.
  - The resin shall be compounded with carbon black. The carbon black content in the material shall be within  $2.5 \pm 0.5\%$  and the dispersion of carbon black shall be satisfactory when tested according to the procedure described in IS 2530: 1963.



## TS – HDPE CASING FOR MDPE PIPE

4.1.3 The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS 10141: 1982.

4.1.4 The addition of not more than 10 percent of the manufacturer's own rework material resulting from the manufacture of pipes is permissible. No other reworked or recycled material shall be used.

### 4.2 Protection: -

- The ends shall be protected by proper end caps to prevent from shocks and ingress of the foreign body.
- Coils shall be covered by black PVC/ PE Film to prevent exposure to direct sun light.

## 5.0 MARKING

Each straight length of pipe shall be clearly marked in indelible ink/paint on either end and for coil at both ends or hot embossed on white base every meter throughout the length of pipe/coil with the following information:

- HINDUSTHAN PETROLIUM CORPORATION LIMITED
- HPCL Logo
- Manufacturer's name/Trade mark
- Designation of pipe
- Sequential length marking at every meter
- Date of manufacturing

### 5.1 BIS certification Marking

Each pipe may also mark with Standard Mark

## 6.0 INSPECTION AND ACCEPTANCE TESTS:

Bidder shall submit Quality Assurance Plan (QAP) immediately after receipt of order for client's approval. The test and inspection shall be carried out as per the QAP in accordance with the codes and standards outlined in the specification. Following test shall be conducted as a minimum as per the codes and standards indicated in this document in the manufacturers premises. Test results must comply with specifications as per IS 4984, including all the other requirements, which are necessary.

### 6.1 Visual Appearance:

The internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects. The ends shall be clean cut and shall be square with axis of pipes. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided that the wall thickness remains within the permissible limits.

### 6.2 Dimension of Ducts:

Please refer Technical data sheet of HDPE Casing for MDPE Pipe



## TS – HDPE CASING FOR MDPE PIPE

### 6.3 Hydraulic Characteristics:

When subjected to internal pressure creep rupture test in accordance with procedure given in Annexure B, of IS 4984, the pipes under test shall show no signs of localized swelling, leakage, or weeping, and shall not burst during the prescribed test duration.

### 6.4 Reversion Test:

The value of the longitudinal reversion shall not be greater than 3%.

### 6.5 Overall Migration Test:

The overall migration of constituents shall be within the limits stipulated in IS 10146

### 6.6 Density:

The density shall be between  $940.5 \text{ kg/m}^3$  and  $946.4 \text{ kg/m}^3$  (both inclusive) when determined at  $27^\circ\text{C}$  according to procedure prescribed in Annex. A of IS 7328. The value of the density shall not also differ from the nominal value by more than  $3 \text{ kg/m}^3$

### 6.7 Melt Flow Rate (MFR):

When tested from a composite sample of minimum three pipes as per IS 2530, at  $190^\circ\text{C}$  with nominal load of 5 kgf, MFR shall be between 0.4 to 1.1 g/10 minutes and also shall not differ by more than 30% of the MFR of the material used in manufacturing pipes.

### 6.8 Carbon Black Content and Dispersion

When tested from a composite sample of minimum three pipes, in accordance with IS 2530, the carbon black content shall be within  $2.5 \pm 0.5$  percent, and the dispersion of carbon~ black shall be satisfactory.

## 7.0 TYPE APPROVAL AND ACCEPTANCE TEST:

### 7.1 Type Test

Three samples of the same size, same pressure rating and same grade selected at random shall be tested for compliance with the requirements of the type test.

If all the samples pass the requirements of the type test, the type of the pipe under consideration shall be considered eligible for type approval.

In case of any of the samples fails in the-type test, the testing authority, at its discretion, -may call for fresh samples not exceeding the original number and subject them to the type test again. If in repeat test, no single failure occurs, the type of pipe under consideration shall be considered eligible for type approval. If any of the samples fails in the repeat tests, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

### 7.2 Acceptance Tests

Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot. All pipes of the same size, same pressure rating and same grade and also, manufactured essentially under similar conditions of manufacture, shall constitute a lot.

The lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristics, reversion, overall migration, density, MFR and carbon black content/dispersion requirements.

|                                                                                  |                                                                 |  |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------|--|
|  | <p align="center"><b>TS – HDPE CASING FOR MDPE<br/>PIPE</b></p> |  |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------|--|

## 8.0 PACKAGE AND DELIVERY

The store shall be supplied in coils of suitable size for delivery in such a manner that they arrive at their distribution in a safe and undamaged condition and will permit the loading, unloading and handing the stores using standard moving equipment. The minimum inner bending diameter of technical coiled duct shall be 25 times the outer diameter of the cut. The material used for packaging wrapping sealing, moisture, resistant, corrosion prevents etc. as per applicable shall be of recognized brands and shall conform to best standards for packaging. The packing shall protect the material from impact vibration rough handling rain, dust, damp, insects, rodents etc., Each packing should have packing slip and test dispatch clearance documents.

## 9.0 QUALITY ASSURANCE PLAN: -

The successful bidder shall submit following for approval of Purchaser/ Consultant after placement of order

- The Quality Assurance Plan (QAP & Sampling Plan)
- Material test report as per clause 5 of IS:4984.
- Performance Requirements (clause 8 of IS:4984)
- Type Test (clause 9.1 of IS:4984).

## 10.0 DOCUMENTS REQUIRED: -

The bidder shall submit following documents at the time of bidding.

- BIS Certification.
- List of current orders in hand for similar items with full details such as specification, name or purchase etc.
- Details of the largest supply executed.
- Name and address of proposed test laboratories along with their credentials / past records for carrying out all required tests.





ENERGISING QUALITY

## VCS PROJECT CONSULTANTS PVT. LTD.

### STANDARD SPECIFICATION FOR LAYING OF POLYETHYLENE MAIN PIPELINES AND SERVICE PIPELINE FOR DOMESTIC CONNECTIONS VPC – SS – PE - 0001

|      |          |                    |                |               |                |
|------|----------|--------------------|----------------|---------------|----------------|
|      |          |                    |                |               |                |
|      |          |                    |                |               |                |
|      |          |                    |                |               |                |
|      |          |                    |                |               |                |
| 00   | 18.06.18 | ISSUED AS STANDARD | BS             | MVK           | AD             |
| REV. | DATE     | Purpose            | Prepared<br>By | Checked<br>By | Approved<br>By |



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## GENERAL INFORMATION

The main scope of this Specification comprises of laying of underground Medium Density Polyethylene (MDPE) main pipelines and service pipeline. The scope covers all the activities associated with the purchasing (specified items only), laying, testing and commissioning of MDPE main pipelines and service pipelines in new & existing gas charged areas of sizes ranging from 20mm up to 180mm OD, which includes PE/GI transition fitting above ground level and above ground laying and commissioning of powder coated GI/ CU pipe line, meter regulator etc. including burner conversion and commissioning.

This technical specification defines the basic guidelines to develop an acceptable design and suitable construction methodology for carrying out different activities listed out in the schedule of rates of this tender.

Compliance with these specifications and/ or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

## 1.0 DEFINITIONS

|       |                                                           |
|-------|-----------------------------------------------------------|
| OWNER | HINDUSTAN PETROLEUM CORPORATION LIMITED (HPCL)            |
| PMC   | VCS QUALITY SERVICES PVT. LTD. (VCSQSPL)                  |
| SS    | STANDARD SPECIFICATION                                    |
| TPIA  | THIRD PARTY INSPECTION AGENCY (TO BE APPOINTED BY CLIENT) |
| EIC   | ENGINEER-IN-CHARGE                                        |

## 2.0 SCOPE OF WORK

Generally, the following shall constitute the contractor's scope of work but not limited to:

Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be issued by Owner/Owner's representative. Contractor has to submit the Construction/Execution procedures before commencement of work to Owner/ Owner's representative for approval.

Prior to start of construction activity, contractor shall prepare route survey drawing marked for proposed gas pipe line laying and submit to CLIENT/PMC for approval

Obtaining permissions from respective land-owning agencies such as Municipal Corporation of State, PWD, Development Authority of State, NHAI, Railway Irrigation department etc. road cutting for laying of the pipelines, liaison with the concerned authorities during execution of the job, obtaining NOC from concerned authorities once the work is completed. Getting back/refund of bank guarantee/security deposits made to the agencies for laying of the pipelines.

Obtaining clearances and coordination with concerned RWA of the allotted area



for internal network laying and obtaining NOC from RWA after completion of work.

Transportation of Free Issue Material from CLIENT stores to contractor stores, proper storing, and stacking, providing security, transit insurance cover during storage, laying, commissioning and handling over pipelines to owner.

Obtaining the approval for optimum route and ROU from the concerned authority.

Making trial pits to determine the underground utilities/services such as existing pipelines, cables (electrical/communication), conduits, U/G drainage, sewers, tunnels, subways foundations etc. for deciding optimum feasible route and depths for laying the pipelines based on the route plans indicated by Owner.

Wherever required the grass/turfing, pavement, linings, drains, roads and other such 'pucca' area shall be locally removed to facilitate trenching and pipe laying works. The same is to be reinstated as original.

Installation of safety/warning signs and barricading of the entire route to be trenched. Pits to be similarly barricaded along with warning signs and caution boards.

To make trenches with stable slopes but restricting minimum disturbance to above ground/underground services/installation as per specifications and approved route plans keeping the trenches free from water and soil till placement of pipes.

Uncoiling/stringing the MDPE pipes of required sizes (i.e. 180, 125, 63, 32 & 20 mm) pipes into trenches as per approved procedure.

Joining the pipe ends with fittings of valves by approved automated electro-fusion techniques only as per tender specification.

Installation of pipe fittings like elbow, tees, reducers, couplers, tapping saddles, transition fittings, valves etc., including construction of supports, valves pits, inspection chambers etc. as per specification & satisfaction of the EIC.

Laying pipelines by any methodology including trenchless technology methods with or without casing pipes (HDPE pipes) as per specifications and as directed by EIC.

Fabrication, supply and inspection of approved quality GI sleeve and half concrete sleeves and other materials, fittings to be supplied by the contractors as per the provisions of tender.

Back filling and compaction by jumping jack compactor wherever required, using approved 'good' soil or using excavated earth or borrow earth as per requirement



and specifications and replacement of the tiles, slabs removed during the excavation. Cleaning all unserviceable materials, debris, excess earth trenches etc. to designated disposal area.

Carrying out pneumatic testing and purging as per specifications and approved procedures, providing all tools & tackles, instruments, manpower and other related accessories for carrying out the testing of pipes.

Supply, fabrication & installation of Stone route marker, Pole marker with foundations, Plate markers, valve chamber etc. as per the directions of the EIC/Owner's representative.

Commissioning of gas in the tested PE line shall be done as per the approved procedure.

Restoration of existing ground features such as grass/turfing, paving, roads, drains, concrete, floral beds, fencing, tiles, marbles, flooring masonry etc. to original condition and to match with adjoining conditions, functionally and aesthetically up to the entire satisfaction of Owner/ Owner's representative /any other third party agency designated by owner and local authorities, failing which, it will be done at the risk and cost of the contractor. Obtaining No Objection Certificates for the restoration work done from the concerned authorities.

Returning surplus material to Owner stores after obtaining clearance from TPIA/Consultant/ Owner, reconciliation of free issue material/consumables.

Handing over the completed works to owner for their operation/use purposes.

Rectification of defects arising due to poor workmanship during defect liability period of pipelines/installations handed over to Owner.

Preparation and submission of all documents like Pit wise As graph, As-built drawings, details of crossings, utility graphs, PE cards for service line and deviation statements on completion/commissioning of work by way of drawing, sketches and tables in soft & hard copy.

Providing adequate manpower, minimum 2 no's each such as data entry operator, customer care executive etc. for data logging like new connection request, NG conversion request & GI tracking, attending complaints, day to day interaction with customers and residents so that work can be executed within defined time period (TAT) Turnaround Time. At present TAT period is 90 days which may vary time to time as per guidelines of PNGRB and CLIENT policy. Data entry operator & customer care executive should be minimum 12th pass (intermediate) with minimum experience of 2 years in relevant field.

Providing adequate manpower for carrying out laying for PNG installation for emergency cases as and when required. Providing adequate manpower for



material for carrying out laying for PNG installation for emergency cases as and when required, as per instruction of EIC.

Following activities are also in contractor's scope:

- Receive Customer's request and complaints logged on CLIENT's CRM/ Offline.
- Carry out joint technical feasibility survey for requests received.
- Attend and resolve customer complaints.
- Maintain and update the request and complaint status in CLIENT's CRM.
- Maintain new connection tracking on CLIENT's CRM.

The warehousing of bulk supply items should be in laying contractor scope. Vendor to mobilize yard/ covers immediately on award, and takeover after checking, on arrival of materials from MDPE supplier.

Any other activities not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/ safety/ statutory/ maintenance of the works shall also be covered under the Scope of work and has to be completed by the Contractor within specified schedule at no extra cost to Owner.

### **3.0 MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY**

Material to be supplied by Owner as Free Issue.

Unless otherwise specified, owner will supply following material such as MDPE - pipes, fittings, valves, transition fittings, HDPE pipe as casing material to contractor (of all sizes) and all materials other than mentioned above shall be supplied by contractor as per technical specification to complete the laying of gas main pipelines and service pipelines.

The free issue material shall not be procured from any other source by contractor. Material reconciliation statement of free issue material duly certified by Owner and PMC shall be submitted to CLIENT on monthly basis.

Material to be supplied by the contractor:

The supply of items as indicated in SOR but not limited to shall be strictly as per relevant technical specifications enclosed with the Tender and as per guidelines of various clauses of SCC and SOR.

All materials shall be handled safely and stored in a permanent, covered, lockable store/ ware house preferably near site in such a manner as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The MDPE pipes and fittings shall be stored in covered storage to protect material from sunshine, rain etc. Pipe should be stacked with clearance from ground level.

### **3.1 Backfilling Material**

The contractor shall be responsible to arrange the supply of approved coarse sand (size 0.6 - 2 mm as per IS-383) free from any impurities like clay, mica, and soft flaky pieces, as per the instructions of EIC/ Owner's representative. For supply of sand in trench for rocky terrain, no separate charges are payable and is included in rates. Also supply of sand in valve chambers, Normal surface & built up surface, if required, as per the instructions of EIC is not separately payable.

In case specified trench depths are not achieved or if directed by Engineer-In-Charge Contractor has to provide concrete casing pipes/ slabs, extra rate of PCC may be payable with prior approval of EIC/ PMC.

Other materials: The contractor shall supply the following items wherever required:

- All materials required for framework, trench support and temporary trench Crossings.
- All sign boards, barricades, tin sheets, lighting arrangement and protective equipment.
- All minor items not mentioned in the specification but necessary for the satisfactory completion and performance of the work.
- Material required for installation of valve chambers.
- GI, Half Round Concrete Sleeves.(Refer Annexure-A-List of Standard Drawings)
- Permanent markers (Refer Annexure-A-List of Standard Drawings)
- Warning Mat

### **3.2 Manpower**

The contractor shall provide the skilled labour, tools, material and equipment necessary for the proper execution of the work.

### **3.3 Equipment, Machinery & Tools**

This will include but is not limited to the list of specialized items included in Annexure# I

All vehicular type machinery shall be in good working order and shall not cause spillage of oil or grease. To avoid damage to paved surfaces, the Contractor will provide pads of timber or thick rubber under the hydraulic feet or outriggers of machinery.

Contractor must also have to arrange his own equipment for restoration work like water tanker and jumping jack compactor for compaction of backfilled trenches and roller and other required equipment/ machinery for asphaltting/ road works.

In case there is non-availability of approved equipment's, tools and tackles during the work at site, suitable penalties, as per special terms and conditions of the contract, will be



levied and deducted from the running bills.

### 3.4 Acquisition, Receipt & Storage of Materials

The Contractor shall collect all materials from CLIENT during stores working hours following all documentation procedures laid down and as directed by the EIC. The Contractor shall carry pipe in such a manner as to preclude damage during transportation and handling. PE pipes supplied in straight lengths may be carried in straight pipe racks.

The contractor shall at the time of receipt of material physically examine all materials and notify the EIC immediately of any damage or defect noticed by the contractor. Any damage not so recorded will be deemed not to have existed at the time of receipt of material by the contractor and the cost of repair or replacement or rectification shall be borne by the contractor. Any material once issued from CLIENT store, if found in non-working condition at site shall be brought to the notice of EIC with PO reference in written within 15 days and after subsequent approval shall return defective material in CLIENT stores within 30 days.

If delay is more than 30 days and material is under warranty, the material will be accepted with a penalty, else the material will not be reconciled and amount of the same will be deducted from bills. Penalty shall be levied as per SCC. The contractor shall ensure that no defective material shall be returned to store at the time of closure of contract. The format for defective materials returning to stores will be made available by EIC.

The contractor shall maintain locked store preferably near at site so that all the materials are stored in such a manner so as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The PE pipes and fittings shall be stored in covered storage to protect material from sunshine, rain, water logging etc. The contractor shall make adequate security arrangements for the stacked material & any loss to the material on account of theft on improper storage is attributable to the contractor.

The Contractor shall maintain log book at their respective stores stating issue and availability of free issue material at a given day. Further, it is mandatory that the contractor is required to undertake and submit inventory details of free issue and purchased materials on monthly basis to Owner/ Owner's representative as per the approved format of the owner. The inventory details shall be in correlation with the Daily progress chart and material reconciliation sheet.

In case of non-submission of material reconciliation on first week of every month, applicable penalties shall be levied as per SCC from the running bills. In case if shortage in free issue material is observed at the time of quarterly physical verification by CLIENT, equivalent value of material found short shall be withheld from running bills, same shall be released after settlement of free issue material.





## 4.0 PROGRESS OF WORK

The contractor shall proceed with the work under the contract with due expedition and without delay. The EIC may direct in what order and at what time, the various stages or parts of the work under the contract shall be performed. Contractor has to regularly submit daily progress reports, weekly progress reports, graphs with utilities, testing reports, material consumption and inventory reports, deviation statements, completion schedule etc.

## 5.0 APPROVALS & PERMISSIONS FOR PIPELINE LAYING

Contractor has to obtain permissions from statutory bodies for laying of pipelines. Statutory bodies in this case are Municipal Corporation of State, PWD, NHAI, CPWD, AAI, Indian railways and any other government agencies who maintain the public lands and accord permissions for laying of the utilities. The contractor shall obtain demand note (road restoration charges) from these statutory bodies. Contractor shall ensure that the road restoration charges are to the minimum against the work to be carried out. CLIENT may return back the demand note, if the charges are not found reasonable and contractor shall not be liable for any liaison charges against the same.

However, CLIENT will pay the road restoration / Departmental charges / security deposit/ Bank guarantees for getting the clearances from statutory bodies. It is the contractor's responsibility to inform and co-ordinate the concerned local authorities and also other utility agencies before and after the commencement of work at site. To ensure smooth execution of the work on a day-do-day basis, the contractor has to liaison with respective authorities. The contractor shall plan and ensure that work taken up under a single permission shall be completed within the stipulated time period and revalidation process is avoided. No separate liaison charges are liable to CLIENT for revalidation cases.

It is the responsibility of the contractor to obtain "No Objection Certificate" (NOC) from land owing agencies/ Statutory bodies after completion of the restoration to their satisfaction and getting released the security deposit/ bank guarantees submitted by CLIENT for obtaining permissions on production of documentary evidence. Separate payment in running meters will be made on account of approvals/permissions as per the SOR item No.6 based on total applied length, where the rates are inclusive of liaison rates. In case of any deviation/ change in the route/ additional laying, CLIENT shall pay the additional Road Restoration Charges only after receiving of revised estimate and further to written confirmation from the concerned Owner site-in-charge.

On behalf of the Owner, contractor shall prepare in advance and submit the proposed route plan complete in all respect and well ahead of time so that the actual construction work is not delayed because of approval/inspection/permission by concerned authorities. Further, the contractor shall also coordinate with the relevant authorities for necessary approvals of these proposed pipeline route drawings/certificates. The inspection of work by statutory authorities shall be the responsibility of the contractor without any extra cost to CLIENT.



In case contractor delays laying of pipeline work under a single permission, the work or part of work may be offloaded to some other contractor on his risk and cost. Any change / addition required to be made to meet the requirements of the statutory authorities shall be carried out by the contractor without any extra cost to CLIENT. The inspection and acceptance of the work by statutory authorities shall however, not absolve the contractor from any of his responsibilities under this contract.

## **6.0 REFERENCE SPECIFICATION, CODES AND STANDARD**

The contractor shall carry out the work in accordance with the requirement of latest relevant applicable standards, this specification, Owner's Engineering Standards; relevant Oil Indian Safety Directorate (OISD) norms, PNGRB Regulations, ASME B31.8-Gas Transmission and Distribution Piping Systems; Australian Standard 3723-Installation and Maintenance of Plastics Pipe Systems for Gas; and the American Gas Association Document - Purging Principles and Practice. ISO-4437/JS: 14885 for underground polyethylene pipes and OWNER's approved procedures.

Should the contractor find any discrepancy, ambiguity or conflict in or between any of the standards and the contract documents, then this should be promptly referred to the Engineer-In-Charge (EIC) for his decision, which shall be considered binding on the contractor.

## **7.0 QUALITY OF WORK**

All works carried out under this contract shall conform to applicable standards, codes of practice, construction procedures and other technical requirements as defined in the technical specifications.

The manpower deployed on the respective activities shall be adequately trained & shall have necessary skills to execute / supervise the work. However, the assessment on the qualification of the personnel shall be at the discretion of EIC.

Fusion operators and other skilled personnel shall be approved by Owner/ Owner's representative and identification cards duly signed by EIC shall be issued to them. Only those personnel who are approved by shall be allowed to execute the critical activities like electro fusion jointing of MDPE pipes & fittings. CLIENT may provide training and certification on chargeable basis where the cost shall be borne by contractor.

## **8.0 SAFETY**

The Contractor shall conform to the safety requirements outlined elsewhere in the tender document. In addition, the Contractor shall observe safe working practices in the storage and handling of cleaning fluids, flammable fluids, etc., and ensure smoking or naked flames are not permitted in the vicinity when these materials are being used.



Trench walls shall be battered with sufficient slope in order to minimize a trench collapse. Where there is a danger of an earth slide or collapse, the trench shall remain open for the minimum time possible with proper barricading. The Contractor is to ensure that no person enters a trench, which is of a depth of 1.5 meters or greater, unless the trench has adequate shoring or the sides are battered to such an extent as to prevent a trench collapse.

The Contractor shall also protect all work sites with warning signs, barricades and night lighting. The Contractor shall inspect all fenced excavations daily, and maintain them in good order.

The trenches/ pits shall not be kept open in night times. However in case the same is essential the same shall be properly barricaded with proper lighting arrangements & manned.

The Contractor shall provide PPE's like helmets, safety shoes, etc. to the labour which are necessary for safe working practice.

Any accident causing injury to any person or damage to property or equipment shall be reported to the EIC and the cost of repair / replacement of the damage equipment shall be borne by the contractor. Where the EIC determines that the work is being performed by the Contractor in an unsafe manner, he may suspend the Work until corrective action is taken by the Contractor.

PPE, Continuous Barricades and caution tapes along the trenches as per approved drawing in tender, Use of Safety Boots, Hand gloves, Reflective jackets, Hard hats(helmets), Safety shoes, eye and ear safety equipment, Fire extinguishers and as per the detailed scope of work in tender specifications. Contractor shall be paid as per SOR item No. 7.a; measurement sheet of laying should also include length of barricading. (Refer Annexure-A-List of Standard Drawings) . For further details Refer "Special Terms and conditions of Contract" & SOR.

## **9.0 ROUTE SURVEY**

Planning, detailing the size, route survey drawings, identification of underground utilities, foreign pipelines, crossings, and location of valve chamber, FRS, DRS, MRS as well as service line location is in scope of contractor.

### **9.1 Mainlines**

The final alignment of mainlines will be worked out at site in consultations with the Owner/Owner's representatives after route survey and trial pits, at contractor cost. Any change in routing from the issued drawings due to site constraint will be notified to EIC & his specific written approval shall be obtained before carrying out the job.

### **9.2 Service lines**

Consultant/Third Party Inspection Agency and the contractor will conduct a joint survey at each probable premise/ housing colony/pockets/area to be supplied with gas. The survey



record will note customer's detailed potential gas supply points, proposed regulator positions and estimates of material quantities. The contractor's representatives will make sketch of the agreed pipe routes.

The contractor will be responsible for contacting the customer and making the necessary arrangements for access and appointments to carry out the work. Contractor shall maintain job card and complaint books at site. Owner will not be responsible for time lost due to failed appointments or disputes with customers.

## **10.0 ORGANISATION STRUCTURE**

Contractor shall designate Project Manager / Coordinator who will be responsible to interact with EIC/Consultant/TPIA and authorized to attend review meetings, receive material, authorized to sign documents, claims and receive payments etc. Contractor shall employ a Project Manager Coordinator on company roll. Project manager / coordinator & Site Engineers on company roll. The Project Manager/ Coordinator must have qualification of BE Mech. /Diploma in Mech. Engg. with min. 2-5 years & Site Engineer must have minimum Diploma in Mechanical Engineering with 3 years of work experience in gas pipe line job. He shall be single point of contact for all the works and must represent company in the review meetings.

All construction work will be carried out as per direction of EIC, and this will be the primary point of contact between the contractor and Owner on site. All work will be issued and sanctioned through the EIC and site control exercised by Site Engineers. The contractor shall ensure that technical quality standards are maintained, that construction is carried out cost effectively and that a good customer and public image is maintained for Owner.

The contractor will deploy his own supervisors as directed by site engineers/EIC. These personnel will be reporting to the Site Engineer for monitoring construction standards and for ensuring that all technical requirements are met for the job being carried out. The contractor's supervisor(s) will have day-to-day liaison with the Site Engineer, and will provide the Site Engineer with technical reports and audits, and other management information as is required on work progress and construction quality standards.

The contractor's supervisor shall have mobile telephones to ensure that they can be contacted at all times. The contractor will also nominate one person who can be contacted if necessary in odd hours, for the duration of the works. The contractor's supervisor will have access to transport at all times to allow them to visit sites and attend meetings with Owner. Supervisor shall attend to normal day-to-day issue of work instructions, communication between Owner and the contractor's supervisor and the Site Engineer.

Contractor shall maintain a Customer Care Centre, Project Site Office, and Material Store in their allotted site with following facilities:

- Telephone, Mobile Phones, Fax machines, Printers/Scanning/Xerox machines, Computers with internet facility.



- One Nos. - Four wheeler with driver, he shall be well equipped with tools and tackles for attending any emergency complaints and ongoing execution work.
- On award of the contract, the contractor shall establish and submit documentary evidence for above, which will be verified by the owner before award of the work order.

## **11.0 STRUCTURES, SERVICES AND OTHER PROPERTY**

### **11.1 Location of Underground Utilities**

The contractor shall locate all buried utility pipes, underground cables, water mains and other obstructions intersecting or adjacent to the Works, and shall make available the necessary labour to expose and record the depth of cover over all obstructions in advance of excavation. This shall be done far enough in advance of excavation to facilitate gradual change in grade or position found necessary to clear any obstructions.

In addition, the contractor shall excavate trial pits as necessary to determine the pipe route. The number of trial pits will be agreed with the Site Engineer in advance of any excavation. In any event, trial pits shall be made at intervals of a maximum of 30 meters. Restoration of the abandoned trial pits and trenches shall be the contractor's responsibility. No payments shall be made for such type of jobs. The trial pits shall be excavated to minimum depth of 1.5 meters so as to locate any utilities present in the trench.

It is contractor's responsibility to interact with other utility agencies regarding their existing utilities and finalize the route along with these agencies and Owner/ Owner's representative.

There will be no additional payments in respect of abandoned trenches incurred because of insufficient or inadequate trial pits, or any associated loss of time or delays.

Contractor must ensure that before starting the execution of laying of pipeline, the intimation/information must cascade to all utilities agencies seeking the information about the existing utility in the proposed route.

### **11.2 Protection of Structures and Utilities**

The Contractor shall at his own cost support and protect all buildings, walls, fences or other structures and all utilities e.g. Electrical cables, Telephone Cables, Water pipelines, Sewer pipelines etc., and property which may be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work. Special care shall be taken while laying of pipelines near the trees.

### **11.3 Interference with Traffic, Street Drainage and General Public**



The Work shall be executed in such a manner so as to cause a minimum inconvenience to persons using public or private roads, lanes, thoroughfares, walkways, rights-of use or passages through which the Works are to be executed. The trench shall be back filled; compacted, leveled and extra soil shall be removed immediately after laying of pipeline to avoid public inconvenience. Closure of roads, etc., shall not be permitted without the approval of the EIC.

The Contractor shall comply with all local Authorities requirements to traffic and keep roads open to traffic and maintain access to and within any private property.

Wherever the pipe route crosses driveways, access tracks or entrances to private properties the Contractor shall give the owner, occupier or relevant authority at least 24 hours prior notice of intended commencement of excavation and shall be restricted to pass through.

The Contractor shall not use a private driveway, access track or entrance without the prior approval of the EIC in any circumstance.

The Contractor shall provide suitable access wherever necessary in the form of temporary bridges, culverts, flumes, etc., of a size and type approved by the EIC.

The Contractor shall comply with all relevant road Laws. Where limits and/or speed limits have been placed in the vicinity of the Works, the Contractor shall provide for the necessary movement of plant and equipment in accordance with the requirements of the relevant authority.

The Contractor shall not obstruct any drainage pipes or channels in any road but shall divert them wherever necessary and use all proper measures to provide for the free passage of water.

The Contractor shall handover the completed works after proper cleaning of the site. The contractor shall conduct his operation at all times, with a view to minimize as far as practicable noise and other objectionable nuisances (e.g. oil leakage, spillage, debris etc.)

## **12.0 TRENCHING**

The schematic drawing with the details of trench is enclosed in the tender as per drawing No. (Refer Annexure-A-List of Standard Drawings)

The Contractor shall perform the excavation works so as to enable the pipe to be laid in conformity with the levels, depths, slopes, curves, dimensions and instructions shown in the Drawings, Specifications or as otherwise directed by the EIC.

Contractor shall excavate and maintain the pipeline trench on staked center line as per approved drawing taking into account the horizontal curves of the pipelines.



While trenching, care shall be taken to ensure that all underground structures and utilities are disturbed to the minimum. Suitable crossing shall be provided and maintained over the ROU wherever necessary to permit general public, property owners or his tenants to cross or move stock or equipment from side of the trench or another.

Trenching shall be made with sufficient slopes on sides in order to minimize collapsing of the trench. On slopes wherever there is danger of landslides, the pipeline trench shall be maintained open only for the time strictly necessary. Owner may require excavation by hand, local route and detouring and limiting the period of executing of the works. Before trench cuts through water table, proper drainage shall be ensured, both near the ditch and ROU in order to guarantee the soil stability.

The Contractor shall ensure that trench bottom is maintained in the square form as far as possible, with equipment, so as to avoid/minimize the hand grading at the bottom of the trench. The Contractor shall do all such handwork in the trench as required to free the bottom of trench from loose rock, pebbles and to trim protruding roots the bottom and sidewalls of the trench.

### **12.1 Depth of Trench**

The minimum depth of cover shall be measured from top of pipe to the top of undisturbed surface of the soil or top of the graded working strip or top of road or top of rail, whichever is lower.

In case of crossing of water bodies the minimum depth shall be measured from the top of the pipe to the bottom of Scour level.

The depth of the trench will be such as to provide minimum cover as stipulated below:

For Distribution and service lines:

|                             |           |
|-----------------------------|-----------|
| Minor Water Crossing/Canal  | 1.5 Meter |
| Uncased/Cased Road Crossing | 1.2 Meter |
| Rail/Road Cased Crossing    | 1.7 Meter |
| Normal Areas                | 1.0 Meter |

The minimum depth may be greater than as mentioned above as may be required by Government/Public authorities under jurisdictions. The Contractor shall perform such work without extra compensation, according to the requirement of concerned authorities.

Also, in case of Drains/Culverts/Utilities crossing through open cut where excavation cut is more than 1.5m, the extra excavation is inclusive in the laying rates. No separate payment is chargeable for extra excavation and includes backfilling as well.

In case, the depth could not be achieved due to practical problems and the same is demonstrated, EIC after examining thoroughly and considering the codes and standards





may allow the contractor to provide suitable protection by way of concrete casing pipes or slabs.

## **12.2 Width of Trench**

The width of the trench shall be wide enough to provide bedding around the pipe as specified and to prevent damage to the pipe inside the trench. Unless otherwise directed by the EIC and where ground conditions permit, the minimum distance from the inside edge of the trench wall to the outside of the pipe shall be as per the Drawing no. (Refer Annexure-A-List of Standard Drawings)

## **12.3 Trench Base**

The trench bottom shall be cut or trimmed to provide a uniform bedding for the pipe and shall be free from stones, metal, wood, vegetation, clods of earth or other debris before placement of the pipe.

In case trenching is done in rocky terrain, a bedding of soft soil or sand shall be provided in the trench base at no extra cost to the satisfaction of EIC.

## **12.4 Hard Rock:**

Hard rock is defined as trench material with a single piece of rock, dimension exceeding 1.0 m in any direction, which requires cutting only by use of chisel/pneumatic chisel/drill or sledge hammer or removal of the same by additional excavation technique approved by EIC. Additional rates shall be payable for hard rock excavation as per the item SOR no 4a over and above the pipeline laying rates. Excavation through soil mixed with small boulders that have been used for a road base will not be considered as hard rock for the purpose of payment.

## **12.5 Morrum**

Morrum shall be defined as the type of soil, whose excavation is not possible manually, but it can be excavated mechanical means such as sludge hammer, excavator, pneumatic breaker hammer etc. The SOR no.: 4b shall be applicable only after recommendation from PMC and prior approval from EIC. These rates will be over and above pipeline rates.

## **12.6 Boulder**

It is a rock with grain size of usually not less than 300mm (12 inches) diameter. Additional rates shall be payable for Boulders excavation as per the SOR item no. 4b over and above the pipeline laying rates.

## **12.7 Clearances**





Unless otherwise approved, the following clearances shall be maintained between the external wall of the gas pipe and the external surface of other underground assets/utilities in the vicinity of the Works.

- 150 - 300 mm where the gas pipe crosses other assets/utilities, etc., for electric cables, the clearance shall be 300mm minimum or special protection shall be provided as per approval of EIC.
- 300mm where the gas pipe is on a similar alignment to the other assets/utilities.

Where the above clearances cannot be achieved, or in other special circumstances, the EIC may approve/specify protection with concrete/ MS coated pipe, etc. The protective material shall be supplied and installed by the Contractor at his cost subject to discretion of EIC.

## **12.8 Under Ground Interferences**

The Contractor shall locate and expose manually all underground facilities if any during trenching. Safety barriers shall be erected along the trench to prevent any damages or accident. On locations where pipeline is laid under the existing facilities and near the approaches of the crossing, the trench shall be gradually deepened to avoid sharp bends.

All sewers, drains, ditches and other natural waterways encountered while trenching shall be maintained open and functional by providing proper temporary installations if required. Suitable dewatering pumps shall be deployed to dewater, if required.

Whenever it is permitted by Authorities and/or Owner to open cut paved road crossing, or where the line is routed within the road pavement, the Contractor shall remove the paving in accordance with the restrictions and requirements of the authorities having jurisdiction thereof as directed by Owner. After laying the pipeline, backfilling shall be immediately performed and all the areas affected connected with the excavation works shall be temporarily restored.

In case of damage to any of above referred structures/utilities the Contractor shall be responsible for repairs/replacement at his own cost, which shall be carried out to the satisfaction of concerned authorities, resident and Owner.

## **12.9 Others**

Throughout the period of execution of such work, the Contractor shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman etc. As required by the local authorities' jurisdiction and/or Owner.

For all roads, paths, walkways etc. which are open-cut, the Contractor shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum inconvenience and interruptions.

The paving shall be resorted to its original condition after the pipeline is installed.



The Contractor shall excavate to additional depth at all the points where the contour of the earth may require extra depth, or where deep trench is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage and ditches without any extra cost implication to Owner.

The Contractor shall excavate all such aforesaid depths as may be required at no extra cost to Owner. The trench shall be cut to a grade that will provide a firm, uniform and continuous support for the pipe.

The Contractor shall take conducive measures to ensure the protection of underground utilities as per the instructions of Owner or relevant authorities.

Where the pipeline crosses underground utilities/structures, Contractor shall first manually excavate to a depth and in such a manner that the utilities/structures are located, then proceed with the conventional methods.

The locations, where the pipeline has to be laid more or less parallel to an existing pipeline cable and/or other utilities in the Right-of-way the Contractor shall perform the work to the satisfaction of the Owner of the existing pipeline/cable/utility. In such locations, the Contractor shall perform work in such a way that even under the worst weather and flooding conditions, the existing pipeline/utilities remain stable and shall neither become undermined nor have the tendency to slide towards the trench.

### **12.10 Bedding**

The Contractor shall ensure that the pipe when placed in the trench is supported and surrounded by a bed of screened excavated soil, which shall be stone free and have a maximum grit size of 5mm, in order to ensure no damage occurs to the pipe. However, in case of rocky soil the bedding shall be done with approved good quality packing sand subject to the approval of the Site Engineer. The packing sand shall be placed to a minimum thickness of 150mm around the pipe in case of rocky terrain.

Unless directed by the EIC the quantity of bedding and surrounding sand shall confirm specifications. There shall be no void space in the packing sand around the pipe.

## **13.0 LAYING**

### **13.1 Main line**

Laying of MDPE pipelines shall be commenced only after ensuring proper dimensions and clean surface of the trench. The trench bottom shall be free from the presence of cuts, stones, roots, debris, stakes, rock projections up to 150mm below underside of pipe and any other material, which could lead of perforation/tearing of the pipe wall. After ensuring above, the MDPE pipe coil shall be uncoiled smoothly through proper equipment's/care before laying pipe inside the trench ensuring no damage to pipe.



The contractor must ensure that Pipe caps are provided before lowering of Pipeline. The trench after this can be released for back filling leaving adequate lengths open at the ends for jointing.

Contractors shall ensure open ends of pipe placed in the trench shall be securely capped or plugged to prevent the ingress of water or other matter. The Contractor is to ensure that nothing enters inside the pipe during the laying process as this could cause a future blockage or regulator malfunction due to dust, etc.

In case of open cuts and moiling, where two pipes are to be laid parallel in same trench or same pits, 30% of the respective SOR of the lower size pipe for the laid length shall be paid extra.

Valves shall be installed at locations shown in the Design Plan or as directed by the EIC and joined with PE pipes by electro fusion techniques. The valves shall be placed on a concrete square block at the bottom to achieve equivalent support of the incoming and outgoing pipe.

Laying graphs/As-graphs with details of depth, length, offsets from minimum three (03) fixed different references, other utility crossings, fittings, sizes of the casing pipe used for the pipeline shall be prepared on daily basis and to be submitted to CLIENT representative/ EIC for approval. These details will further be incorporated in to As-Built Drawings.

Pipe may pass through an open drain or nallah with prior approval from EIC. Where this is permitted, the PE pipe shall be installed inside a concrete or steel sleeve for protection with no cost implications to the owner. The sleeve material shall be procured and laid by the Contractor with prior inspection and approval of the EIC for the quality of material. In general, the GI Sleeve material specification shall be confirming to IS 1239 (Heavy Duty) specification of reputed make; cost of GI sleeve shall be paid to contractor as extra item.

In case of service line laying, where the excavated pit for mainline is used for laying of service line, the length of service pipe laid in the same pit and vertical pipe which rises out of the ground with transition fittings shall be paid as per SOR item nos. 1,3,6,7 and 8. The contractor shall excavate a minimum pit of size 0.5 meter x 0.5 meter (L X W) on any kind of surface along the wall at the customer premises for the service pipe which rises out of the ground with transition fittings through GI pipe sleeve/Half Round Concrete sleeve. This excavation along with other work necessary to break through the walls of the obstruction, insertion of MDPE pipe, sealing of the annulus between the pipe and the sleeve, sleeve and the wall, installation of sleeve, making of pedestal as per Drawing No.(Refer Annexure-A-List of Standard Drawings) min. Size 300 x 150 x 150 mm for GI Sleeve, min. Size 550 x 230 x 150 mm for Half Round Concrete Sleeve Drawing No.(Refer Annexure-A-List of Standard Drawings) and simultaneous restoration of these pits shall be deemed included in the laying rates of pipes respectively. No separate payment of GI Sleeve / Half round concrete sleeve shall be charged to the owner. The material shall be inspected by TPIA / Consultant before installation. Also, the material test certificates, inspection reports approved by TPI/Consultant shall be



submitted at the time of submission of bill. Any installation without inspection & approval may lead to penalties as per Special Conditions of Contract.

In case of service lines, EIC shall decide either half round concrete sleeve or GI pipe sleeve shall be installed at any particular site depending upon site condition. The half round concrete sleeve shall be preferred over GI Sleeve, however in case where the installation of half round Concrete Sleeve is not possible due to technical feasibility and site conditions, GI sleeves shall be installed only after written approval from EIC. The rate of GI Sleeve / half round concrete sleeve shall be included in laying of 20/32 mm dia. As per respective SOR item no., depending upon surface conditions.

### **13.2 GI Sleeve**

The contractor shall supply the minimum dia. Size of 2.5" & 3", 300 mm in length, GI sleeves (Heavy Duty reputed make) respectively for domestic & commercial / industrial installations. The material shall be inspected by TPIA / Consultant before installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

The installation of GI sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the GI sleeves by concrete mix pedestal, clamping, sand filling, etc.

The vertical portion of the sleeves shall be fixed to the wall of the premises in a secure manner. The Service lines shall be installed in accordance with the drawing enclosed in the tender.

### **13.3 Half Round Concrete Sleeve**

The installation of Half Round Concrete sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the Concrete sleeves by concrete mix pedestal, clamping, sand filling, etc. Half round concrete sleeve shall be made as per attached drawing no.(Refer Annexure-A-List of Standard Drawings) as per instruction of EIC. The dimensions shown are tentative and may vary depending upon the site conditions. The material shall be inspected by TPIA / Consultant at the fabrication stage & prior to final dispatch at site for installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

### **13.4 Crush Guard/ half Round Concrete Sleeve: - (For O&M and Project)**

The installation of pre-cast RCC crush guard over Half Round Concrete Sleeve/ Pedestal shall be done by installing it resting on wall of building by fixing it with grouting nut and bolts in wall that may be detached during the event of leakage/testing. The material shall be inspected by TPIA / Consultant at the fabrication stage & prior to final dispatch at site



for installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

The Crush Guard shall be installed in accordance with the standard drawing, enclosed in the tender as per instruction of EIC.

### **13.5 LAYING OF SERVICE LINE IN PROJECT AND O&M AREA:**

O&M area shall be defined as those areas where PE line is already charged and handed over to owner.

Laying of pipeline (for 20 & 32mm) in all type of surface i.e. all kinds including Kutcha, metal, concrete (PCC/RCC), bituminous, tiled, brick lined etc. after racking up of hard surface of any type by any methodology. Roads, Pavement, Footpaths etc. shall be made motor able once the pipeline is laid. Supply & installation of GI Sleeve / Half round Concrete sleeve shall be included in laying rates. The rate includes liasoning with statutory bodies and no separate rates are payable. Wherever service lines are to be laid after dismantling nallah / drain, additional cost for dismantling and repairing shall be payable under respective SOR item no.

All service lines left out initially during mainline laying and laid by same contractor within six months of gas charging of that particular area shall be paid as per respective SOR item no.

All service lines left out initially during mainline laying and laid by same contractor after six months of gas charging of that particular area shall be paid as per respective SOR item no.

All service lines left out initially during mainline laying and laid by other contractor after gas charging shall be paid as per respective SOR item no.

### **13.6 MDPE PIPE LINE LAYING (20MM / 32 MM / 63MM) IN ALREADY EXCAVATED TRENCH IN BUILDER SEGMENT**

Scope includes laying of MDPE pipeline in already excavated trench with or without casing ; insertion of the carrier pipe in casing pipe (on case to case basis) laying of warning mat electro-fusion of joints and re-installation of pre-cast slabs as per specification after instruction of EIC / Site Engineer of Owner.

### **14.0 JOINTING OF POLYETHYLENE PIPE**

The procedure for jointing of PE pipe and fittings machines is attached as Annexure #2 and as per Specification for ELECTROFUSION FOR PE PIPES AND FITTINGS. Only Bar coded into electro-fusion machine (Automatically Readable) that can read the bar code of the fittings automatically shall be used for joining of the MDPE pipes/fittings. Manual feeding Electro-fusion machines are not acceptable for jointing purpose. The contractor has to submit the certificate of calibration of Fusion machine at the time of start of work and at fixed intervals as per the instructions of Owner. Contractor shall ensure that the machines are always available at site. No stoppage of work due to the non-availability of machines shall be allowed.



The contractor shall flush the Pipeline with air to remove dust, water, mud etc. before fusing the joints. Before jointing, the Contractor shall place packing sand under the pipes on both sides of the joint to keep the pipes in line and at the correct alignment during the jointing process. The jointing process shall start only after Alignment clamps with the correct size are aligned with the pipe and coupler during the electro-fusion cycle.

The Contractor shall ensure that polyethylene pipe is only cut with an approved plastic pipe-cutting tool (Rotary Cutter up to 63mm/Guillotine Cutter for 63mm and above). Before fusion is attempted, the contractor shall remove the oxidized surface of the pipe using Universal Scraper up to 63mm/Rotary Peeler for 63 mm and above before inserting into the electro-fusion coupler. The tool must remove a layer of 0.1mm to 0.4mm from the outer surface of the polyethylene pipe. No fusion will be allowed without clamping device and the approved cutting tools (Hack saw shall not be allowed for cutting the pipe).

The contractor has to supply all the consumables required for carrying fusion of the joints (like tissue paper, napkin, acetone etc.).

If, upon inspection, the EIC determines a joint is defective, Contractor shall remove the joint by an approved method. The cost of replacing joint shall be borne by the Contractor including the cost of pipe and fittings removed.

For electro-fusion joining, the contractor must bring own tools, tackles and equipment's. Only, approved Jointers shall carry out fusion of all joints. Contractors shall provide the list of jointers to be used on the job and make arrangements for Qualification Testing of the jointers in presence of Owner / Owner's representative as per the standard procedures. All approved Jointers shall bear identity cards signed by Owner / Owner's representative during fusion job and shall furnish the same on demand by Owner / Owner's representative. Applicable penalties shall be levied, in case; it is found that fusion is being carried by non-qualified jointers as per the provisions made in Special Conditions of the Contract.

Contractor shall arrange generator along with voltage stabilizer for power supply to fusion machine. Taking power connection from electric poles, connections without written permission from the concerned authorities or residential premises is strictly not permitted.

## **15.0 BACKFILLING**

Backfilling shall be done after ensuring that appurtenance have been properly fitted and the pipe is following the trench profile at the required depth that will provide the required cover and has a bed which is free of extraneous material and which allows the pipe to rest smoothly and evenly. Dewatering shall be carried out prior to backfilling. No backfilling shall be allowed if the trench is not completely dewatered.

Prior to backfilling it should be ensured that the post padding of compacted thickness 150 mm is put over and around the pipe immediately after lowering where required.





Backfilling shall be carried out immediately after the post padding where required has been completed in the trench, inspected and approved by Owner/ Owner's representative, so as to provide a natural anchorage for the pipe avoiding sliding down of trench sides and pipe moment in the trench. If immediate backfilling is not possible, a padding of at least 300mm of earth, free of rock and hard lumps shall be placed over and around the pipe and coating.

The backfill material shall contain no extraneous material and/or hard lumps of soil, which could damage the pipe and/or coating or leave voids in the backfilled trench. In case, it is required and directed by EIC screening of the backfill material shall be carried out with specified equipment before backfilling the trench.

The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench to such a height which will, in Owner/Owner's representative opinion of provide adequately for future settlement of the trench backfill during the maintenance period and thereafter. The down shall be high enough to prevent the formation of the depression in the soil when backfill has settled into its permanent position should depression occur after backfill, Contractor shall be responsible for remedial work at no extra cost to Company. Surplus material, including rock left from this operation shall be disposed off to the satisfaction of landowner or authority having jurisdiction at no extra cost to Owner.

Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a height of 150 mm above the top of the pipe. Select backfill materials for padding that area acceptable shall be soil, sand, clay or other material containing no gravel, required selected backfill material has been placed, provided the rock or lumps of hard soil. The padding earth shall not contain any stones, i.e. the earth shall be screened for sand padding of the Pipeline in order to avoid damage to the pipeline. Contractor shall carry out all these works at no extra cost to Owner. Loose rock may be returned to the trench after the required selected backfill material has been placed, provided the rock placed in the ditch will not interfere with the use of the land by landowner, or tenant.

In case where hard rock is encountered or as desired by EIC / site engineer sand padding is to be provided up to height of 150 mm around the pipe.

When the trench has been dug through driveways or roads, all backfilling shall be executed with sand/suitable material in layers as approved by Owner /Owner's representative and shall be thoroughly compacted. Special compaction methods as specified may be adopted. All costs incurred there upon shall be borne by the Contractor. Trenches excavated in dikes which are the properties of railways or which are parts of main roads shall be graded and backfilled in their original profile and condition. If necessary, new and/or special backfill materials shall be supplied and worked-up to.



PE Warning Grid/Mat shall be placed on distribution main and service line inside premises, after backfill of the trench up to a height of 300mm on the top of the carrier pipes. The warning grid is to be unrolled centrally over the pipe section and thereafter further backfilling will commence.

Backfilling activity shall include proper compaction by jumping jack compactor, wherever required and as per instruction of EIC, and watering in layers of 150mm above the warning mat. Proper crowning of not more than 150mm shall be done. All the excavated material that could be used during the Restoration process shall be stacked and kept separately and properly. Wherever Road cutting/Tiles removal/PCC cutting has been done during excavation for laying, the area shall be back filled and compacted immediately so that no inconvenience is caused to the general public.

Electro-fusion of joints is to be undertaken immediately after lowering and the activity shall not be kept pending for lack of Electro-fusion jointing. The backfilling shall be considered complete only after the jointing of pipes.

Debris and other surplus material shall be removed immediately after the back filling.

The contractor shall not be entitled for payment as defined in commercial on laying and backfilling till the above activities are completed.

## **16.0 MOLING**

The Manual Moling shall be carried out as per the requirement specified by Owner / Owner's representative and approved procedures. The contractor has to carry out survey of the underground utilities before going for the Moling to avoid any damage to other utilities. No extra payment will be made for any trial/abandoned pits made during the survey. The supply of all equipment required for carrying out moling work is in contractor's scope. The type of moling to be carried out i.e. with or without casing shall be at the discretion of Owner and prior approval is to be taken before starting the Moling.

For Moling the contractor shall ensure that the size of the hole shall not be more than 20% of the size of the casing/carrier pipes whichever is applicable. After completion of Moling the hole shall be properly compacted / filled with soil by watering and by approved procedures.

The moling rates are payable as per the SOR item no. 1 & 3 and the moling rates are common for MDPE pipe laying with or without casing pipe through the hole. The length of the Hole (excluding the sizes of the pits on both ends) shall be considered for the measurement of Moling length. However, the extra length of casing shall be considered for material consumption purpose only. In case of moling, where partial laying is carried out in casing and rest without casing, the SOR item no. 3. Shall be applicable for both. Further, the payment for the pipeline laying in the excavated pits for Moling purpose will be made as per the SOR for normal laying.





Any damage occurred to other utilities during the moling operation shall be immediately, notified and rectified by the contractor without any cost implication to owner.

## 17.0 HORIZONTAL DIRECTIONAL DRILLING (HDD)

HDD is required to be carried out by the Contractor where conventional Trenching/Moling is not possible viz. Railways, major waterways, highways, roads, congested areas etc. The Contractor shall obtain details of such crossings and the Contractor in consultation with Owner shall prepare construction drawings. Execution of the work shall be based on the Owner / Owner's representative approved drawings. The contractor has to do the thorough survey of the underground utilities before commencement of HDD to avoid the damage to the other utilities. No other extra payment will be made for any trail/abandoned pits made during the survey. The supply of all equipment required for carrying out the HDD is in contractor's scope. The HDD operation shall be carried out in accordance with API-1102. The type and availability of machines is sole responsibility of the contractor and as per the site conditions & requirements to entire satisfaction of EIC.

Once the work is allotted, any delay in mobilizing / non-availability of HDD machines as per site requirement and conditions shall result in levying of penalties on daily basis as per SCC. However, in such cases, owner shall mobilize HDD machines and carry out execution of work on the contractor's risk and cost and as per SCC.

The type of HDD to be carried out with or without casing shall be at the discretion of Owner and prior approval is to be taken before starting the HDD.

The rates for HDD, as indicated in SOR item no. 6 & 7, as applicable on the site conditions, are payable as per the size of the carrier pipe and inclusive of excavation of pits, jointing, pilot boring, bentonite cleaning, reaming, insertion of carrier pipe, backfilling, compaction, etc.

As per the specification, HDD to be carried out with or without casing pipe depends on the type of crossing as per instruction of Owner/ Consultant.

Any damages occurred to other utilities during the HDD operation shall be immediately notified and rectified by the contractor without any cost implication to OWNER.

The measurement for the payment shall be measured as per the span for which the beacon/sensing source which is attached to the reamer at the time of pulling carrier pipe for HDD. HDD profiles should be properly marked in the as built drawing in scale.

## 18.0 CASING PIPE

The tentative sizes of the HDPE casing pipe for Moling/ Horizontal Directional Drilling shall be as follows:



| <b>S.No.</b> | <b>MDPE Carrier Pipe Dia.<br/>size (mm)</b> | <b>Min. Dia. of HDPE<br/>Casing Pipe (mm)</b> | <b>Max. Dia. of HDPE<br/>Casing Pipe (mm)</b> |
|--------------|---------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| 1            | 20                                          | 40                                            | 80                                            |
| 2            | 32                                          | 50                                            | 90                                            |
| 3            | 63                                          | 125                                           | 160                                           |
| 4            | 125                                         | 200                                           | 250                                           |
| 5            | 180                                         | 250                                           | 315                                           |

However, the size of the casing pipe may vary according to the length of the carrier pipe and requirement of laying of HDPE duct & OFC cable, if required. Also, the higher size of HDPE casing pipe shall be preferred over lower size casing pipe without any extra cost to the Owner.

## **19.0 RESTORATION**

Wherever the restoration to the original surface condition is in the scope of Owner or as directed by EIC, all roads, footpaths (including roads and footpaths inside colonies) shall be restored to its original condition and the same shall be done as per CPWD/IRC norms and to the satisfaction of the concerned local Authority/Third Party Agencies designated by Owner. To retard curing of the installed concrete, wet sackcloth is to be placed on the finished surface and kept damp for a period of 7 days.

Where slabs and blocks are to be restored, the level of the compacted sub-base is to be adjusted according to the slab/block thickness. The slabs or blocks should be laid on moist bedding material, which should be graded sand, mortar or mortar mix. The slabs or blocks should be tapped into position to ensure they do not rock after lying.

The restored slabs or blocks should match the surrounding surface levels. Joint widths should match the existing conditions, and be filled with a dry or wet mix of mortar.

The procedure for restoration of Road/Footpath is just indicative. However, the restoration shall be done in accordance with the norms of the concerned Land owning agencies.

Turf shall be replaced in highly developed grassed area. In lesser-developed grassed areas top soil should be replaced during the restoration process.

Where permanent surface restoration cannot be completed immediately, the Contractor shall provide and maintain a suitable temporary running surface for vehicular traffic and pedestrians. The Contractor will be responsible for the maintenance of all restoration carried out, for the duration of the Contract guarantee period.

The Contractor is to ensure the restoration work is properly supervised and that the material used is suitable for the purpose and properly compacted. Where the required standards are not achieved, the Contractor will be required to restore the defective work.



Payment to the restoration shall be paid as per SOR item no. 3. Further, the rate of restoration includes WBM, Asphalted /Bituminous, concrete pavement, Agra Stone/ Kota stone/ Tiles (Chequered/ any other type of tiles), interlocking paver blocks, Dry brick pavements etc. and payable under one SOR.

Note that payment for restoration will be released only after satisfactory completion and certification by Third party/Consultant.

Contractor has to obtain the No Objection Certificate (NOC) from the concerned local authorities/RWA after completion of the restoration work. The restoration specification specified in the tender is only a typical specification and the contractor has to carry out restoration as per the latest version CPWD/IRC/ MUNICIPAL CORPORATION OF STATE specification to its original condition and also to the entire satisfaction of landowner (Private/Public).

The expenditure incurred towards testing of the material used for restoration, as per the applicable standards, shall be borne by contractor.

## **20.0 TESTING**

Pressure testing will be carried out with compressed air (free from oil and greases). Compressed air will be provided by Contractor for testing purposes and is to be included in the laying rates.

For main pipeline laying, the Contractor shall perform progressive pressure testing to ensure no leaks in long lengths of pipe. The test pressure shall be 6.0 bar (g), and there shall be no unaccountable pressure loss during the test period.

Overall scheme drawing for pressure testing shall be prepared by the contractor and get approval from Owner/Owner representative.

For main line the test duration shall be 24 Hrs. with these tests, the pressure should be allowed to stabilize for a period of 30 minutes after pressurization. The holding period may then commence and continue for 24 hours. Measuring instruments shall have been calibrated and their accuracy and sensitivity confirmed. For testing of Network, calibrated pressure gauges of suitable range shall be supplied by the contractor. The pressure gauges shall be calibrated from time to time as desired by EIC. All testing shall be witnessed and approved by the EIC or his delegated representative. Tie-in joints may be tested at working pressure following commissioning. In special cases, where the mainline length is less than 500 mtrs, holding period for testing may be reduced to 4 hrs.

For service lines up to a length of 15 mtrs testing will be carried out independently of the testing of the mains (if service line is laid separately after commissioning of mainline) for which the test duration may be reduced to 30 minutes at 6 bar (g) pressure. The service line testing in this case will be performed after the service line installation is complete but

before the service line tee has been tapped. Also in some cases the tapping of the service tee will be delayed pending the completion and purging of the main pipelines.

## **21.0 PURGING**

Purging shall be carried out in accordance with the principles defined in the American Gas Association publication "Purging Principles and Practice".

The Contractor shall also provide nitrogen required for purging as per the direction of Site In-charge. Nitrogen shall be supplied in labeled, tested and certified cylinders and completed with all necessary regulators, hoses and connections, which will be in good and working condition. No separate payment shall be paid for supplying Nitrogen cylinders for purging and is included in the laying rates. Before purging cylinder should be checked for containing Nitrogen only.

In addition, the Contractor shall submit purging plan and get approval from Owner / Owner representative before commencing any purging work. The Plan shall include, but not be limited to the provision of the following materials and equipment: Personal Safety Equipment, Fire Extinguisher, Purging Adaptor, Purge stack with flame trap and gas sampling point, Gas sampling equipment (may be gas leak detector), squash-off tool, Polyethylene connecting pipe.

The Plan shall also include the purging process along with detail on the sequence of events. The process is to also specifically mention the need to lay a wet cloth over the PE main and in contact with the ground, to disperse static electricity during the purging work.

A purge stack with flame trap shall be used when purging services. Care shall be taken to ensure that the purge outlet is so located that vent gas cannot drift into buildings.

## **22.0 VALVE PITS**

Valve pits (RCC/ Brick Wall) shall be constructed as per enclosed drawing no. (Refer Annexure-A-List of Standard Drawings) in the document.

Payment for the valve pit construction shall be paid as per SOR item no.15 a & b. The construction of the valve chambers shall be taken up immediately after installation of valve.

### **22.1 Material for Valve Pit**

RCC Pre-cast Slab shall conform to IS: 456. Heavy Duty RCC Manhole Cover shall be used. It shall be with raised with Lifting hooks. The RCC manhole cover shall have a clear opening as per the Construction Drawings issued to the contractor.

### **22.2 Workmanship**



The excavation work shall be done at a location given by Engineer-in-Charge. All care shall be taken not to damage existing facilities and surface of construction shall be restored to its original state.

Sand bags to be placed below pipeline without disturbing the laid pipe. Gunny bags and Sand should be of approved quality.

PCC to be placed below the pipe as indicated. Once PCC is set sand is to be filled and properly rammed so that pipe and pre-cast concrete blocks are firmly place.

Valve will be supplied without the operating stem. Approved quality sand is to be placed in between area. The supply of sand is included in the rates.

Surrounding area to be properly cleared and PCC to be placed around the location where pre-cast slab with RCC Manhole cover is placed. The RCC pre-cast slab to be laid in level and finished smooth.

## **23.0 CONSTRUCTION OF TRENCHES AND OTHER SCOPE OF WORK IN BUILDER SEGMENT-**

### **23.1 Construction of dedicated trench (as per approved drawing)**

Trench Dimension- 0.6m x 0.66m x 1.0m (d x w x l)

Scope includes excavation of trench in any type of surface, construction of brick wall, waterproofing of trench(If required), removal of surplus malba, plastering of walls, watering and curing including supply & installation of precast RCC slab covers Site cleaning and restoration of all damaged surfaces during construction activity. Contractor should submit NOC through concerned RWA/Builder/Authority. For other details please refer drawing no.(Refer Annexure-A-List of Standard Drawings)

### **23.2 Construction of dedicated trench (as per approved drawing)**

Trench Dimension- 0.375m x 0.66m x 1.0m (d x w x l)

Scope includes excavation of trench in any type of surface, construction of brick wall, waterproofing of trench(If required), removal of surplus malba, plastering of walls, watering and curing including supply & installation of precast RCC slab covers Site cleaning and restoration of all damaged surfaces during construction activity. Contractor should submit NOC through concerned RWA/Builder/Authority. For other details please refer drawing no.- (Refer Annexure-A-List of Standard Drawings)

### **23.3 Excavation of trench and installation of casing pipe by any method (Open /Moling)**

Scope includes excavation of trench/moling in any type of surface and installation of 6" GI Pipe C Class as casing pipe, restoration for road crossing up-to 7.0 m inside society and obtaining NOC through concerned RWA/Builder/Authority.

### 23.4 Sand Filling in any type of trenches in builder segment only;

Scope includes supply and filling of coarse sand (Size 0.6 To 2.0mm) as per IS 383 free from impurity like clay, mica and soft flaky pieces in the trench as per instruction of EIC/Owners representatives.

Note- In all of the above items 10% amount shall be withheld till availability of NOC from concerned authority.

### 24.0 ROUTE MARKERS

Route Markers shall be fabricated, supplied and installed on the ROU at regular intervals as per the instructions of the EIC immediately after laying of the Pipeline. The installation of the type of the Permanent Marker shall be decided by the EIC depending on the site condition. The contractor shall also ensure that a sample of all type of markers shall be inspected and approved by Owner / Owner representative before shipment of the lot at site and prior to installation at the site. The inspection of all types of markers shall be carried out lot wise.

The Stone Markers shall be painted before installation as per the approved procedure. Whereas the Pole marker (Markers with foundation) and plate marker are to be supplied with powder coated Golden Yellow paint the supply of the paint as per drawing no. (Refer Annexure-A-List of Standard Drawings) and application. The supply of paint and application as per the specification is in contractor's scope. Payment shall be paid as per relevant SOR item no. 5a, b & c. Contractor shall obtain the approval lot wise & before installation at site from the Consultant / TPIA.

### 25.0 GUIDELINES:

- The installation of these markers shall be such that in between two pole markers two Stone markers are installed with spacing of 50 mtrs on either side. However, Pole markers shall be installed at all the Tapping /Branching points in the mainline.
- Interval between any two Stone Route markers for mainline (180mm to 63mm) shall not be more than 50m.
- A Pole marker shall be installed near to valve chambers on Mainline & inside the pockets respectively for indication.
- Pole markers with foundations (As per the Drawings in Tender document) shall be installed after two Stone markers.
- The entry and exit pits for laying of pipeline by HDD / Moling for Road crossings shall be marked by Pole markers or Stone markers depending upon the site conditions.

In addition to above, Pole markers with foundation (As per drawings in Tender document) shall be installed outside of individual societies/areas as per the instructions of the Owner

representative.

- For the distribution network 32mm & 20mm pipe, Stone / plate markers shall be installed as per the site conditions and directions of the Site-in-Charge.
- The artwork is typical for all the markers, with Owner's logo on it. The contractor must take prior approval for the artwork from EIC before installation of Markers. The lot wise approval shall be attached with bills.

## **26.0 ASSISTANCE IN COMMISSIONING**

Contractor shall provide the required personnel, Vehicles, labour, supervision, tools, equipment, instruments and technical assistance for performance tests and commissioning activities as per requirement/ satisfaction of Owner /Owner's representative.

## **27.0 STANDARD OF WORK**

All work carried out under this contract shall be to standards, codes of practice construction procedures and other technical requirements as defined in the technical specifications. The manpower deployed on the respective work shall be adequately trained and shall have necessary skills to execute/supervise the work. However, the assessment on the qualification of the personal shall be at the discretion of EIC.

Fusion Operators and other skilled personnel like plumbers, conversion techniques shall be approved by Consultant/ Owner. Simultaneously Identification Cards duly signed by Consultant/ Owner shall be issued to them. The contractor shall maintain proper record for the identification cards issued to their workers.

## **28.0 RECORDING (AS-BUILT DRAWINGS)**

- The following points shall be taken care to the preparation of as built drawings.
- The as built drawings should be in the scale of 1:200 and shall be submitted in an A-0 sheet. The drawings shall be in layers according the AUTOCAD features category.
- Pipeline feature shall be shown as a continuous line, breaks only at joints, fittings, valves, tee point, etc. Diameter, Pipe material, length, and location of pipeline whether on the road or footpath, should be clearly indicated.
- Minimum three (03) offsets of every joint, from permanent structure shall be recorded on As Built.
- Distance of pipeline from permanent property/structure should be provided at least every 20 mtrs. If there is any change in alignment / orientation and offset distances etc. Of the pipeline in between the above said 20 mtrs, the same shall be clearly mentioned in the as laid. Gas objects (off valves, tees, elbows, couplers, transition





fittings etc.,) shall be shown as block objects (which form a single node to connect) with respect to Owner symbols / legend. The As laid drawings shall be as per the approved legends provided by EIC.

- Details & offset distances from other utilities present (e.g. MTNL, Electricity Board of State, Water/ Sewage Board of State, etc.) should be given in as laid drawing. If there is any change in depth of the pipeline, the same shall be clearly marked with details in the as laid drawings. The details (material, size & Length) of additional protection provided to pipeline shall also be clearly indicated.
- Details of the PE stop off valves &. Other fittings used (i.e. tees, elbows, couplers, transition fittings, etc.) should be shown with adequate information orientation &. Offsets from permanent structures in the immediate vicinity.
- Technical deviations (if any) should be provided with reference to the buildings permanent structures around, and the same should be cited clearly with all the relevant details, including separate sketches/Blowups / sectioned drawings / exploded view.
- Total as laid-length (size wise), bill of materials should be mentioned in each sheet.
- Complete details of nallah crossings should be shown in a separate sketch.
- Names of roads, major landmarks and buildings should be mentioned appropriately for reference.
- Proper chainage shall be mentioned on all the drawings to be referred with continuation reference.
- Direction of gas flow shall be indicated in each of the drawings.
- Text on the as laid drawing should be clearly visible.
- Land base features shown on the drawing shall match the exact distance as they were on real ground with respect to scale (1:200).
- As built drawings shall be duly signed & stamped by area TPIA / Consultant.
- The details shall be prepared in standard format using MAP INFO/ AUTOCAD MAP and submitted CD RAM. Contractor shall also make the item wise material consumption report for the respective areas in a soft copy and to be submitted along with the as-built drawings.

## **29.0 CIVIL WORKS**

The contractor has to supply the adequate materials and skilled manpower for the completion of all the civil works. The contractor shall also ensure that the work is carried out as per the details mentioned in the Schedule of rates.

Special cares shall be taken at the time of labours working in depths/lifting of the skids by





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SERVICE PIPELINE FOR DOMESTIC CONNECTIONS**

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Rev No : 00**

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hydras/ cranes considering all the safety guidelines.

The contractor has to ensure that sample of the all the materials shall be inspected and approved by EIC before carrying out installation or erection work. The contractor has to submit the test certificates for all the materials to be used at the site. The construction shall be carried out strictly as per the drawings provided by the CLIENT/Consultant. The contractor shall ensure extra / surplus materials/ malba shall be immediately removed from the site after completion of the job. Separate payments shall be made as per the SOR PART III.



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**ANNEXURE # 1**

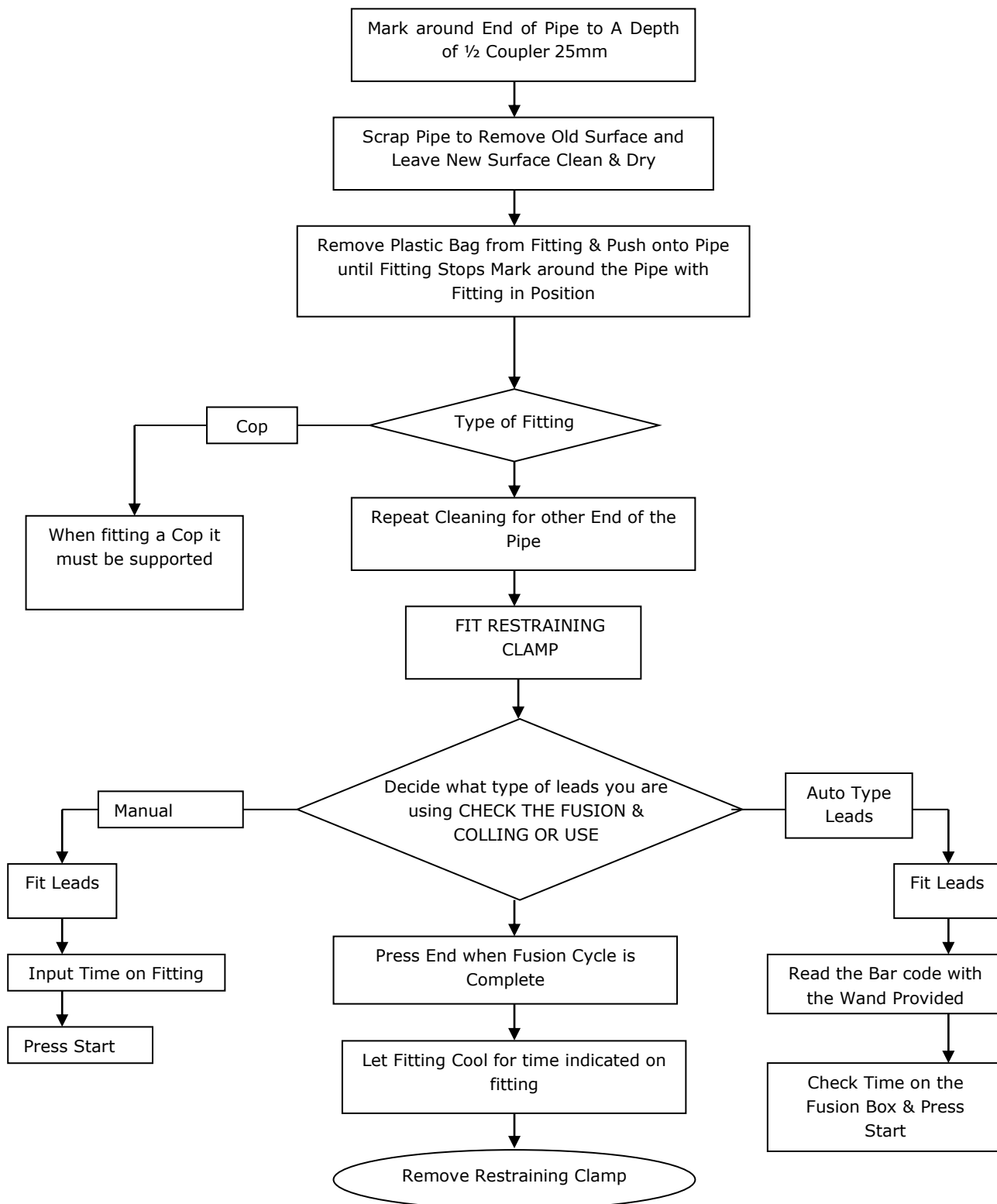
**TOOLS & EQUIPMENTS TO BE PROVIDED BY THE CONTRACTOR FOR PRE  
LAYING**

| Sl. No. | Equipment Details                                                                     | Minimum Requirement (In Nos.) |
|---------|---------------------------------------------------------------------------------------|-------------------------------|
| 1       | Electro Fusion Box (Automatically readable)                                           | 2                             |
| 2       | Voltage Stabilizer                                                                    | 1                             |
| 3       | Generator (5.5 KVA)                                                                   | 2                             |
| 4       | Moiling Equipment (for all sizes)                                                     | As and when required          |
| 5       | HDD Machines & Equipment (for all types & sizes)                                      | As and when required          |
| 6       | Squeeze Tools (Manual) up to 63 mm                                                    | 2                             |
| 7       | Squeeze Tools (Hydraulic) from 63 mm up to 180 mm                                     | 2                             |
| 8       | Rotary Peelers                                                                        | 2                             |
| 9       | Universal Scrapers                                                                    | 3                             |
| 10      | Tapping Tools/Allen Keys                                                              | Two sets of all sizes         |
| 11      | Pipe Cutter (Round)                                                                   | 2                             |
| 12      | Pipe Cutter (Guillotine)                                                              | 1                             |
| 13      | Pipe Cutter (ratchet type)                                                            | 2                             |
| 14      | Gas Detection Unit                                                                    | As and when required          |
| 15      | Cable and Pipe Locator                                                                | As and when required          |
| 16      | Test Ends                                                                             | One set of all sizes          |
| 17      | Pipe Alignment Clamps                                                                 | As and when required          |
| 18      | Joining Clamps for Coupler ( All sizes )                                              | 2                             |
| 19      | Joining Clamps for Saddle ( All sizes )                                               | 2                             |
| 20      | Pipe Straightness                                                                     | As and when required          |
| 21      | Re-rounding Tools ( All sizes )                                                       | As and when required          |
| 22      | Jumping Jack Compactor                                                                | As and when required          |
| 23      | Roller for Asphaltting                                                                | As and when required          |
| 24      | Calibrated Pressure Gauges (0-6 Bar)                                                  | 6                             |
| 25      | Water Tankers                                                                         | As and when required          |
| 26      | Automatic Thread cutting machine                                                      | As and when required          |
| 27      | GI Pipe cutter                                                                        | As and when required          |
| 28      | Heating Element for HDPE Butt joint along with clamping, roller and other accessories | As and when required          |



## ANNEXURE # 2

### FUSION COUPLERS FROM 20MM TO 180MM



## ANNEXURE # 3

### **RESTORATION PROCEDURE/GUIDELINES FOR ROAD CUTS OF MUNICIPAL CORPORATION OF STATE AND OTHER LANDOWNING AGENCIES**

#### **PURPOSE AND OBJECTIVE**

The main purpose and objective of this document is to ensure that all the work are carried out with proper specifications and standards with high quality and timely accomplishment, and the restoration of infrastructure is according to standards Aimed at achieving the original condition of the road infrastructure.

#### **DOCUMENTS/FILES TO BE MAINTAINED:**

The following documents shall be maintained during execution of the job and shall be handed over to OWNER/ Consultant/ TPI after completion of the job;

- Copy of permission letter obtained from Municipal Corporation of State.
- Drawing/ Sketch showing the details of stretch to be cut, highlighting the type of surfaces and its chainage/ length (area)
- Stage wise Photographs of the stretch.
- Test Certificates of the Construction materials to be used.
- Routine Test Certificates for construction materials during progress of job.

### **30.0 RESTORATION OF TRENCHES/PITS:**

After laying pipeline, backfill material without containing extraneous material or hard lumps of soil or stones shall be filled and watered in layers of 150mm. Warning mats shall be placed as per specification. Earth shall be filled watered and compacted in layers with the help of earth compactor (Jumping jack compactor where ever space is available). After backfilling, the crown of the earth shall be between 50mm and 100mm above road surface and shall be free from sharp-edge stone and boulders.

After consolidation of backfill, the surplus earth shall be removed and disposed at place directed by OWNER (at suitable locations, as per direction of Municipal Corporation of State)

Further, depending upon the Surface types of following specification shall be adopted:



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| Sl. No. | Surface Types                                                                                              | Specification Recommended                                                                                                                                                                                                                                 |
|---------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Cement Concrete Surface                                                                                    | Top Surface – PCC 1:2:4, 100 mm Thick Compacted with Plate Vibrator shall be laid over base course.<br>Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.                                                                        |
| 2       | Brick Soiling                                                                                              | Top Surface – Brick Soiling (as per original type) shall be laid over base course.<br>Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.                                                                                         |
| 3       | Interlocking CC Paver Block                                                                                | Top Surface – Interlocking CC Paver Blocks (as per original type) shall be laid over compacted fine sand 50 mm Thick over base course.<br>Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.                                     |
| 4       | Chequered Cement Concrete Tiles/Pre-cast CC Tiles/Kota Stone Floor/Red Stone Floor                         | Top Surface – Tiles/Floor (as per original type) shall be laid over Cement Sand Mortar 1:6, 20mm Thick over base course, Joints shall be pointed/finished to match colour.<br>Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth. |
| 5       | Bituminous Surface (for Category D Roads i.e.; Roads less than 13.70 M width)                              | Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 100 mm Thick over base course.<br>Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.                                           |
| 6       | Bituminous Surface (for Category C Roads i.e.; Roads less than 18 M width but greater than 13.70 M width.) | Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 150mm Thick over base course.<br>Base Course – PCC 1:5:10, 150 mm Thick laid over compacted backfilled earth.                                           |

The specification mentioned above may be modified in line with relevant Municipal Corporation of State/ CPWD/ IRC specifications. Contractor has to follow the changes as informed to them time and again.

**NOTE:**

Wherever the Bituminous portion is cut in small patches or isolated location where area of Bituminous portion is very less due to constraints like other utilities, the



surface shall be restored, same as specified for the cement concrete surface, with prior approval of EIC/TPI.

### **31.0 TESTING OF CONSTRUCTION MATERIALS**

For the different construction materials proposed to be used the following tests are required to be carried out for approval:

| <b>Sl.No.</b> | <b>Material</b>   | <b>Test</b>                                                                                                                      | <b>Method of Testing</b> | <b>Frequency of Test</b>                                             |
|---------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------------------------------------------|
| 1             | Cement            | Setting time, soundness, compressive strength and fineness                                                                       | As per IS: 4031          | Once for each consignment or as and when required/directed           |
| 2             | Bricks            | Compressive strength, water absorption and efflorescence                                                                         | As per IS: 3495          | Minimum five samples or as per IS: 5454                              |
| 3             | Coarse Aggregates | Sieve analysis, flakiness index, estimation of deleterious materials, organic impurities, moisture contents and specific gravity | As per IS: 2386          | One test per source of supply and routine test regularly as directed |
| 4             | Fine Aggregates   | Sieve analysis, clay silt and moisture contents and specific gravity                                                             | As per IS: 2386          | One test per source of supply and routine test regularly as directed |

In addition to the above construction materials such as inter locking paver blocks, chequered cement concrete tiles, Pre-cast CC tiles, Kota/Red Stones Flooring samples shall be arranged for approval before use and if required testing shall be arranged.

For Cement concrete works the minimum frequency of sampling of concrete (CC cubes) shall be as follows:

| <b>Sl.No.</b> | <b>Quantity of concrete in Cu.M</b> | <b>No. of Samples</b>                                                  |
|---------------|-------------------------------------|------------------------------------------------------------------------|
| 1             | 1 – 5                               | 1                                                                      |
| 2             | 6 – 15                              | 2                                                                      |
| 3             | 16 – 30                             | 3                                                                      |
| 4             | 31 – 50                             | 4                                                                      |
| 5             | 51 and above                        | 4 + 1 additional sample for each additional 50 Cu. M and part thereof. |



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The cement concrete cubes shall be tested for 7 & 28 days as per relevant IS code.

### **33.0 INSPECTION BY THIRD PARTY INSPECTION (TPI) AGENCIES NOMINATED BY LAND OWNING AGENCIES**

It is the responsibility of the contractor to give inspection call, at least one week in advance to OWNER, to arrange for inspection by TPI nominated by land owning agencies along with the file containing all documents mentioned in Clause No. 2 of this document. Before inspection by TPI nominated by land owning agencies, contractor has to arrange for the inspection of the restored area by OWNER/Consultant/TPI and get the work certified. Contractor has to arrange for all necessary equipment, tools & tackles, labour for carrying out the inspection of the restored area. It is the responsibility of the contractor to obtain "No Objection Certificate" (NOC) from the TPI nominated by the land owning agencies and further NOC from Land Owning Agencies and to get the securities/Bank Guarantees paid to them, for obtaining the permissions.



ENERGISING QUALITY

## VCS PROJECT CONSULTANTS PVT.LTD.

### STANDARD SPECIFICATION ELECTRO FUSION FOR PE PIPES & FITTINGS

VPC – SS – PE - 0002

|      |          |                    |                |               |                |
|------|----------|--------------------|----------------|---------------|----------------|
|      |          |                    |                |               |                |
|      |          |                    |                |               |                |
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|      |          |                    |                |               |                |
| 00   | 19.06.18 | ISSUED AS STANDARD | BS             | MVK           | AD             |
| REV. | DATE     | Purpose            | Prepared<br>By | Checked<br>By | Approved<br>By |



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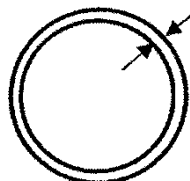


## 1.0 ELECTRO FUSION FOR PE PIPE

### 1.1 ELECTRO FUSION FITTING JOINTING

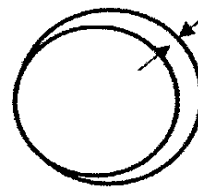
- 1.1.1** For electro fusion fitting jointing, an electrical resistance element is incorporated in the socket of the fitting which, when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
- 1.1.2** The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surfaces area clean. Also, the pipe should be checked for ovality. If ovality causes a gap between concentrically located pipe and the fitting to exceed 1% of the pipe OD, the pipe must be re-rounded to ensure correct welding. If the gap still exceeds 1% of the pipe OD after re-rounding then a check should be made of the pipe OD dimensions to determine if it meets specification.

Max gap 1% of pipe OD



Concentrically Located

Max gap 2% of pipe OD



Eccentrically Located

- 1.1.3** The maximum gap between eccentrically located pipe and fitting i.e. Pipe touching fitting at one point, must not exceed 2% of the pipe OD.
- 1.1.4** Sometimes coiled pipes may be too oval to fit into couplers, or the end of the pipe may make the alignment of the ends impossible. In such circumstances the use of a mechanical pipe straightener or rounding tool is necessary.
- 1.1.5** The equipment and procedures following relate to fittings with center stops. If fittings without center stops are used, the maximum insertion depth must be clearly marked on the pipe ends prior to joining (felt tip pen).

#### Equipment

- The control box input supply to be from a nominal 240V generator, which is normally of approximately 5kVA capacity. The nominal output of the generator is to be 240V +15%, I 0% between no load and full load. Control boxes are to include safety devices to prevent excessive voltages being present at the control box output. The safety device shall operate in less than 0.5s.

**Note that extension leads are not to be used on the control box outlet connections.**

**WARNING:** Control boxes are not intrinsically safe and must therefore not be taken into the trench.



- A mechanical pipe surface preparation tool is to be used before fusion is attempted. The tool is to be capable of removing the oxidized surface of the pipe in excess of the insertion depth. The tool is to remove a layer of surface material 0.20.4 mm thick from the outer surface of the pipe preferably in a continuous strip of swarf over that length and round of the pipe.
- Pipe clamps for restraining, aligning and re-rounding the pipes in the fusion process are to be used.
- Pipe cutters with saw and saw guide.
- Protection against adverse weather conditions.

## 1.2 ELECTRO FUSION JOINTING METHOD / PROCEDURE

### Preparation

- Ensure there is sufficient space to permit access to the jointing area. In a trench, a minimum clearance of 150 mm is required.
- Check that the pipe ends to be jointed are cut square to the axis of the pipe and any burrs removed.
- Wipe pipe ends using clean lint-free material to remove traces of dirt or mud, etc...
- Mark the area over which the oxidized pipe surface is to be removed, i.e. In excess of the insertion depth, on each pipe to be joined by placing the socket of the bagged fitting alongside the pipe end. Trace a line round the circumference at the appropriate distance from the end of the pipe using a felt tip pen or similar.

**Note that the fitting should not be removed from the packaging at this stage.**

- Connect the electro fusion control box input leads to the generator.
- Check that the reset stop button, if fitted on the control box, is in the correct mode.
- Using the pipe end preparation tool, remove the entire surface of the pipe uniformly, preferably in continuous swarf over the area identified, i.e. In excess of the insertion depth.
- A mechanical scraper could be used however; there is a considerable risk that the end preparation will not be adequate with the use of such a tool.

**Note that the prepared pipe surface should not be touched by hand.**

- Remove the fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Iso-propanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.



**Note that while Iso-propanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.**

- Check that the pipe clamps are of the correct size for the pipes to be joined.
- Insert the pipe ends into the fitting so that they are in contact with the center stop.
- Using the pipe clamps, secure the pipes so that they cannot move during the fusion cycle. Check that the pipe ends and the fitting are correctly aligned.
- Check that there is sufficient fuel for the generator to finish the joint. Start the generator and check that it is functioning correctly.
- Switch on the control box.
- Connect the control box output leads to the fitting terminals and check that they have been fully inserted.

If required by the control box enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

**Note 1: Automatic control boxes are available which obviate the need to enter the fusion time.**

**Note 2: Gloves and goggles should be worn during the Fusion process.**

- Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle, the melt indicators should have risen. If there is no apparent move in the melt indicators, the joint should be cut out and a fresh joint made (See note 3 below).
- If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting or the automatic control box.

**Note 3: If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. DO NOT attempt a second fusion cycle within one hour of cooling of joint at Ambient Temperature of the first attempt.**

### 1.3 RECORDS

Records of appropriate servicing and calibration shall be kept.

### 1.4 TRAINING



It is necessary that operators, inspection and supervisory personnel acquire the skills of electro fusion fitting fusion. The necessary training should be carried out by a qualified instructor with the objective of enabling participants to;

- Understand the principles of electro fusion fitting jointing.
- Identify pipe and appropriate fitting markings.
- Carry out pre-jointing machine and equipment checks.
- Make satisfactory electro fusion fitting joints from pipes and fittings of different sizes.
- Inspect for and identify joints of acceptable quality.

**Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range. And the equipment used. A register of successful participants should be kept.**

## 1.5 ELECTRO FUSION SADDLE JOINTING

- With electro fusion saddle jointing, an electrical resistance element is incorporated in the base of the saddle which, when connected to the appropriate power supply, melts and fuses the material of the fitting and the pipe together.
- The success of the technique depends on effective preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the area equivalent to the area of the saddle base, and cleaning of the pipe surfaces.
- Methods of holding the tapping tee saddle during the fusion cycle are used namely, top loading and under clamping. The general parameters are similar. In some cases, if the manufacturer's procedure for holding the fitting is provided, then the same should be followed during the fusion cycle.

## 1.6 ELECTRO FUSION SADDLE JOINTING METHOD/ PROCEDURE

- Expose the pipe onto which the tapping tee is to be assembled, ensuring there is sufficient clear space around the pipe. In a trench, a minimum clearance of 150 mm is required.
- Clean the pipe over the general area on which the saddle is to be assembled using clean, disposable lint-free material.
- Without removing the fitting from its packaging, place it over the required position on the main. Mark the pipe surface all around and clear of the saddle base area using a felt tip pen or similar.
- Remove the surface of the pipe to a depth of 0.2 to 0.4 mm over the full area marked using a suitable tool. Remove the swarf.



- Connect the electro fusion control box input leads to the generator.

**Check that the reset stop button, if fitted on the control box, is in the correct mode.**

- Remove the two halves of fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Iso-propanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.

**Note again that while Iso-propanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.**

- Position the fitting base onto the prepared pipe surface, and bring the lower saddle into position then gradually and evenly tighten the nuts until the upper saddle makes firm contact with the scraped pipe.
- Check that there is sufficient fuel for the generator to complete the joint. Start the generator and check that it is functioning correctly.
- Switch on the control box if applicable.
- Connect the control box output leads to the fitting terminals and check that they have been fully inserted.
- If required by the control box, enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

**Note 1:** Automatic control boxes are available which obviate the need to enter the fusion time.

**Note 2:** Gloves and goggles should be worn during the jointing process.

- Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle, the melt indicators, where incorporated should have risen. If there is no apparent move in the melt indicators, a new saddle joint should be made. Cut the tee of the faulty joint from its base.
- If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting label or by the automatic control box.

**Note 3:** If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. DO NOT attempt a second fusion cycle within one hour of the first



attempt.

**Note 4:** The connection of the service pipe to the fitting outlet should be carried out in accordance with the procedure of the appropriate section of this Item.

**Note 5:** DO NOT attempt to tap the main with the integral cutter for at least 10 minutes after completion of the cooling cycle.

## 1.7 RECORDS

Records of appropriate servicing and calibration of Electro Fusion machines/ joints shall be kept.

## 1.8 TRAINING

AS PER 1.6

Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range and the equipment used. A register of successful participants should be kept.

## 1.9 STOPPING THE GAS FLOW

In the operation of a distribution system there is a periodic need to stop the gas flow for either routine or emergency maintenance. The flow may be stopped through the use of installed fittings such as valves. Where installed fittings are not available or the use of such would cause significant supply disruption, then one of the following methods may be employed.

### 1.10 SQUEEZE-OFF

- To control the gas flow a special tool may be used to squeeze the pipe walls together. Hydraulic jacks are used to supply the necessary force to compress the pipe walls for sizes 90 mm and above.
- It will be seen the squeeze-off equipment comprises two bars to apply pressure to the outside of the pipe. The bars are brought together, either manually or hydraulically, squeezing the pipe material together until a seal is formed where the upper and lower walls meet.
- The hydraulic machines should have a spring return for the jack and locking to prevent accidental release of pressure during operation. All squeeze-off machines should be fitted with check plate or stops to avoid over compression of the pipe.
- Where the pipe walls are compressed the polyethylene pipe will be severely deformed in the regions of maximum compression. The pipe will eventually regain its original shape after squeezing but there will be some reduction in the pressure bearing properties.
- A complete stop may not always be obtainable because of wrinkling of the inside of



the pipe. If a complete stop is required then a second squeeze can be used, with an intermediate vent to remove the gas which passes the first squeeze from say the trench area. A second squeeze-off procedure should be a minimum of three pipe diameters and right angles to the initial squeeze.

- While not essential it would be good practice to fit a reinforcing stainless steel band do not squeeze again adhesive tape around the pipe upon the completion of a squeezing operation.

### **1.11 BENDING-BACK**

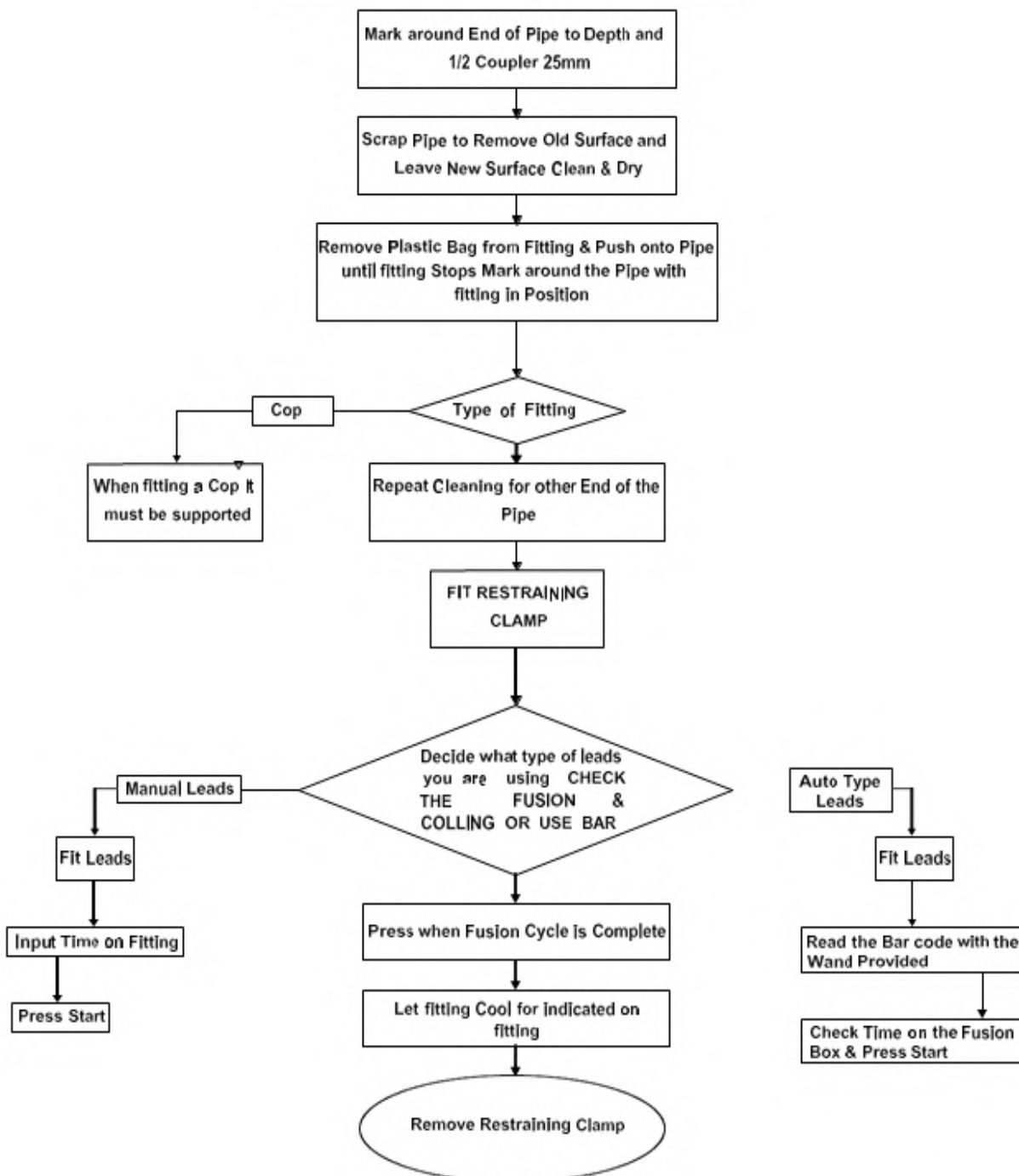
Bending back of the pipe may be performed where the pipe has been severed damaged and stopping the gas flow is imperative. Its application is of a temporary nature, and will provide relief until a permanent repair can be affected. The section of pipe, which has been bent back, will have to be replaced because of the damage caused by the severe ness of the bend back operation. The need for any bend back operation is most likely to occur as a consequence of damage caused to a PE service pipe.

While it is not the prime function of a saddle tee, controlling the flow in a service may be achieved by opening up on an installed saddle tee and winding down the internal tapping tool to shut off the flow into the service pipe.



PTS- ELECTRO FUSION  
FOR PE PIPES & FITTINGS

## ANNEXURE # 1

FUSION COUPLERS FORM 20MM TO 180MM

**ITP**



## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR FLANGES & SPECTACLE BLINDS VCS – ITP – PP – 2003

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 01      | 19/12/2021 | SR          | MC         | HK          | GW            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |

| REVISION RECORD |               |                 |                    |                    |                    |                      |
|-----------------|---------------|-----------------|--------------------|--------------------|--------------------|----------------------|
| Rev.            | Revision Date | Prepared by     | Checked by         | Approved by        | Authorized by      | Revision Description |
| 00              | 22/04/2020    |                 |                    |                    |                    |                      |
|                 |               | MB              | MC                 | AD                 | SK                 |                      |
| 01              | 19/12/2021    | <i>R. Jaini</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | Revised as Marked    |
|                 |               | SR              | MC                 | HK                 | GW                 |                      |
|                 |               |                 |                    |                    |                    |                      |
|                 |               |                 |                    |                    |                    |                      |
|                 |               |                 |                    |                    |                    |                      |
|                 |               |                 |                    |                    |                    |                      |

| <b>ABBREVIATIONS:</b>                                                                            |                                |             |                               |
|--------------------------------------------------------------------------------------------------|--------------------------------|-------------|-------------------------------|
| CE                                                                                               | Carbon Equivalent              | NDT         | Non-Destructive Testing       |
| DCN                                                                                              | Dispatch Clearance Note        | PO          | Purchase Order                |
| HT                                                                                               | Heat Treatment                 | PR          | Purchase Requisition          |
| IC                                                                                               | Inspection Certificate         | RT          | Radiography Testing           |
| IR                                                                                               | Inspection Report              | TC          | Test Certificate              |
| IRC                                                                                              | Inspection Release Certificate | TPI or TPIA | Third Party Inspection Agency |
| ITP                                                                                              | Inspection and Test Plan       | UT          | Ultrasonic Testing            |
| MPT/MT                                                                                           | Magnetic Particle Testing      | VDR         | Vendor Data Requirement       |
| MTC                                                                                              | Material Test Certificate      |             |                               |
| <b>LEGENDS:</b>                                                                                  |                                |             |                               |
| <b>H</b> - Hold (Do not proceed without approval)                                                |                                |             |                               |
| <b>W</b> - Witness (Give due notice, work may proceed after scheduled date)                      |                                |             |                               |
| <b>P</b> - Perform                                                                               |                                |             |                               |
| <b>R</b> - Review                                                                                |                                |             |                               |
| <b>RW</b> - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)] |                                |             |                               |

## 1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Flanges, Spectacle Blinds & Drip Rings.

## 2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

## 3.0 INSPECTION AND TEST REQUIREMENTS:

| SL.NO.     | STAGE/ACTIVITY                           | CHARACTERISTICS                  | QUANTUM OF CHECK | RECORD              | SCOPE OF INSPECTION |        |      |
|------------|------------------------------------------|----------------------------------|------------------|---------------------|---------------------|--------|------|
|            |                                          |                                  |                  |                     | SUB VENDOR          | VENDOR | TPIA |
| <b>1.0</b> | <b>Procedure</b>                         |                                  |                  |                     |                     |        |      |
| 1.1        | Heat Treatment, NDT and Other Procedures | Documented Procedures            | 100%             | Procedure Documents | -                   | H      | R    |
| <b>2.0</b> | <b>Material Inspection</b>               |                                  |                  |                     |                     |        |      |
| 2.1.       | Raw Material Inspection                  | Chemical, Mechanical, Properties | 100%             | Test Certificates   | -                   | H      | R    |
| <b>3.0</b> | <b>In Process Inspection</b>             |                                  |                  |                     |                     |        |      |

| SL.NO.     | STAGE/ACTIVITY                       | CHARACTERISTICS                                                                                                              | QUANTUM<br>OF<br>CHECK                 | RECORD            | SCOPE OF INSPECTION |        |      |
|------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------|---------------------|--------|------|
|            |                                      |                                                                                                                              |                                        |                   | SUB<br>VENDOR       | VENDOR | TPIA |
| 3.1        | Heat Treatment                       | Stress Relieving,<br>Normalising, Tempering,<br>Solution Annealing,<br>Stabilization Heat<br>Treatment etc. as<br>applicable | 100%                                   | HT Chart          | -                   | H      | R    |
| 3.2        | Identification of<br>Test<br>Samples | Product Chemical,<br>Mechanical, Impact and<br>Other test as applicable                                                      | One/Heat/Lot                           | Test Report       | -                   | H      | H    |
| 3.4        | Product Analysis<br>(As applicable)  | Chemical Composition                                                                                                         | As per<br>PR/Purchase<br>Specification | Test Reports      | -                   | H      | R    |
| 3.5        | Destructive Testing                  | Mechanical, Impact<br>and Other test as<br>applicable                                                                        | One/Heat/Lot                           | Test Reports      | -                   | H      | H    |
| 3.6        | MPI                                  | Surface & Internal<br>Imperfections                                                                                          | As per<br>PR/Purchase<br>Specification | NDT Reports       | -                   | H      | R    |
| <b>4.0</b> | <b>Final Inspection</b>              |                                                                                                                              |                                        |                   |                     |        |      |
| 4.1        | Final Inspection                     | 1. Visual<br>2 Dimensions<br>3. Hardness<br>4. Marking etc                                                                   | 100%                                   | Inspection Report | -                   | H      | W    |

| SL.NO.     | STAGE/ACTIVITY                                                     | CHARACTERISTICS                                                          | QUANTUM<br>OF<br>CHECK                                      | RECORD                             | SCOPE OF INSPECTION |        |      |
|------------|--------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------|---------------------|--------|------|
|            |                                                                    |                                                                          |                                                             |                                    | SUB<br>VENDOR       | VENDOR | TPIA |
| 4.2        | PMI Check                                                          | Chemical                                                                 | As per Spec.                                                | Inspection<br>Report               | -                   | H      | RW   |
| 4.3        | Final Stamping                                                     | Stamping Of Accepted<br>Flanges & Spectacle<br>Blinds                    | Stamping of<br>Valves<br>which are<br>witnessed<br>by TPIA. | Inspection<br>Report               | -                   | H      | H    |
| <b>5.0</b> | <b>Painting</b>                                                    |                                                                          |                                                             |                                    |                     |        |      |
| 5.1        | Rust Preventive<br>Coating &<br>Colour Coding                      | Visual & Colour Coding<br>as<br>applicable                               | 100%                                                        | Inspection<br>Report               | -                   | H      | -    |
| <b>6.0</b> | <b>Documentation &amp;<br/>IC</b>                                  |                                                                          |                                                             |                                    |                     |        |      |
| 6.1        | Documentation &<br>Inspection<br>Certificate (IC)                  | Review of Stage<br>Inspection Reports /<br>Test Reports & Issue of<br>IC | 100%                                                        | Vendor TC & IC                     | -                   | H      | H    |
| <b>7.0</b> | <b>Final<br/>Documentation<br/>&amp; Submission of<br/>Reports</b> | Compilation of<br>IR/IRC/DCN/MTC/DRGS.<br>/VDR                           | 100%                                                        | Compliance Certificate<br>(Note-1) | -                   | H      | -    |

**NOTES (As applicable):**

1. If the certification is specified as EN 10204 Type 3.1 in Datasheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.





## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR LONG RADIUS BENDS FOR ONSHORE PIPELINES VCS –ITP –PP –2004

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 02      | 19/12/2021 | SR          | MC         | HK          | GW            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

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| REVISION RECORD |               |                                                                                    |                                                                                     |                                                                                      |                                                                                      |                                                                                                                 |
|-----------------|---------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                        | Checked by                                                                          | Approved by                                                                          | Authorized by                                                                        | Revision Description                                                                                            |
| 00              | 05/06/2017    |                                                                                    |                                                                                     |                                                                                      |                                                                                      | Issued as Standard ITP                                                                                          |
|                 |               | GS                                                                                 | ADE                                                                                 | AD                                                                                   | SK                                                                                   |                                                                                                                 |
| 01              | 22/04/2020    |                                                                                    |                                                                                     |                                                                                      |                                                                                      | Document formatting, Doc numbering updated from VCS-PL-ITP-004 to VCS-ITP-PP-2004 other detail update as marked |
|                 |               | MB                                                                                 | MC                                                                                  | AD                                                                                   | SK                                                                                   |                                                                                                                 |
| 02              | 19/12/2021    |  |  |  |  | Revised as Marked                                                                                               |
|                 |               | SR                                                                                 | MC                                                                                  | HK                                                                                   | GW                                                                                   |                                                                                                                 |
|                 |               |                                                                                    |                                                                                     |                                                                                      |                                                                                      |                                                                                                                 |
|                 |               |                                                                                    |                                                                                     |                                                                                      |                                                                                      |                                                                                                                 |

| <b>ABBREVIATIONS:</b>                                                                            |                           |             |                               |
|--------------------------------------------------------------------------------------------------|---------------------------|-------------|-------------------------------|
| CE                                                                                               | Carbon Equivalent         | PR          | Purchase Requisition          |
| IC                                                                                               | Inspection Certificate    | RT          | Radiography Testing           |
| ITP                                                                                              | Inspection and Test Plan  | TC          | Test Certificate              |
| MPT/MT                                                                                           | Magnetic Particle Testing | TPI or TPIA | Third Party Inspection Agency |
| MTC                                                                                              | Material Test Certificate | UT          | Ultrasonic Testing            |
| NDT                                                                                              | Non-Destructive Testing   | VDR         | Vendor Data Requirement       |
| PO                                                                                               | Purchase Order            |             |                               |
| <b>LEGENDS:</b>                                                                                  |                           |             |                               |
| <b>H</b> - Hold (Do not proceed without approval)                                                |                           |             |                               |
| <b>W</b> - Witness (Give due notice, work may proceed after scheduled date)                      |                           |             |                               |
| <b>P</b> - Perform                                                                               |                           |             |                               |
| <b>R</b> - Review                                                                                |                           |             |                               |
| <b>RW</b> - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)] |                           |             |                               |

## 1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of long radius Bends for onshore Pipelines.

## 2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

## 3.0 INSPECTION AND TEST REQUIREMENTS:

| SL.NO.     | STAGE/ACTIVITY                                                                       | CHARACTERISTICS                                                                                  | QUANTUM<br>OF<br>CHECK | RECORD                                                             | SCOPE OF INSPECTION |        |      |
|------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------|---------------------|--------|------|
|            |                                                                                      |                                                                                                  |                        |                                                                    | SUB<br>VENDOR       | VENDOR | TPIA |
| <b>1.0</b> | <b>Procedure</b>                                                                     |                                                                                                  |                        |                                                                    |                     |        |      |
| 1.1        | Hydro Test, NDT,<br>Bend<br>Manufacturing, Heat<br>treatment and Other<br>Procedures | Documented Procedures                                                                            | 100%                   | Procedure<br>Documents                                             | -                   | H      | R    |
| <b>2.0</b> | <b>Material<br/>Inspection</b>                                                       |                                                                                                  |                        |                                                                    |                     |        |      |
| 2.1        | Raw Material<br>Inspection                                                           | Chemical, mechanical<br>properties, method of<br>manufacturing, Heat<br>Treatment Condition, etc | 100%                   | Mill Test<br>Certificates<br>(EN 10204<br>Type 3.2<br>certificate) | H                   | R      | R    |

**INSPECTION AND TEST PLAN FOR  
LONG RADIUS BENDS FOR ONSHORE PIPELINES**

**DOC NO: VCS-ITP-PP-2004  
Rev No : 02**

| SL.NO.     | STAGE/ACTIVITY                                                        | CHARACTERISTICS                                                                                                                   | QUANTUM<br>OF<br>CHECK | RECORD                                                                                             | SCOPE OF INSPECTION |        |      |
|------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------|---------------------|--------|------|
|            |                                                                       |                                                                                                                                   |                        |                                                                                                    | SUB<br>VENDOR       | VENDOR | TPIA |
| <b>3.0</b> | <b>In Process Inspection</b>                                          |                                                                                                                                   |                        |                                                                                                    |                     |        |      |
| 3.1        | Material Identification<br>(In case of EN 10204 Type 3.1 certificate) | Review of Test Certificates, Markings, Visual and Dimensional inspection, identity co-relation & Transfer of identification marks | One/Heat               | Material Clearance Record (3.2 certificate or check test [mechanical, chemical, impact, hardness]) | -                   | H      | H    |
| 3.2        | Bend Manufacturing Procedure Qualification                            | Bend forming parameters, Mechanical, Impact, Micro and Hardness                                                                   | 100%                   | Test Report                                                                                        | -                   | H      | H    |
| 3.3        | Induction Bending (Production bends)                                  | Bending temp<br>Bending rate<br>Power input<br>As per qualified procedure of test bend                                            | 100%                   | Inspection Report                                                                                  | -                   | H      | M    |

**INSPECTION AND TEST PLAN FOR  
LONG RADIUS BENDS FOR ONSHORE PIPELINES**

**DOC NO: VCS-ITP-PP-2004  
Rev No : 02**

| SL.NO.     | STAGE/ACTIVITY                                    | CHARACTERISTICS                                                          | QUANTUM<br>OF<br>CHECK | RECORD                | SCOPE OF INSPECTION |        |      |
|------------|---------------------------------------------------|--------------------------------------------------------------------------|------------------------|-----------------------|---------------------|--------|------|
|            |                                                   |                                                                          |                        |                       | SUB<br>VENDOR       | VENDOR | TPIA |
| 3.4        | Heat Treatment<br>(If Applicable)                 | Time / temp record                                                       | 100%                   | HT Graph              | -                   | H      | R    |
| <b>4.0</b> | <b>Final Inspection</b>                           |                                                                          |                        |                       |                     |        |      |
| 4.1        | NDT-RT, UT & MPT<br>as<br>applicable              | Defects                                                                  | 100%                   | Films/Test<br>Reports | -                   | H      | R    |
| 4.2        | Hydrostatic Test                                  | Soundness / Leak check                                                   | 100%                   | Test Report           | -                   | H      | W    |
| 4.3        | Final visual and<br>dimension                     | Visual and Dimension                                                     | 100%                   | Inspection<br>Report  | -                   | H      | W    |
| 4.4        | Gauging Pig Passing<br>(95% of ID)                | Verification of ID / Profile                                             | 100%                   | Inspection<br>Report  | -                   | H      | W    |
| <b>5.0</b> | <b>Documentation &amp;<br/>IC</b>                 |                                                                          |                        |                       |                     |        |      |
| 5.1        | Documentation &<br>Inspection<br>Certificate (IC) | Review of Stage<br>Inspection Reports /<br>Test Reports & Issue of<br>IC | 100%                   | Vendor TC<br>& IC     | -                   | H      | H    |

| SL.NO. | STAGE/ACTIVITY                | CHARACTERISTICS                                                                    | QUANTUM<br>OF<br>CHECK | RECORD        | SCOPE OF INSPECTION |        |      |
|--------|-------------------------------|------------------------------------------------------------------------------------|------------------------|---------------|---------------------|--------|------|
|        |                               |                                                                                    |                        |               | SUB<br>VENDOR       | VENDOR | TPIA |
|        |                               |                                                                                    |                        |               |                     |        |      |
| 5.2    | Final documents as applicable | Verification & compilation of inspection & test records for submission to customer | 100%                   | Final dossier | -                   | H      | H    |

**NOTES (As applicable):**

1. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW) VCS – ITP – PP – 2005

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 01      | 19/12/2021 | SR          | MC         | HK          | GW            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

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**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

| REVISION RECORD |               |                |                    |                    |                    |                      |
|-----------------|---------------|----------------|--------------------|--------------------|--------------------|----------------------|
| Rev.            | Revision Date | Prepared by    | Checked by         | Approved by        | Authorized by      | Revision Description |
| 00              | 22/04/2020    |                |                    |                    |                    |                      |
|                 |               | MB             | MC                 | AD                 | SK                 |                      |
| 01              | 19/12/2021    | <i>R. Jain</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | Revised as Marked    |
|                 |               | SR             | MC                 | HK                 | GW                 |                      |
|                 |               |                |                    |                    |                    |                      |
|                 |               |                |                    |                    |                    |                      |
|                 |               |                |                    |                    |                    |                      |
|                 |               |                |                    |                    |                    |                      |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

| <b>ABBREVIATIONS:</b>                                                                           |                                |             |                                   |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------|-----------------------------------|
| CE                                                                                              | Carbon Equivalent              | PMI         | Positive Material Identification  |
| DCN                                                                                             | Dispatch Clearance Note        | PO          | Purchase Order                    |
| DFT                                                                                             | Dry Film Thickness             | PQR         | Procedure Qualification Record    |
| DPT                                                                                             | Dye Penetrant Testing          | PR          | Purchase Requisition              |
| HT                                                                                              | Heat Treatment                 | RT          | Radiography Testing               |
| IC                                                                                              | Inspection Certificate         | TC          | Test Certificate                  |
| IR                                                                                              | Inspection Report              | TPI or TPIA | Third Party Inspection Agency     |
| IRC                                                                                             | Inspection Release Certificate | UT          | Ultrasonic Testing                |
| ITP                                                                                             | Inspection and Test Plan       | VDR         | Vendor Data Requirement           |
| MPT/MT                                                                                          | Magnetic Particle Testing      | WPQ         | Welders Performance Qualification |
| MTC                                                                                             | Material Test Certificate      | WPS         | Welding Procedure Specification   |
| NDT                                                                                             | Non-Destructive Testing        |             |                                   |
| <b>LEGENDS:</b>                                                                                 |                                |             |                                   |
| <b>H-</b> Hold (Do not proceed without approval)                                                |                                |             |                                   |
| <b>W-</b> Witness (Give due notice, work may proceed after scheduled date)                      |                                |             |                                   |
| <b>P-</b> Perform                                                                               |                                |             |                                   |
| <b>R-</b> Review                                                                                |                                |             |                                   |
| <b>RW-</b> Random Witness [As specified or 10% (min. 1 no. of each size and type of Bulk item)] |                                |             |                                   |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

**1.0 SCOPE:**

This Inspection and Test Plan covers the minimum testing requirements of Forged, Seamless & Welded Fittings.

**2.0 REFERENCE DOCUMENTS:**

PO / PR / Standards referred there in / Job specifications / Approved documents.

**3.0 INSPECTION AND TEST REQUIREMENTS:**

| SL.NO.     | STAGE/ACTIVITY                                                                       | CHARACTERISTICS                                                            | QUANTUM<br>OF<br>CHECK | RECORD                                                        | SCOPE OF INSPECTION |        |                          |
|------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------|---------------------------------------------------------------|---------------------|--------|--------------------------|
|            |                                                                                      |                                                                            |                        |                                                               | SUB<br>VENDOR       | VENDOR | TPIA                     |
| <b>1.0</b> | <b>Procedure</b>                                                                     |                                                                            |                        |                                                               |                     |        |                          |
| 1.1        | Heat Treatment /<br>NDT                                                              | Documented Procedures                                                      | 100%                   | Procedure<br>Documents                                        | -                   | H      | R                        |
| 1.2        | WPS, PQR & WPQ                                                                       | Welding Parameters &<br>Qualification Record                               | 100%                   | WPS, PQR &<br>WPQ                                             | -                   | H      | W- New<br>R-<br>Existing |
| <b>2.0</b> | <b>Material<br/>Inspection</b>                                                       |                                                                            |                        |                                                               |                     |        |                          |
| 2.1        | Raw Material<br>Identification<br>(Billets, Rounds,<br>Pipes, Coil, Plates,<br>etc.) | Chemical and Mechanical<br>Properties, Size & Steel<br>making practice etc | 100%                   | Mill test<br>certificate,<br>Vendor's<br>Inspection<br>Report | -                   | H      | R                        |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

| SL.NO.     | STAGE/ACTIVITY                 | CHARACTERISTICS                                                                                               | QUANTUM OF CHECK            | RECORD             | SCOPE OF INSPECTION |        |                    |
|------------|--------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------|---------------------|--------|--------------------|
|            |                                |                                                                                                               |                             |                    | SUB VENDOR          | VENDOR | TPIA               |
| <b>3.0</b> | <b>In Process Inspection</b>   |                                                                                                               |                             |                    |                     |        |                    |
| 3.1        | Welding                        | Welding Parameters as per WPS / PQR                                                                           | 100%                        | Inspection Reports | -                   | H      | -                  |
| 3.2        | Heat Treatment                 | Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable | 100%                        | HT chart           | -                   | H      | R                  |
| 3.3        | RT For Fittings As Applicable  | Weld defects                                                                                                  | PR / Purchase Specification | RT films & Reports | -                   | H      | R (RT film review) |
| 3.4        | Identification of Test Samples | Product Chemical, Mechanical, Impact, Hardness and other test as applicable                                   | One/Heat/Lot                | Test Reports       | -                   | H      | H                  |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

| SL.NO.     | STAGE/ACTIVITY                          | CHARACTERISTICS                                           | QUANTUM OF CHECK           | RECORD            | SCOPE OF INSPECTION |        |      |
|------------|-----------------------------------------|-----------------------------------------------------------|----------------------------|-------------------|---------------------|--------|------|
|            |                                         |                                                           |                            |                   | SUB VENDOR          | VENDOR | TPIA |
| 3.5        | Product Analysis                        | Chemical Composition                                      | PR/ Purchase Specification | Test Reports      | -                   | H      | R    |
| 3.6        | Destructive Testing                     | Mechanical, Impact, Hardness and Other test as applicable | One/Heat/Lot               | Test Reports      | -                   | H      | H    |
| 3.7        | MPT/LPT                                 | Surface & Internal Imperfections                          | PR/ Purchase Specification | NDT Reports       | -                   | H      | R    |
| <b>4.0</b> | <b>Final Inspection</b>                 |                                                           |                            |                   |                     |        |      |
| 4.1        | Visual and Dimensional Inspection (VDI) | Surface finish, Dimensions, Marking etc                   | 100%                       | Inspection report | -                   | H      | RW   |
| 4.2        | PMI Check                               | Chemical Check                                            | As Per Spec./Code          | Inspection report | -                   | H      | RW   |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

| SL.NO.     | STAGE/ACTIVITY                                                   | CHARACTERISTICS                                                       | QUANTUM<br>OF<br>CHECK | RECORD                                | SCOPE OF INSPECTION |        |      |
|------------|------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------|---------------------------------------|---------------------|--------|------|
|            |                                                                  |                                                                       |                        |                                       | SUB<br>VENDOR       | VENDOR | TPIA |
| 4.3        | Final Stamping                                                   | Stamping of accepted Items                                            | 100%                   | Inspection<br>report                  | -                   | H      | H    |
| <b>5.0</b> | <b>Painting</b>                                                  |                                                                       |                        |                                       |                     |        |      |
| 5.1        | Rust Preventive<br>Coating<br>& Colour Coding                    | Visual Inspection & Colour<br>Coding                                  | 100%                   | Inspection<br>report                  | -                   | H      | -    |
| <b>6.0</b> | <b>Documentation<br/>&amp; IC</b>                                |                                                                       |                        |                                       |                     |        |      |
| 6.1        | Documentation &<br>Inspection<br>Certificate (IC)                | Review of Stage<br>Inspection Reports / Test<br>Reports & Issue of IC | 100%                   | Vendor TC &<br>IC                     | -                   | H      | H    |
| <b>7.0</b> | <b>Final<br/>Documentation<br/>and Submission<br/>of Reports</b> | Compilation of<br>IR/IRC/DCN/MTC/DRGS.<br>/VDR                        | 100%                   | Compliance<br>Certificate<br>(Note-1) | -                   | H      | -    |



**INSPECTION AND TEST PLAN  
FOR  
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005  
Rev No : 01**

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**NOTES (As applicable):**

1. If the certification is specified as EN 10204 Type 3.1 in Datasheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



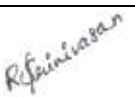
## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR BALL VALVE VCS – ITP – PP – 2007

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
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| 04      | 27/05/2022 | SR          | MC         | HK          | GW            |
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| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |
| <hr/>   |            |             |            |             |               |

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| REVISION RECORD |               |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                         |
|-----------------|---------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Rev.            | Revision Date | Prepared by                                                                         | Checked by                                                                           | Approved by                                                                           | Authorized by                                                                         | Revision Description                                                                    |
| 00              | 16/06/2017    |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                         |
|                 |               | GS                                                                                  | ADE                                                                                  | AD                                                                                    | SK                                                                                    |                                                                                         |
| 01              | 20/01/2020    |                                                                                     |                                                                                      |                                                                                       |                                                                                       | Formatting update,<br>Doc Numbering change<br>from VCS-SD-ITP-007<br>to VCS-ITP-PP-2007 |
|                 |               | AG                                                                                  | MC                                                                                   | AD                                                                                    | SK                                                                                    |                                                                                         |
| 02              | 19/05/2020    |                                                                                     |                                                                                      |                                                                                       |                                                                                       | Revised as Marked                                                                       |
|                 |               | AG                                                                                  | MC                                                                                   | AD                                                                                    | SK                                                                                    |                                                                                         |
| 03              | 19/12/2021    |                                                                                     |                                                                                      |                                                                                       |                                                                                       | Revised as Marked                                                                       |
|                 |               | SR                                                                                  | MC                                                                                   | HK                                                                                    | HK                                                                                    |                                                                                         |
| 04              | 27/05/2022    |  |  |  |  | Revised as Marked                                                                       |
|                 |               | SR                                                                                  | MC                                                                                   | HK                                                                                    | HK                                                                                    |                                                                                         |

**ABBREVIATIONS:**

|          |                                |             |                                   |
|----------|--------------------------------|-------------|-----------------------------------|
| CE       | Carbon Equivalent              | NDT         | Non-Destructive Testing           |
| DCN      | Dispatch Clearance Note        | PO          | Purchase Order                    |
| DFT      | Dry Film Thickness             | PQR         | Procedure Qualification Record    |
| DPT      | Dye Penetrant Testing          | PR          | Purchase Requisition              |
| HT       | Heat Treatment                 | RT          | Radiography Testing               |
| ITP      | Inspection and Test Plan       | TC          | Test Certificate                  |
| IC       | Inspection Certificate         | TPI or TPIA | Third Party Inspection Agency     |
| IGC      | Inter Granular Corrosion       | UT          | Ultrasonic Testing                |
| IR       | Inspection Report              | VDR         | Vendor Data Requirement           |
| IRC      | Inspection Release Certificate | WPQ         | Welders Performance Qualification |
| MPT / MT | Magnetic Particle Testing      | WPS         | Welding Procedure Specification   |
| MTC      | Material Test Certificate      |             |                                   |

**LEGENDS:**

**H** - Hold (Do not proceed without approval)

**W** - Witness (Give due notice, work may proceed after scheduled date)

**P** - Perform

**R** - Review

**RW** - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]



**INSPECTION AND TEST PLAN  
FOR  
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007  
Rev No : 04**

**1.0 SCOPE:**

This Inspection and Test Plan covers the minimum testing requirements of Ball Valves.

**2.0 REFERENCE DOCUMENTS:**

PO / PR / Standards referred there in / Job specifications / Approved documents.

**3.0 INSPECTION AND TEST REQUIREMENTS:**

| SL. NO. | COMPONENT & OPERATION                        | CHARACTERISTICS / METHOD OF CHECK                  | QUANTUM OF CHECK                 | REFERENCE DOCUMENT & ACCEPTANCE CRITERIA | FORMAT OF RECORD        | SCOPE OF INSPECTION |        |                       |
|---------|----------------------------------------------|----------------------------------------------------|----------------------------------|------------------------------------------|-------------------------|---------------------|--------|-----------------------|
|         |                                              |                                                    |                                  |                                          |                         | SUB VENDOR          | VENDOR | TPIA                  |
| 1.0     | PROCEDURES                                   |                                                    |                                  |                                          |                         |                     |        |                       |
| 1.1     | Hydrostatic Test, NDT and Other Procedures   | Documented Procedures                              | 100%                             |                                          | Procedure Documents     | -                   | H      | R                     |
| 1.2     | WPS,PQR & WPQ                                | Welding Parameters & Qualification Record          | 100%                             |                                          | WPS ,PQR & WPQ          | -                   | H      | W- New<br>R- Existing |
| 1.3     | Pre-Qualification Tests                      | Fire safe, Cryogenic & Other Test as applicable    | As per PR/Purchase Specification |                                          | Acceptance Report       | -                   | H      | H<br>(If new)         |
| 2.0     | RAW MATERIAL                                 |                                                    |                                  |                                          |                         |                     |        |                       |
| 2.1     | Forging / Casting:                           |                                                    |                                  |                                          |                         |                     |        |                       |
|         | 1) Body                                      | Visual & Dimension                                 | 100%                             | Material & Technical Specification       | Inspection Report       | H                   | H      | -                     |
|         | 2) End Piece<br>3) Ball                      | Chemical: Chemical Analysis IGC (For SS component) | All Heats                        | Material & Technical Specification       | Vendor Test Certificate | H                   | R      | R                     |
|         | 4) Seat Ring<br>5) Pup Piece (as applicable) | Mechanical: Mechanical Test                        | All Heats                        | Material & Technical Specification       | Vendor Test Certificate | H                   | R      | W<br>(Note-1)         |

**INSPECTION AND TEST PLAN  
FOR  
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007  
Rev No : 04**

| SL. NO.    | COMPONENT & OPERATION                      | CHARACTERISTICS / METHOD OF CHECK                                                                      | QUANTUM OF CHECK | REFERENCE DOCUMENT & ACCEPTANCE CRITERIA          | FORMAT OF RECORD               | SCOPE OF INSPECTION |                       |                       |
|------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------|--------------------------------|---------------------|-----------------------|-----------------------|
|            |                                            |                                                                                                        |                  |                                                   |                                | SUB VENDOR          | VENDOR                | TPIA                  |
|            |                                            | Impact Test (@ - 29°C): for CS<br>Impact Test (@ - 45°C): for LTCS                                     | All Heats        | Material & Technical Specification / ASME B 16.34 | Test Report                    | H                   | R                     | W<br>(Note-1)         |
|            |                                            | Non-Destructive Examination (NDT): Radiography (100% Critical Area)                                    | 100%             | Material & Technical Specification / ASME B 16.34 | RT Report                      | H                   | R<br>(RT-Film review) | R<br>(RT-Film review) |
|            |                                            | Non-Destructive Examination (NDT): Magnetic Particle Examination (100% exterior & accessible interior) | 100%             | Material & Technical Specification / ASME B 16.34 | MPI Report                     | H                   | R                     | R                     |
|            |                                            | ENP (For Ball): Visual, Thickness & Hardness                                                           | 100%             | 25 microns (min) & 50 HRC (min)                   | Vendor Test Certificate        | H                   | R                     | R                     |
|            |                                            |                                                                                                        |                  |                                                   |                                |                     |                       |                       |
| <b>3.0</b> | <b>INCOMING / BOF ITEMS</b>                |                                                                                                        |                  |                                                   |                                |                     |                       |                       |
| 3.1        | Stem                                       | Chemical: Chemical Analysis                                                                            | All Heats        | Material & Technical Specification                | Vendor Test Certificate        | H                   | R                     | R                     |
|            |                                            | Mechanical: Mechanical Test                                                                            | All Heats        | Material & Technical Specification                | Vendor Test Certificate        | H                   | R                     | R                     |
| 3.2        | Fasteners                                  | Chemical: Chemical Analysis                                                                            | All Heats        | Material & Technical Specification                | Vendor Test Certificate        | H                   | R                     | R                     |
|            |                                            | Mechanical: Mechanical Test                                                                            | All Heats        | Material & Technical Specification                | Vendor Test Certificate        | H                   | R                     | R                     |
|            |                                            | Impact Test (@ - 29°C): for CS<br>Impact Test (@ - 45°C): for LTCS                                     | All Heats        | Material & Technical Specification / ASME B 16.34 | Test Report                    | H                   | R                     | R                     |
| 3.3        | Gaskets, Gear units, Gland, Packings, etc. | Physical / Chemical Properties                                                                         | 100%             | Material & Technical Specification                | Test Certificates & Lab Report | H                   | R                     | R                     |



**INSPECTION AND TEST PLAN  
FOR  
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007  
Rev No : 04**

| SL. NO. | COMPONENT & OPERATION                                     | CHARACTERISTICS / METHOD OF CHECK                                                                      | QUANTUM OF CHECK | REFERENCE DOCUMENT & ACCEPTANCE CRITERIA | FORMAT OF RECORD   | SCOPE OF INSPECTION |                    |                    |
|---------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------|------------------------------------------|--------------------|---------------------|--------------------|--------------------|
|         |                                                           |                                                                                                        |                  |                                          |                    | SUB VENDOR          | VENDOR             | TPIA               |
| 4.0     | MACHINED COMPONENTS                                       |                                                                                                        |                  |                                          |                    |                     |                    |                    |
| 4.1     | Body, Connector, Ball & Seat Ring                         | Surface examination & Dimension Inspection: Visual & Measurement                                       | 100%             | Manufacturer’s Drawing                   | Inspection Reports | 100%                | R                  | R                  |
| 5.0     | IN-PROCESS                                                |                                                                                                        |                  |                                          |                    |                     |                    |                    |
| 5.1     | Body & Connector joint welding                            | Non-Destructive Examination (NDT): Magnetic Particle Examination (MPI)                                 | 100%             | ASME Sec VIII - Appendix V & VI          | MPI Report         | 100%                | R                  | R                  |
| 5.2     | Valve & Pup Piece Bevel Ends joint welding                | Non-Destructive Examination (NDT): Radiography (100% on weld joint)                                    | 100%             | ASME B16.34                              | RT Report          | 100%                | R (RT-Film review) | R (RT-Film review) |
| 6.0     | FINAL INSPECTION                                          |                                                                                                        |                  |                                          |                    |                     |                    |                    |
| 6.1     | Finished Valve Assembly: Pressure Test & Final Inspection | Shell Test: Hydrostatic                                                                                | 100%             | Testing Procedure as per Code            | Test Record        | -                   | H                  | RW                 |
| 6.2     |                                                           | Seat Test: Hydrostatic                                                                                 |                  |                                          |                    | -                   | H                  | RW                 |
| 6.3     |                                                           | Seat Test: Pneumatic                                                                                   |                  |                                          |                    | -                   | H                  | RW                 |
| 6.4     |                                                           | Functional Test - Actuated Valve @ Atm. Pressure & Max. Diff. Pressure: Operation- Open / Close        |                  |                                          |                    | -                   | H                  | RW                 |
| 6.5     |                                                           | Double Block & Bleed: Hydrostatic                                                                      |                  |                                          |                    | -                   | H                  | RW                 |
| 6.6     |                                                           | Final Inspection: Visual, Dimension, TC Verification, Special Requirements & Marking as per sale order | 100%             | Approved GA Drawing (if applicable)      | Test Report        | -                   | H                  | RW                 |
| 6.7     |                                                           | Anti-Static Test                                                                                       | 100%             | API 6D & Technical Specification         | Test Record        | -                   | H                  | RW                 |

| SL. NO. | COMPONENT & OPERATION                       | CHARACTERISTICS / METHOD OF CHECK                               | QUANTUM OF CHECK                                   | REFERENCE DOCUMENT & ACCEPTANCE CRITERIA                                     | FORMAT OF RECORD           | SCOPE OF INSPECTION |        |      |
|---------|---------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------|----------------------------|---------------------|--------|------|
|         |                                             |                                                                 |                                                    |                                                                              |                            | SUB VENDOR          | VENDOR | TPIA |
| 6.8     |                                             | Fire Safe Test                                                  | 100%                                               | API-6FA / ISO-10497                                                          | Fire safe type test report | -                   | H      | R    |
| 6.9     | Final Stamping                              | Stamping Of Accepted Valves                                     | Stamping of Valves which are witnessed by VCS/TPIA | As per Tender Specification                                                  | Inspection Report          | -                   | H      | H    |
| 6.10    | Strip Test                                  | Component integrity, PMI of BOM                                 | One per size per rating                            | -                                                                            | Test report                | H                   | H      | H    |
| 7.0     | PAINTING & PACKING                          | Surface examination & DFT Inspection: Visual & Measurement      | 100%                                               | As per Tender Specification                                                  | Painting Record            | -                   | H      | R    |
| 8.0     | DOCUMENTATION & INSPECTION CERTIFICATE(IC)  | Review of Stage Inspection Reports / Test Reports & Issue of IC | 100%                                               | As per Tender Specification                                                  | Vendor TC & IC             | -                   | H      | H    |
| 9.0     | FINAL DOCUMENTATION & SUBMISSION OF REPORTS | Compilation of IR/IRC/DCN/MTC/DRGS./VDR                         | 100%                                               | EN 10204 type 3.2/3.1 certification as specified in valve datasheet (Note-1) | Compliance Certificate     | -                   | H      | -    |

### NOTES (As applicable):

- If the certification is specified as EN 10204 Type 3.1 in Data sheet / Material Requisition, then 'W' may be replaced with 'R' with Material Traceability.
- ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR GATE/GLOBE/CHECK VALVES VCS –ITP –PP –2008

|                   |            |                       |            |             |               |
|-------------------|------------|-----------------------|------------|-------------|---------------|
| 02                | 27/05/2022 | SR                    | MC         | HK          | GW            |
| Rev. No           | Date       | Prepared By           | Checked By | Approved By | Authorized By |
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| CONTROLLED COPY   | :          | If in soft and signed |            |             |               |

| REVISION RECORD |               |              |                    |                    |                    |                      |
|-----------------|---------------|--------------|--------------------|--------------------|--------------------|----------------------|
| Rev.            | Revision Date | Prepared by  | Checked by         | Approved by        | Authorized by      | Revision Description |
| 00              | 22/04/2020    |              |                    |                    |                    | Revised as Marked    |
|                 |               | MB           | MC                 | AD                 | SK                 |                      |
| 01              | 19/12/2021    |              |                    |                    |                    | Revised as Marked    |
|                 |               | SR           | MC                 | HK                 | HK                 |                      |
| 02              | 27/05/2022    | <i>Rajiv</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | Revised as Marked    |
|                 |               | SR           | MC                 | HK                 | GW                 |                      |
|                 |               |              |                    |                    |                    |                      |
|                 |               |              |                    |                    |                    |                      |





**INSPECTION AND TEST PLAN  
FOR  
GATE/GLOBE/CHECK VALVES**

**DOC NO: VCS-ITP-PP-2008  
Rev No : 02**

| <b>ABBREVIATIONS:</b>                                                                            |                                |             |                                   |
|--------------------------------------------------------------------------------------------------|--------------------------------|-------------|-----------------------------------|
| CE                                                                                               | Carbon Equivalent              | NDT         | Non-Destructive Testing           |
| DCN                                                                                              | Dispatch Clearance Note        | PO          | Purchase Order                    |
| DFT                                                                                              | Dry Film Thickness             | PQR         | Procedure Qualification Record    |
| DPT                                                                                              | Dye Penetrant Testing          | PR          | Purchase Requisition              |
| HT                                                                                               | Heat Treatment                 | RT          | Radiography Testing               |
| IC                                                                                               | Inspection Certificate         | TC          | Test Certificate                  |
| IR                                                                                               | Inspection Report              | TPI or TPIA | Third Party Inspection Agency     |
| IRC                                                                                              | Inspection Release Certificate | UT          | Ultrasonic Testing                |
| ITP                                                                                              | Inspection and Test Plan       | VDR         | Vendor Data Requirement           |
| MPT/MT                                                                                           | Magnetic Particle Testing      | WPQ         | Welders Performance Qualification |
| MTC                                                                                              | Material Test Certificate      | WPS         | Welding Procedure Specification   |
| <b>LEGENDS:</b>                                                                                  |                                |             |                                   |
| <b>H</b> - Hold (Do not proceed without approval)                                                |                                |             |                                   |
| <b>W</b> - Witness (Give due notice, work may proceed after scheduled date)                      |                                |             |                                   |
| <b>P</b> - Perform                                                                               |                                |             |                                   |
| <b>R</b> - Review                                                                                |                                |             |                                   |
| <b>RW</b> - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)] |                                |             |                                   |

### 1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Valves.

### 2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

### 3.0 INSPECTION AND TEST REQUIREMENTS:

| SL.NO.     | STAGE/ACTIVITY                                   | CHARACTERISTICS                              | QUANTUM<br>OF<br>CHECK | RECORD                 | SCOPE OF INSPECTION |        |                          |
|------------|--------------------------------------------------|----------------------------------------------|------------------------|------------------------|---------------------|--------|--------------------------|
|            |                                                  |                                              |                        |                        | SUB<br>VENDOR       | VENDOR | TPIA                     |
| <b>1.0</b> | <b>Procedure</b>                                 |                                              |                        |                        |                     |        |                          |
| 1.1        | Hydrostatic Test,<br>NDT and<br>Other Procedures | Documented Procedures                        | 100%                   | Procedure<br>Documents | -                   | H      | R                        |
| 1.2        | WPS, PQR & WPQ                                   | Welding Parameters &<br>Qualification Record | 100%                   | WPS, PQR & WPQ         | -                   | H      | W- New<br>R-<br>Existing |



**INSPECTION AND TEST PLAN  
FOR  
GATE/GLOBE/CHECK VALVES**

**DOC NO: VCS-ITP-PP-2008  
Rev No : 02**

| SL.NO.     | STAGE/ACTIVITY                                                        | CHARACTERISTICS                                                                     | QUANTUM<br>OF<br>CHECK                   | RECORD                              | SCOPE OF INSPECTION |                          |                                      |
|------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------|-------------------------------------|---------------------|--------------------------|--------------------------------------|
|            |                                                                       |                                                                                     |                                          |                                     | SUB<br>VENDOR       | VENDOR                   | TPIA                                 |
| <b>2.0</b> | <b>Material<br/>Inspection</b>                                        |                                                                                     |                                          |                                     |                     |                          |                                      |
| 2.1        | Castings &<br>Forgings<br>(Body, Bonnet,<br>Disc, Stem, Body<br>ring) | Chemical, Mechanical,<br>Heat Treatment,<br>NDT & Other<br>Properties as applicable | 100%                                     | Test<br>Certificates                | H                   | R                        | W<br>(Note-1)                        |
| 2.2        | Castings &<br>Forgings<br>(Body, Bonnet,<br>Disc, Stem, Body<br>ring) | Visual & Dimension                                                                  | 100%                                     | Inspection<br>Report                | H                   | H                        | -                                    |
| 2.3        | Body and Bonnet<br>Castings                                           | Radiography<br>Examination                                                          | As per PR /<br>Purchase<br>Specification | Films and<br>report                 | H                   | R<br>(RT-Film<br>review) | R<br>(RT-Film<br>review)<br>(Note-1) |
| 2.4        | Bars for Trim<br>material                                             | Chemical Analysis                                                                   | Each Heat                                | Test<br>Certificates&<br>Lab Report | H                   | R                        | R                                    |
| 2.5        | Gaskets, Gear<br>units, Fasteners,<br>Gland,<br>Packings, etc.        | Physical / Chemical<br>Properties                                                   | 100%                                     | Test<br>Certificates&<br>Lab Report | H                   | R                        | R                                    |

Digitally signed by Divak Kumar

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Date: 2026.04.01 11:29:21 IST

**INSPECTION AND TEST PLAN  
FOR  
GATE/GLOBE/CHECK VALVES**

**DOC NO: VCS-ITP-PP-2008  
Rev No : 02**

| SL.NO.     | STAGE/ACTIVITY               | CHARACTERISTICS                                               | QUANTUM OF CHECK                                | RECORD                         | SCOPE OF INSPECTION |        |      |
|------------|------------------------------|---------------------------------------------------------------|-------------------------------------------------|--------------------------------|---------------------|--------|------|
|            |                              |                                                               |                                                 |                                | SUB VENDOR          | VENDOR | TPIA |
| 2.6        | Actuators as applicable      | Performance, Statutory Certificates as applicable             | 100%                                            | Test Certificates & Lab Report | H                   | H      | R    |
| <b>3.0</b> | <b>In Process Inspection</b> |                                                               |                                                 |                                |                     |        |      |
| 3.1        | Welding                      | Welding Parameters as per WPS / PQR                           | 100%                                            | Inspection Reports             | -                   | H      | R    |
| 3.2        | Machining of components      | Visual / Dimension                                            | 100%                                            | Inspection Reports             | -                   | H      | -    |
| <b>4.0</b> | <b>Final Inspection</b>      |                                                               |                                                 |                                |                     |        |      |
| 4.1        | Hydrostatic / Pneumatic Test | Hydrostatic Test – Shell<br>Pneumatic Test – Seat & Back Seat | As per PR / Purchase Specification              | Test Report                    | -                   | H      | RW   |
| 4.2        | Visual / Dimension           | Surface & Dimension Check                                     | 100%                                            | Test Report                    | -                   | H      | RW   |
| 4.3        | Final Stamping               | Stamping Of Accepted Valves                                   | Stamping of Valves which are witnessed by TPIA. | Inspection Report              | -                   | H      | H    |

| SL.NO.     | STAGE/ACTIVITY                                         | CHARACTERISTICS                                                 | QUANTUM OF CHECK        | RECORD                          | SCOPE OF INSPECTION |        |      |
|------------|--------------------------------------------------------|-----------------------------------------------------------------|-------------------------|---------------------------------|---------------------|--------|------|
|            |                                                        |                                                                 |                         |                                 | SUB VENDOR          | VENDOR | TPIA |
| 4.4        | Strip Test                                             | Component integrity, PMI of BOM                                 | One per size per rating | Test report                     | H                   | H      | H    |
| <b>5.0</b> | <b>Painting</b>                                        |                                                                 |                         |                                 |                     |        |      |
| 5.1        | Painting and Colour coding as applicable               | Visual / DFT Check                                              | 100%                    | Inspection Report               | -                   | H      | R    |
| <b>6.0</b> | <b>Documentation &amp; IC</b>                          |                                                                 |                         |                                 |                     |        |      |
| 6.1        | Documentation & Inspection Certificate (IC)            | Review of Stage Inspection Reports / Test Reports & Issue of IC | 100%                    | Vendor TC & IC                  | -                   | H      | H    |
| <b>7.0</b> | <b>Final Documentation &amp; Submission of Reports</b> | Compilation of IR/IRC/DCN/MTC/DRGS. /VDR                        | 100%                    | Compliance Certificate (Note-1) | -                   | H      | -    |

**NOTES (As applicable):**

1. If the certification is specified as EN 10204 Type 3.1 in Data sheet / Material Requisition, then 'W' may be replaced with 'R' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR ASSORTED PIPES

VCS – ITP – PP – 2021

|         |            |                |                    |                    |                    |
|---------|------------|----------------|--------------------|--------------------|--------------------|
| 01      | 19/12/2021 | <i>R. Jain</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> |
| Rev. No | Date       | Prepared By    | Checked By         | Approved By        | Authorized By      |

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| REVISION RECORD |               |                   |                    |                    |                    |                      |
|-----------------|---------------|-------------------|--------------------|--------------------|--------------------|----------------------|
| Rev.            | Revision Date | Prepared by       | Checked by         | Approved by        | Authorized by      | Revision Description |
| 00              | 22/04/2020    |                   |                    |                    |                    |                      |
|                 |               | MB                | MC                 | AD                 | SK                 |                      |
| 01              | 19/12/2021    | <i>Refinician</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | Revised as Marked    |
|                 |               | SR                | MC                 | HK                 | GW                 |                      |
|                 |               |                   |                    |                    |                    |                      |
|                 |               |                   |                    |                    |                    |                      |
|                 |               |                   |                    |                    |                    |                      |
|                 |               |                   |                    |                    |                    |                      |

| <b>ABBREVIATIONS:</b>                                                                           |                                |             |                                  |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------|----------------------------------|
| CE                                                                                              | Carbon Equivalent              | NDT         | Non-Destructive Testing          |
| HT                                                                                              | Heat Treatment                 | PO          | Purchase Order                   |
| DCN                                                                                             | Dispatch Clearance Note        | PMI         | Positive Material Identification |
| IC                                                                                              | Inspection Certificate         | PR          | Purchase Requisition             |
| IR                                                                                              | Inspection Report              | TC          | Test Certificate                 |
| IRC                                                                                             | Inspection Release Certificate | TPI or TPIA | Third Party Inspection Agency    |
| ITP                                                                                             | Inspection and Test Plan       | VDR         | Vendor Data Requirement          |
| MPT / MT                                                                                        | Magnetic Particle Testing      |             |                                  |
| <b>LEGENDS:</b>                                                                                 |                                |             |                                  |
| <b>H-</b> Hold (Do not proceed without approval)                                                |                                |             |                                  |
| <b>W-</b> Witness (Give due notice, work may proceed after scheduled date).                     |                                |             |                                  |
| <b>P-</b> Perform                                                                               |                                |             |                                  |
| <b>R-</b> Review                                                                                |                                |             |                                  |
| <b>RW</b> - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)) |                                |             |                                  |



## 1. SCOPE

This Inspection and Test Plan covers the minimum testing requirements of small sizes and Assorted length Pipes.

## 2. REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

## 3. INSPECTION AND TEST REQUIREMENTS:

| SL. NO. | STAGE/ACTIVITY                                                    | CHARACTERISTICS                                                                                                             | QUANTUM OF CHECK | RECORD                                                    | SCOPE OF INSPECTION |        |      |
|---------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------|---------------------|--------|------|
|         |                                                                   |                                                                                                                             |                  |                                                           | SUB VENDOR          | VENDOR | TPIA |
| 1.0     | Pipe Inspection                                                   |                                                                                                                             |                  |                                                           |                     |        |      |
| 1.1     | Pipe Inspection                                                   | Chemical & Mechanical Properties                                                                                            | 100%             | Test Certificates and marking on pipe (EN 10204 Type 3.2) | -                   | H      | R    |
| 2.0     | Final Inspection (In case of non-availability of 3.2 Certificate) |                                                                                                                             |                  |                                                           |                     |        |      |
| 2.1     | Hydrostatic Testing                                               | Leak Check                                                                                                                  | 100%             | Test Report                                               | -                   | H      | R    |
| 2.2     | 1) Visual<br>2) Dimension<br>3) Marking w.r.t MTC                 | Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc | 100%             | Inspection Report                                         | -                   | H      | RW   |

| SL. NO. | STAGE/ACTIVITY                 | CHARACTERISTICS                                                   | QUANTUM OF CHECK    | RECORD            | SCOPE OF INSPECTION |        |      |
|---------|--------------------------------|-------------------------------------------------------------------|---------------------|-------------------|---------------------|--------|------|
|         |                                |                                                                   |                     |                   | SUB VENDOR          | VENDOR | TPIA |
| 2.3     | PMI Check                      | Chemical Check                                                    | As Per Spec.        | Inspection Report | -                   | H      | RW   |
| 2.4     | Identification of Test Samples | Product Chemical, Mechanical, Impact and Other test as applicable | As Per Spec. / Code | Test Reports      | -                   | H      | H    |
| 2.5     | Product Analysis               | Chemical Composition                                              | As Per Spec. / Code | Test Reports      | -                   | H      | R    |
| 2.6     | Destructive Testing            | Mechanical, Impact, and Other test as applicable                  | As Per Spec. / Code | Test Reports      | -                   | H      | H    |
| 2.7     | PMI Check                      | Chemical Check                                                    | As Per Spec. / Code | Inspection Report | -                   | H      | RW   |
| 2.8     | Final Stamping                 | Stamping Of Accepted Pipes                                        | Stamping of Pipes   | Inspection Report | -                   | H      | H    |

| SL. NO. | STAGE/ACTIVITY                              | CHARACTERISTICS                                                 | QUANTUM OF CHECK | RECORD                                   | SCOPE OF INSPECTION |        |      |
|---------|---------------------------------------------|-----------------------------------------------------------------|------------------|------------------------------------------|---------------------|--------|------|
|         |                                             |                                                                 |                  |                                          | SUB VENDOR          | VENDOR | TPIA |
| 3.0     | Painting                                    |                                                                 |                  |                                          |                     |        |      |
| 3.1     | Rust Preventive Coating & Colour Coding     | Visual Inspection & Colour Coding                               | 100%             | Inspection Report                        | -                   | H      | -    |
| 4.0     | Documentation & IC                          |                                                                 |                  |                                          |                     |        |      |
| 4.1     | Documentation & Inspection Certificate (IC) | Review of Stage Inspection Reports / Test Reports & Issue of IC | 100%             | Vendor TC/IR/IRC/DCN/DRGS. /VDR (Note-1) | -                   | H      | -    |

**NOTES (As applicable):**

- Items shall be accepted based on EN 10204 type 3.2/3.1 certification as specified in material requisition.
- ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



## VCS QUALITY SERVICES PVT. LTD.

### INSPECTION AND TEST PLAN FOR ASSORTED PIPES

VCS – ITP – PP – 2021

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 01      | 19/12/2021 | SR          | MC         | HK          | GW            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |

| REVISION RECORD |               |                      |                    |                    |                    |                      |
|-----------------|---------------|----------------------|--------------------|--------------------|--------------------|----------------------|
| Rev.            | Revision Date | Prepared by          | Checked by         | Approved by        | Authorized by      | Revision Description |
| 00              | 22/04/2020    |                      |                    |                    |                    |                      |
|                 |               | MB                   | MC                 | AD                 | SK                 |                      |
| 01              | 19/12/2021    | <i>R. Jainivasan</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | Revised as Marked    |
|                 |               | SR                   | MC                 | HK                 | GW                 |                      |
|                 |               |                      |                    |                    |                    |                      |
|                 |               |                      |                    |                    |                    |                      |
|                 |               |                      |                    |                    |                    |                      |
|                 |               |                      |                    |                    |                    |                      |

| <b>ABBREVIATIONS:</b>                                                                           |                                |             |                                  |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------|----------------------------------|
| CE                                                                                              | Carbon Equivalent              | NDT         | Non-Destructive Testing          |
| HT                                                                                              | Heat Treatment                 | PO          | Purchase Order                   |
| DCN                                                                                             | Dispatch Clearance Note        | PMI         | Positive Material Identification |
| IC                                                                                              | Inspection Certificate         | PR          | Purchase Requisition             |
| IR                                                                                              | Inspection Report              | TC          | Test Certificate                 |
| IRC                                                                                             | Inspection Release Certificate | TPI or TPIA | Third Party Inspection Agency    |
| ITP                                                                                             | Inspection and Test Plan       | VDR         | Vendor Data Requirement          |
| MPT / MT                                                                                        | Magnetic Particle Testing      |             |                                  |
| <b>LEGENDS:</b>                                                                                 |                                |             |                                  |
| <b>H-</b> Hold (Do not proceed without approval)                                                |                                |             |                                  |
| <b>W-</b> Witness (Give due notice, work may proceed after scheduled date).                     |                                |             |                                  |
| <b>P-</b> Perform                                                                               |                                |             |                                  |
| <b>R-</b> Review                                                                                |                                |             |                                  |
| <b>RW</b> - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)) |                                |             |                                  |

## 1. SCOPE

This Inspection and Test Plan covers the minimum testing requirements of small sizes and Assorted length Pipes.

## 2. REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

## 3. INSPECTION AND TEST REQUIREMENTS:

| SL. NO. | STAGE/ACTIVITY                                                    | CHARACTERISTICS                                                                                                             | QUANTUM OF CHECK | RECORD                                                    | SCOPE OF INSPECTION |        |      |
|---------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------|---------------------|--------|------|
|         |                                                                   |                                                                                                                             |                  |                                                           | SUB VENDOR          | VENDOR | TPIA |
| 1.0     | Pipe Inspection                                                   |                                                                                                                             |                  |                                                           |                     |        |      |
| 1.1     | Pipe Inspection                                                   | Chemical & Mechanical Properties                                                                                            | 100%             | Test Certificates and marking on pipe (EN 10204 Type 3.2) | -                   | H      | R    |
| 2.0     | Final Inspection (In case of non-availability of 3.2 Certificate) |                                                                                                                             |                  |                                                           |                     |        |      |
| 2.1     | Hydrostatic Testing                                               | Leak Check                                                                                                                  | 100%             | Test Report                                               | -                   | H      | R    |
| 2.2     | 1) Visual<br>2) Dimension<br>3) Marking w.r.t MTC                 | Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc | 100%             | Inspection Report                                         | -                   | H      | RW   |

| SL. NO. | STAGE/ACTIVITY                 | CHARACTERISTICS                                                   | QUANTUM OF CHECK    | RECORD            | SCOPE OF INSPECTION |        |      |
|---------|--------------------------------|-------------------------------------------------------------------|---------------------|-------------------|---------------------|--------|------|
|         |                                |                                                                   |                     |                   | SUB VENDOR          | VENDOR | TPIA |
| 2.3     | PMI Check                      | Chemical Check                                                    | As Per Spec.        | Inspection Report | -                   | H      | RW   |
| 2.4     | Identification of Test Samples | Product Chemical, Mechanical, Impact and Other test as applicable | As Per Spec. / Code | Test Reports      | -                   | H      | H    |
| 2.5     | Product Analysis               | Chemical Composition                                              | As Per Spec. / Code | Test Reports      | -                   | H      | R    |
| 2.6     | Destructive Testing            | Mechanical, Impact, and Other test as applicable                  | As Per Spec. / Code | Test Reports      | -                   | H      | H    |
| 2.7     | PMI Check                      | Chemical Check                                                    | As Per Spec. / Code | Inspection Report | -                   | H      | RW   |
| 2.8     | Final Stamping                 | Stamping Of Accepted Pipes                                        | Stamping of Pipes   | Inspection Report | -                   | H      | H    |



| SL. NO. | STAGE/ACTIVITY                              | CHARACTERISTICS                                                 | QUANTUM OF CHECK | RECORD                                   | SCOPE OF INSPECTION |        |      |
|---------|---------------------------------------------|-----------------------------------------------------------------|------------------|------------------------------------------|---------------------|--------|------|
|         |                                             |                                                                 |                  |                                          | SUB VENDOR          | VENDOR | TPIA |
| 3.0     | Painting                                    |                                                                 |                  |                                          |                     |        |      |
| 3.1     | Rust Preventive Coating & Colour Coding     | Visual Inspection & Colour Coding                               | 100%             | Inspection Report                        | -                   | H      | -    |
| 4.0     | Documentation & IC                          |                                                                 |                  |                                          |                     |        |      |
| 4.1     | Documentation & Inspection Certificate (IC) | Review of Stage Inspection Reports / Test Reports & Issue of IC | 100%             | Vendor TC/IR/IRC/DCN/DRGS. /VDR (Note-1) | -                   | H      | -    |

**NOTES (As applicable):**

- Items shall be accepted based on EN 10204 type 3.2/3.1 certification as specified in material requisition.
- ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



Energising Quality

## QUALITY ASSURANCE PLAN FOR HDPE DUCT

CONSULTANT: VCS Quality Services Pvt. Ltd.

QAP No.: VPC-QAP-PE-004

Rev 0

### INSTRUCTIONS FOR FILLING UP:

1. QAP shall be submitted for each equipment separately with breakup of assembly / sub-assembly & part/component or for group of equipment having same specification.
2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & test may be added as applicable for the plant and equipment.
3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
4. Weight in kilogram must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

### ABBREVIATION USED :

CONTR : CONTRACTOR  
MFR : MANUFACTURER  
TPI : THIRD PARTY  
INSPECTION

### CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:

#### Code Description

1. Visual
2. Dimensional
3. fitment & alignment
4. Physical Test (Sample)
5. Chemical test(Sample)
6. Ultrasonic test
7. Magnetic particle test(MPT)
8. Radiography test
9. Dye Penetrant test
10. Measurement of IR value
  - a) Before HV test
  - b) After HV test
11. High voltage test/Dielectric test

#### Code Description

12. Routine test as per relevant IS other standard
13. Type test as per relevant IS/ other standard
14. Impulse Test
15. Partial Discharge Test
16. Heat run risc test/temper
17. Enclosure protection test
18. Calibration
19. Noise & Vibration
20. Test certificate of bought out components
21. Tank pressure test
22. Paint shed vibration

#### Code Description

23. Short time rating
24. Operational & functional test
25. Over speed test
26. Flame proof Test
27. Clearance and creepage distance
28. Acceptance test
- 29 Honing Test
- 30 Hydro test/ Shell leak test
- 31 Pneumatic Seat leak test
- 32 Impact test

#### Code Description

- D1. Approved GA drawing.
- D2. Approved single line/ schematic diagram
- D3. Test certificates
- D4. Approved Bill of materials
- D5. Un-priced P.O. copy
- D6. Calibration certificates of all measuring instrument and gauges.



Energising Quality

## QUALITY ASSURANCE PLAN FOR HDPE DUCT

CONSULTANT: VCS Quality Services Pvt. Ltd.

QAP No.: VPC-QAP-PE-004

Rev 0

| Sl. No    | Components & Operations | Description of Test.                       | Category    | Extent of Check | Ref. Doc. & Cl. No. | Acceptance Criteria | Format of Records | INSPECTION   |      | Remarks                                     |
|-----------|-------------------------|--------------------------------------------|-------------|-----------------|---------------------|---------------------|-------------------|--------------|------|---------------------------------------------|
|           |                         |                                            |             |                 |                     |                     |                   | Manufacturer | TPIA |                                             |
| HDPE Duct |                         |                                            |             |                 |                     |                     |                   |              |      |                                             |
| 1         | HDPE Duct               | Dimension of Duct                          | Dimensional | ST              | ADS                 | ADS                 | IF                | P            | RW   | Minimum 5% to be randomly witnessed by TPIA |
|           |                         | Tensile Strength and Elongation            | Physical    | ST              | ADS                 | IS-14151 (Part – I) | IF                | P            | RW   | Minimum 5% to be randomly witnessed by TPIA |
|           |                         | Reversion Test                             | Physical    | AT              | ADS                 | IS-4984             | IF                | P            | R    |                                             |
|           |                         | Environmental Stress Crack Resistance Test | Physical    | AT              | ADS                 | ASTM D-1693         | IF                | P            | R    |                                             |
|           |                         | Impact Strength Test                       | Physical    | AT              | ADS                 | IS-12235 (Part – 9) | IF                | P            | R    |                                             |
|           |                         | Crush Resistance Test                      | Physical    | AT              | ADS                 | ADS                 | IF                | P            | R    |                                             |
|           |                         | Mandrel Test                               | Physical    | AT              | ADS                 | ADS                 | IF                | P            | R    |                                             |



Energising Quality

## QUALITY ASSURANCE PLAN FOR HDPE DUCT

CONSULTANT: VCS Quality Services Pvt. Ltd.

QAP No.: VPC-QAP-PE-004

Rev 0

|   |                                  |                                      |          |    |     |         |    |   |    |                                             |
|---|----------------------------------|--------------------------------------|----------|----|-----|---------|----|---|----|---------------------------------------------|
|   |                                  | Ovality Test                         | Physical | AT | ADS | ADS     | IF | P | R  |                                             |
|   |                                  | Coil Set Test                        | Physical | AT | ADS | ADS     | IF | P | R  |                                             |
|   |                                  | Oxidation Induction Test             | Physical | AT | ADS | ADS     | IF | P | R  |                                             |
|   |                                  | Internal pressure creep rupture test | Physical | AT | ADS | IS-4984 | IF | P | R  |                                             |
|   |                                  | Internal Co-efficient of Friction    | Test     | AT | ADS | ADS     | IF | P | R  |                                             |
| 2 | Optical Fibre Cable Blowing Test | Visual damage                        | Physical | AT | ADS | ADS     | IF | P | RW | Minimum 5% to be randomly witnessed by TPIA |

LEGENDS: R – Review, W – Witness, P – Perform, RW – Random Witness, TPIA – Third Party Inspection Agency, AT-All to be tested, ST- Sample test (5%), ATS- Approved Technical Specifications, MTR- Material Test Report, IF-Inspection Format, ADS-Approved Data Sheets

### Notes:

1. The above-mentioned testing and acceptance criteria are minimum requirements; however, supplier shall ensure that the product also comply with additional requirements as per standard specification and Data Sheet.
2. The supplier shall submit their own detailed ITP prepared on the basis of the above for approval of Owner / Owner's representative and TPIA.
3. TPIA shall have right to inspect minimum 5% of all manufacturing activities on each day or as specified above.
4. TPIA along with Owner / Owner's representative shall review / approve all the documents related to QCT / Quality Manuals Drawings etc, submitted by supplier.
5. TPIA shall also review the test certificates submitted by the manufacturer.



Energising Quality

## QUALITY ASSURANCE PLAN FOR HDPE DUCT

**CONSULTANT: VCS Quality Services Pvt. Ltd.**

**QAP No.: VPC-QAP-PE-004**

**Rev 0**

6. Supplier shall in coordination with sub-vendor issue detailed production and inspection schedule indicating the dates and the locations to facilitate Owner / Owner's representative to organize inspection.
7. Supplier shall submit their own Detailed ITP and regulator tag / nameplate format Duly Signed and Stamped.
8. TPIA shall review all the reports 100 %.

|                                                                                                         |                                 |                       |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|
| <br>Energising Quality | <h1>QUALITY ASSURANCE PLAN</h1> | <b>VPC-QAP-PE-002</b> |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|

| <b>ANNEXURE-I</b><br><b>QUALITY ASSUARANCE PLAN</b><br><b>Item: Electrofusion Fittings PE 80/PE100- Coupler, Reducer, Elbow 90°, Elbow 45°, End Caps, Saddle, Equal tee &amp; Transition Fittings</b> |                                                         |                             |                  |                              |                                             |                       |            |         |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------------|------------------|------------------------------|---------------------------------------------|-----------------------|------------|---------|---------|
| Sr. No.                                                                                                                                                                                               | Test Description                                        | Type Of Check               | Quantum Of Check | Ref. Document                | Acceptance Norms                            | Documentation         | Inspection |         | Remarks |
|                                                                                                                                                                                                       |                                                         |                             |                  |                              |                                             |                       | Mfg.       | C/ TPIA |         |
| 1                                                                                                                                                                                                     | Dimension Check                                         | Geometrical Characteristics | 01 No. from Lot  | Mfg. Drawing                 | EN 1555-3 / Mfg. Drawing                    | Mfg. test certificate | P          | W       |         |
| 2                                                                                                                                                                                                     | Melt mass flow rate                                     | Physical Characteristics    | 01 No. from Lot  | ISO 1133                     | MFR 190°/5kg.<br>0.20 – 1.20 gm./10 min.    | Mfg. test certificate | P          | R       |         |
| 3                                                                                                                                                                                                     | Density                                                 | Physical Characteristics    | 01 No. from Lot  | ISO 1183                     | 0.926 to 0.94 g/cm <sup>3</sup>             | Mfg. test certificate | P          | R       |         |
| 4                                                                                                                                                                                                     | OIT (Thermal Stability)                                 | Physical Characteristics    | 01 No. from Lot  | ISO 11357-6/<br>EN 728       | Oxidation Induction Time<br>≥ 20 min/200° C | Mfg. test certificate | P          | R       |         |
| 5                                                                                                                                                                                                     | Appearance, Color                                       | General Characteristics     | 01 No. from Lot  | EN 1555- 3                   | Mfg. Spec.                                  | Mfg. test certificate | P          | W       |         |
| 6                                                                                                                                                                                                     | Hydrostatic Strength (PE100)                            | Mechanical Characteristics  |                  | EN 1555- 3 &<br>ISO 1167-1-4 | Case I- 165h/80°C/(5.5MPa)                  | Hydrotest Report      | P          | W       |         |
|                                                                                                                                                                                                       |                                                         |                             |                  |                              | Case II- 100h/20°C/(12 MPa)                 |                       |            |         |         |
|                                                                                                                                                                                                       |                                                         |                             |                  |                              | Case II- 100h/20°C/(10 MPa)                 |                       |            |         |         |
| 8                                                                                                                                                                                                     | Peel Decohension Test for Electrofusion socket fitting  | Mechanical Characteristics  |                  | ISO 13954                    | EN 1555-3                                   | Inspection Report     | P          | W       |         |
| 9                                                                                                                                                                                                     | Crush Decohension Test for Electrofusion socket fitting | Mechanical Characteristics  |                  | ISO 13955                    | EN 1555-3                                   | Inspection Report     | P          | W       |         |

|                                                                                   |                                 |                       |
|-----------------------------------------------------------------------------------|---------------------------------|-----------------------|
|  | <h1>QUALITY ASSURANCE PLAN</h1> | <b>VPC-QAP-PE-002</b> |
|-----------------------------------------------------------------------------------|---------------------------------|-----------------------|

|    |                                                                |                            |                 |           |           |                   |   |   |  |
|----|----------------------------------------------------------------|----------------------------|-----------------|-----------|-----------|-------------------|---|---|--|
| 10 | Decohension Test (tear test) for Electrofusion saddle fittings | Mechanical Characteristics |                 | ISO 13956 | EN 1555-3 | Inspection Report | P | W |  |
| 11 | Impact Resistance for Electrofusion saddle fittings            | Mechanical Characteristics |                 | EN 1716   | EN 1555-3 | Inspection Report | P | W |  |
| 12 | Pressure Drop.                                                 | Mechanical Characteristics | 01 No. from Lot | ISO 17778 | EN 1555-3 | Inspection Report | P | R |  |
| 13 | Electrical Resistance                                          | Electrical Characteristics | 01 No. from Lot | EN 1555-3 | EN 1555-3 | Inspection Report | P | R |  |

**Note:**

1. The above testing and acceptance criteria are minimum requirements, however, manufacturer shall ensure that the product shall also comply to the additional requirements as per Standard specifications(SS).
2. The supplier shall submit their own detailed QAP prepared on the basis of above / technical specification for approval of Owner/Owner's representative.
3. Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc. submitted by supplier.
4. Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organize Inspection.
5. Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used, in case of conflict between specifications more stringent condition shall be applicable.
6. Owner / Owner's representative including TPIA will have the right to inspect any activity of manufacturing at any time.
7. All reference Codes/ Standards, Documents, P.O. Copies shall be arranged by vendor / supplier for reference of TPIA/ Client at the time of Inspection
8. At the time of delivery of material in stores, vendor will submit copy of all related document of inspection along with release note & MTC.

|                                                                                   |                                 |                         |
|-----------------------------------------------------------------------------------|---------------------------------|-------------------------|
|  | <h1>QUALITY ASSURANCE PLAN</h1> | <h2>VPC-QAP-PE-002</h2> |
|-----------------------------------------------------------------------------------|---------------------------------|-------------------------|

LEGENDS:

- M – Monitor

P – Perform
- R – Review

W – Witness
- H – Hold

C- Customer
- TPIA – Third Party Inspection Agency

V – Verification of Mfg. Test Certificate

| Prepared by                       | Reviewed / Checked by             | Approved by                       |
|-----------------------------------|-----------------------------------|-----------------------------------|
|                                   |                                   |                                   |
| (Name / Signature / Date / Stamp) | (Name / Signature / Date / Stamp) | (Name / Signature / Date / Stamp) |



|                                                                                                         |                                 |                       |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|
| <br>Energising Quality | <h1>QUALITY ASSURANCE PLAN</h1> | <b>VPC-QAP-PE-003</b> |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|

| ANNEXURE-II<br>QUALITY ASSUARANCE PLAN<br>Item: MDPE Ball Valve – PE 80/PE100 (Without/With Stem) |                         |                             |                  |                              |                                             |        |                       |            |        |         |
|---------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|------------------|------------------------------|---------------------------------------------|--------|-----------------------|------------|--------|---------|
| Sr. No.                                                                                           | Test Description        | Type Of Check               | Quantum Of Check | Ref. Document                | Acceptance Norms                            |        | Documentation         | Inspection |        | Remarks |
|                                                                                                   |                         |                             |                  |                              |                                             |        |                       | Mfg.       | C/TPIA |         |
| 1                                                                                                 | Dimension Check         | Geometrical Characteristics | 01 No. from Lot  | Mfg. Drawing                 | EN 1555-3 / EN 1555-4 / Mfg. Drawing        |        | Mfg. test certificate | P          | W      |         |
| 2                                                                                                 | Melt mass flow rate     | Physical Characteristics    | 01 No. from Lot  | ISO 1133                     | MFR 190°/5kg.<br>0.20 – 1.20 gm./10 min.    |        | Mfg. test certificate | P          | R      |         |
| 3                                                                                                 | Density                 | Physical Characteristics    | 01 No. from Lot  | ISO 1183                     | 0.926 to 0.94 g/cm³                         |        | Mfg. test certificate | P          | R      |         |
| 4                                                                                                 | OIT (Thermal Stability) | Physical Characteristics    | 01 No. from Lot  | ISO 11357-6/<br>EN 728       | Oxidation Induction Time<br>≥ 20 min/200° C |        | Mfg. test certificate | P          | R      |         |
| 5                                                                                                 | Volatile Content        | Physical Characteristics    | 01 No. from Lot  | EN 12099                     | ≤ 350 mg/kg                                 |        | Mfg. test certificate | P          | R      |         |
| 6                                                                                                 | Carbon Black Content    | Physical Characteristics    | 01 No. from Lot  | ISO 6964                     | 2.50 ± 0.5%                                 |        | Mfg. test certificate | P          | R      |         |
| 7                                                                                                 | Appearance, Color       | General Characteristics     | 01 No. from Lot  | EN 1555- 4                   | Mfg. Spec.                                  |        | Mfg. test certificate | P          | W      |         |
| 8                                                                                                 | Hydrostatic Strength    | Mechanical Characteristics  | 01 No. from Lot  | EN 1555- 4 &<br>ISO 1167-1/4 | Case I- 165h/80°C/(5.5MPa)                  |        | Hydrotest Report      | P          | W      |         |
|                                                                                                   |                         |                             |                  |                              | Case II- 100h/20°C/(12 MPa)                 |        |                       |            |        |         |
| 9                                                                                                 | Operating Torque        | Mechanical Characteristics  | 01 No. from Lot  | EN 1555- 4                   | Ø≤63                                        | 35Nm   | Mfg. test certificate | P          | R      |         |
|                                                                                                   |                         |                             |                  |                              | Ø63- Ø 125                                  | ≤70Nm  |                       |            |        |         |
|                                                                                                   |                         |                             |                  |                              | Ø125- Ø315                                  | ≤150Nm |                       |            |        |         |
| 10                                                                                                | Leak Tightness          | Mechanical Characteristics  | 01 No. from Lot  | EN 1555- 4                   | Table-1, EN 1555-4                          |        | Mfg. test certificate | P          | R      |         |
| 11                                                                                                | Pressure Drop.          | Mechanical Characteristics  |                  | ISO 17778                    | EN 1555-3                                   |        | Approval Certificate  | P          | R      |         |

|                                                                                                         |                                 |                       |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|
| <br>Energising Quality | <h1>QUALITY ASSURANCE PLAN</h1> | <b>VPC-QAP-PE-003</b> |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|

**Note:**

1. The above testing and acceptance criteria are minimum requirements, however, manufacturer shall ensure that the product shall also comply to the additional requirements as per Standard Specification (SS).
2. The supplier shall submit their own detailed QAP prepared on the basis of above / technical specification for approval of Owner/Owner's representative.
3. Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc. submitted by supplier.
4. Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organize Inspection.
5. Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used, in case of conflict between specifications more stringent condition shall be applicable.
6. Owner / Owner's representative including TPIA will have the right to inspect any activity of manufacturing at any time.
7. All reference Codes/ Standards, Documents, P.O. Copies shall be arranged by vendor / supplier for reference of TPIA / Client Consortium at the time of Inspection
8. At the time of delivery of material in stores, vendor will submit copy of all related document of inspection along with release note & MTC.

**LEGENDS:**

**M** – Monitor  
**P** – Perform

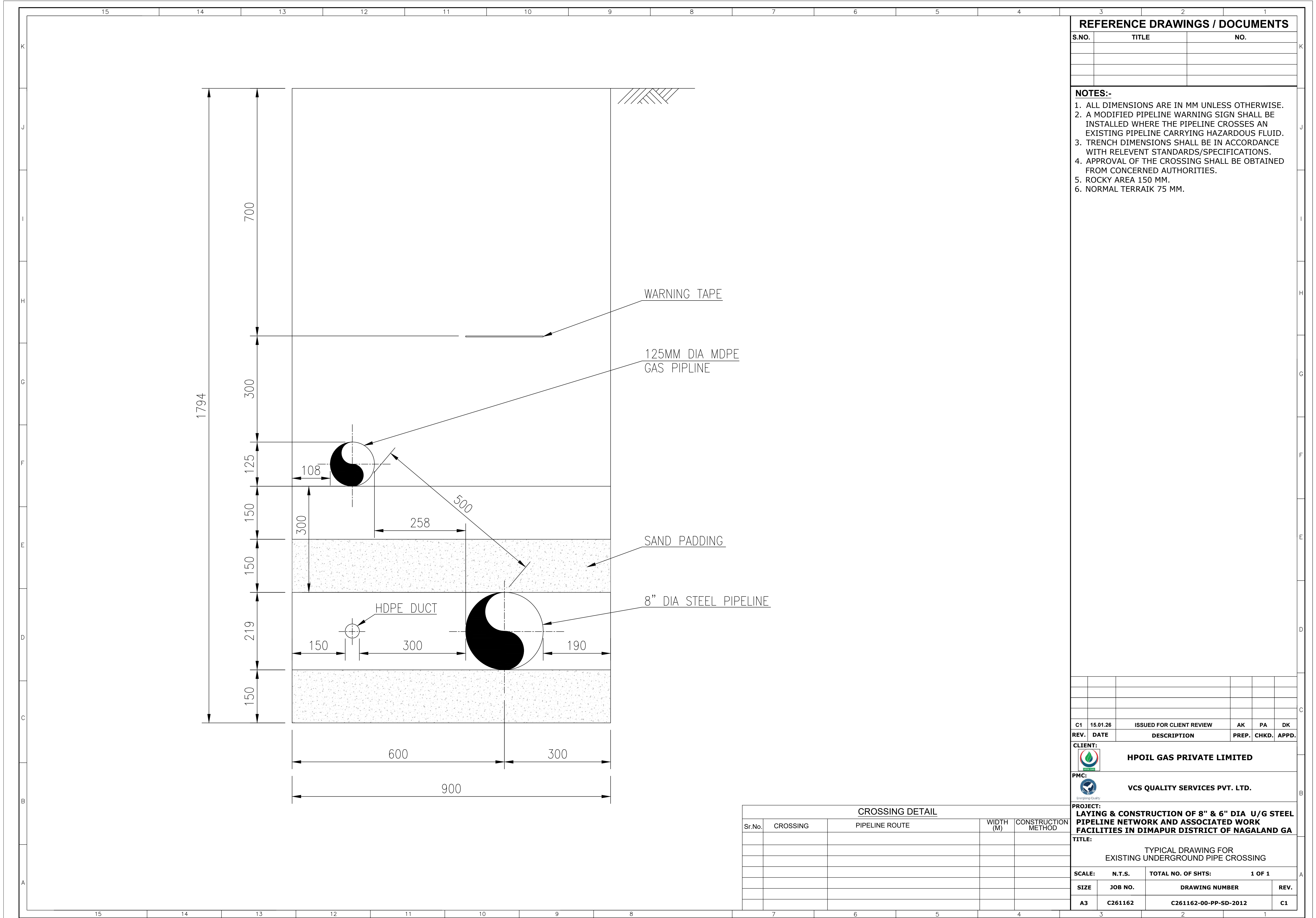
**R** – Review  
**W** – Witness

**H** – Hold  
**C** – Customer

**TPIA** – Third Party Inspection Agency  
**V** – Verification of Mfg. Test Certificate

| Prepared by                       | Reviewed / Checked by             | Approved by                       |
|-----------------------------------|-----------------------------------|-----------------------------------|
|                                   |                                   |                                   |
| (Name / Signature / Date / Stamp) | (Name / Signature / Date / Stamp) | (Name / Signature / Date / Stamp) |

# STANDARD DRAWINGS



REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |

- NOTES:-
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE.
  2. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED WHERE THE PIPELINE CROSSES AN EXISTING PIPELINE CARRYING HAZARDOUS FLUID.
  3. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
  4. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.
  5. ROCKY AREA 150 MM.
  6. NORMAL TERRAIK 75 MM.

|      |          |                          |       |       |       |
|------|----------|--------------------------|-------|-------|-------|
|      |          |                          |       |       |       |
|      |          |                          |       |       |       |
|      |          |                          |       |       |       |
| C1   | 15.01.26 | ISSUED FOR CLIENT REVIEW | AK    | PA    | DK    |
| REV. | DATE     | DESCRIPTION              | PREP. | CHKD. | APPD. |

CLIENT:

HPOIL GAS PRIVATE LIMITED

PMC:

VCS QUALITY SERVICES PVT. LTD.

PROJECT:

LAYING & CONSTRUCTION OF 8" & 6" DIA U/G STEEL PIPELINE NETWORK AND ASSOCIATED WORK FACILITIES IN DIMAPUR DISTRICT OF NAGALAND GA

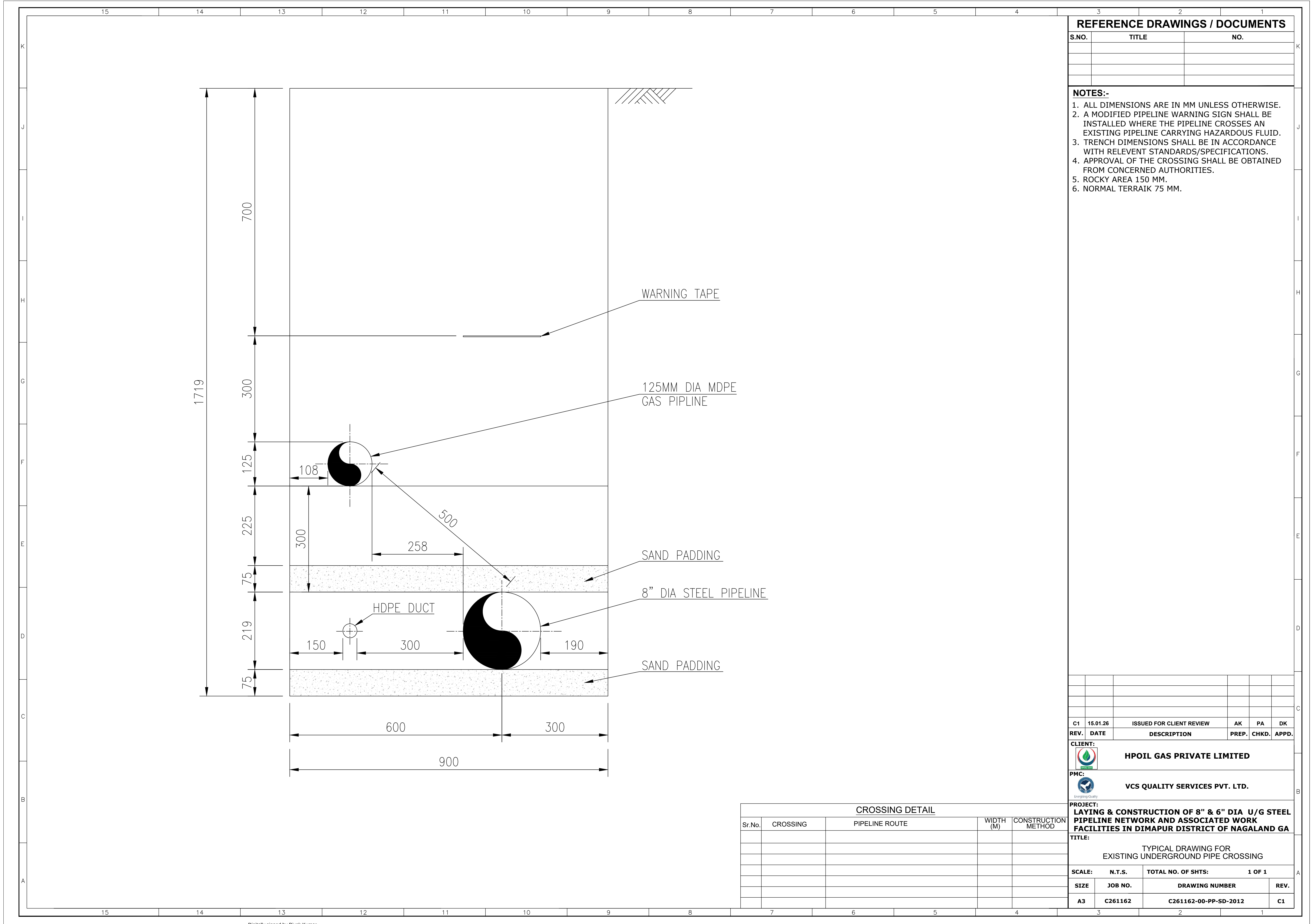
TITLE:

TYPICAL DRAWING FOR EXISTING UNDERGROUND PIPE CROSSING

SCALE: N.T.S. TOTAL NO. OF SHTS: 1 OF 1

| SIZE | JOB NO. | DRAWING NUMBER        | REV. |
|------|---------|-----------------------|------|
| A3   | C261162 | C261162-00-PP-SD-2012 | C1   |





REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |

- NOTES:-
- 1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE.
  - 2. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED WHERE THE PIPELINE CROSSES AN EXISTING PIPELINE CARRYING HAZARDOUS FLUID.
  - 3. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
  - 4. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.
  - 5. ROCKY AREA 150 MM.
  - 6. NORMAL TERRAIK 75 MM.

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|      |          |                          |       |       |       |
| C1   | 15.01.26 | ISSUED FOR CLIENT REVIEW | AK    | PA    | DK    |
| REV. | DATE     | DESCRIPTION              | PREP. | CHKD. | APPD. |

CLIENT:

**HPOIL GAS PRIVATE LIMITED**

PMC:

**VCS QUALITY SERVICES PVT. LTD.**

PROJECT:**LAYING & CONSTRUCTION OF 8" & 6" DIA U/G STEEL PIPELINE NETWORK AND ASSOCIATED WORK FACILITIES IN DIMAPUR DISTRICT OF NAGALAND GA**

TITLE:

TYPICAL DRAWING FOR EXISTING UNDERGROUND PIPE CROSSING

SCALE:

N.T.S.

TOTAL NO. OF SHTS:

1 OF 1

SIZE:

A3

JOB NO.:

C261162

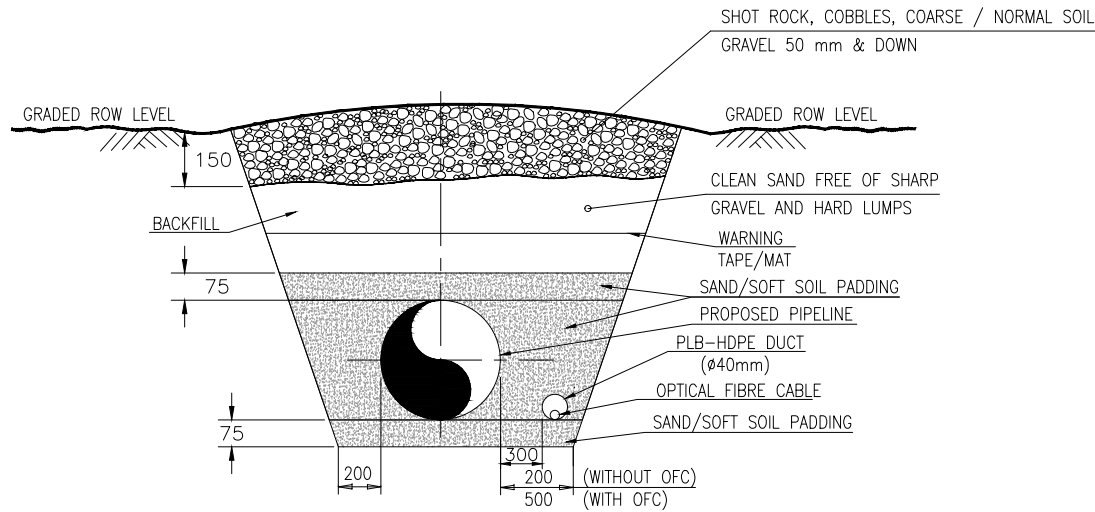
DRAWING NUMBER:

C261162-00-PP-SD-2012

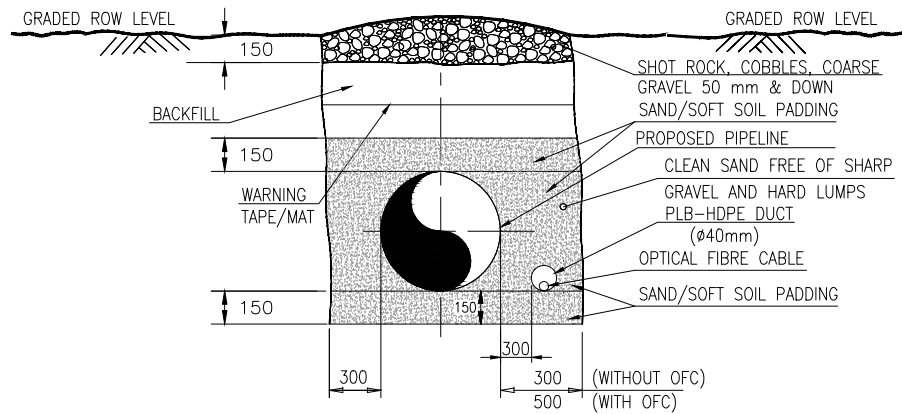
REV.:

C1

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
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|                 |          |                |           |                     |



**TYPE - A**  
(SELECT BACK FILL FOR STATION APPROACH IN NORMAL SOIL)



**TYPE - B**  
(SELECT BACK FILL FOR STATION APPROACH IN HARD SOIL/ROCKY STRATA/GRAVEL AREA)

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
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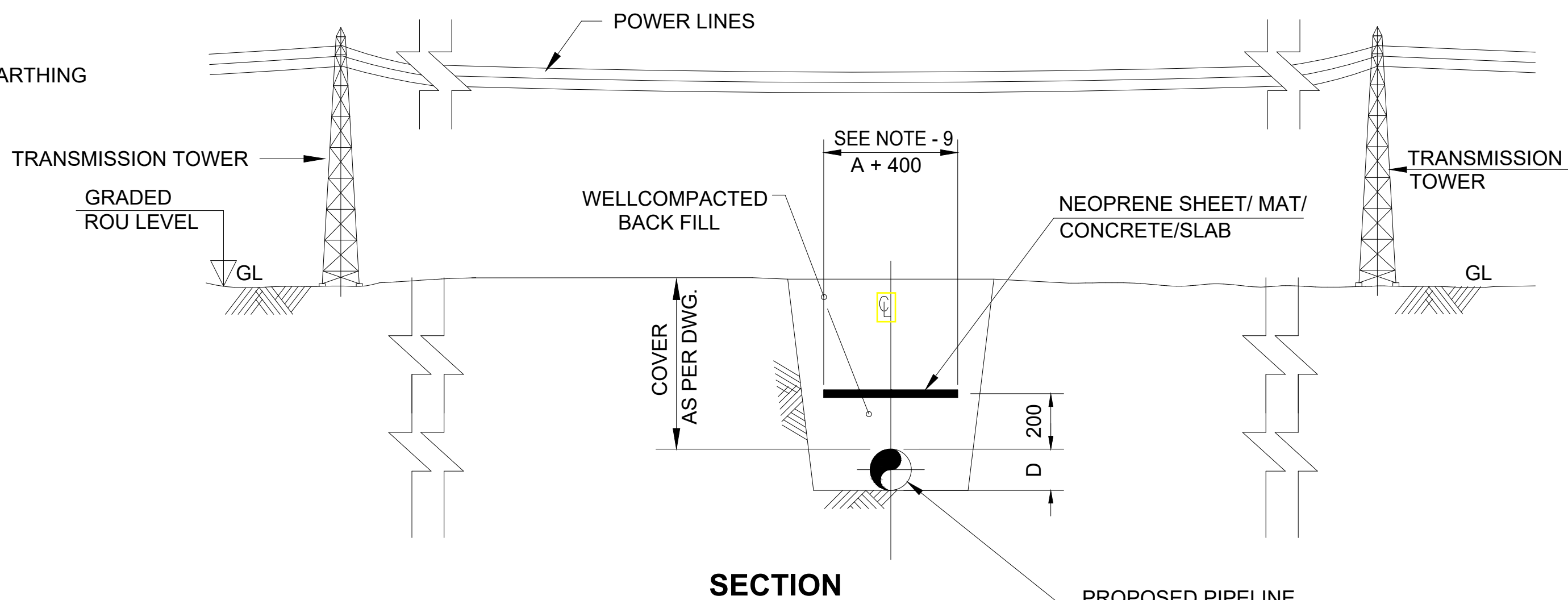
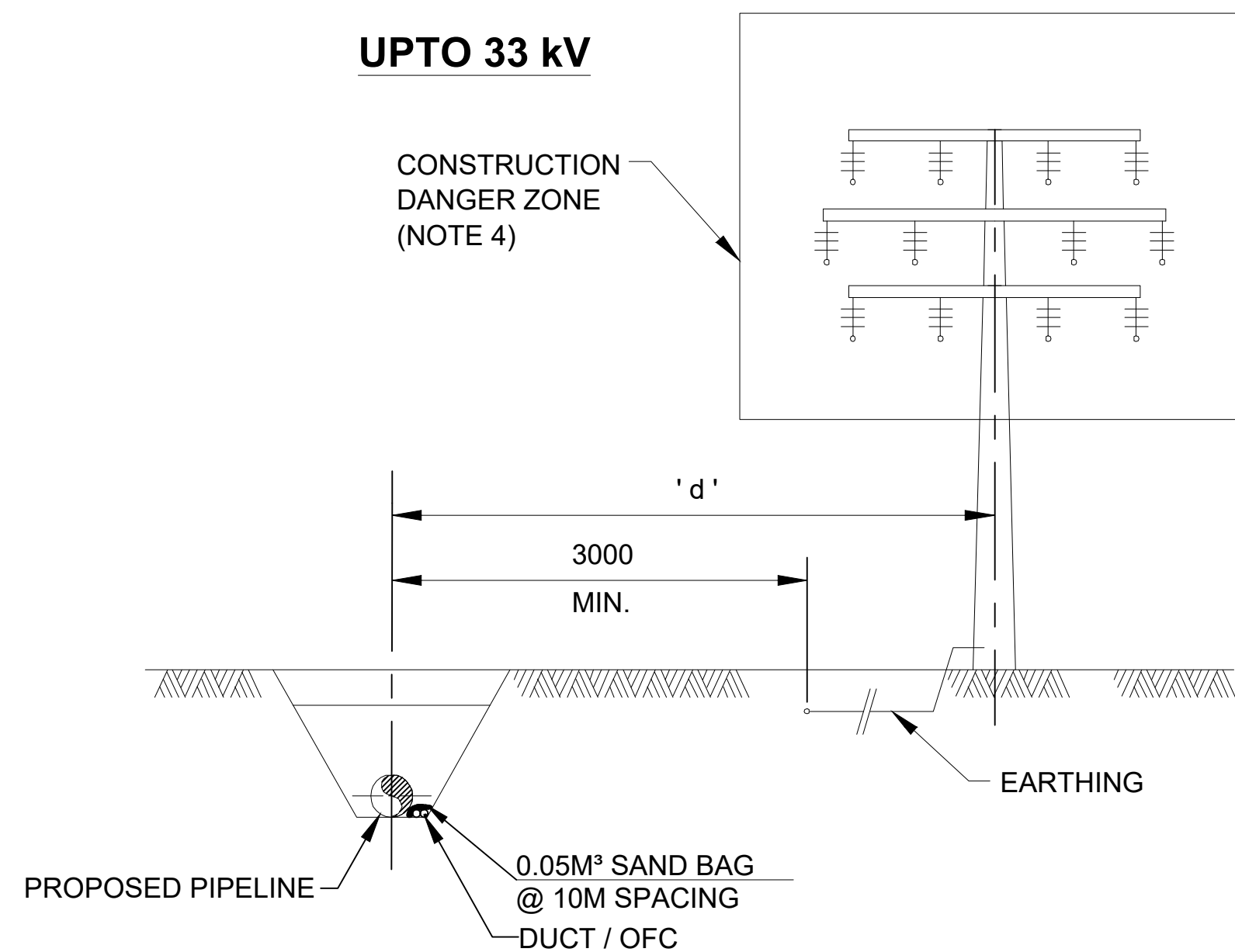
| REFERENCE DRAWINGS / DOCUMENTS |       |     |
|--------------------------------|-------|-----|
| S.NO.                          | TITLE | NO. |
|                                |       |     |
|                                |       |     |
|                                |       |     |

- NOTES:-**
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
  2. SELECT BACKFILL MUST HAVE MIN. AS PLACED DRY DENSITY OF 1800 KG/M<sup>3</sup>. IF FOUND NECESSARY IN FIELD, THE SELECT BACKFILL SHALL BE COMPACTED TO ACHIEVE A MIN. DRY DENSITY OF 1800 KG/M<sup>3</sup>.
  3. MINIMUM PIPELINE COVER SHALL BE 1000 mm. ANY EXTRA COVER REQUIREMENT SHALL BE IN ACCORDANCE WITH SPECIFICATIONS / STANDARDS / DRAWINGS.
  4. MINIMUM COVER REQUIREMENT SHALL BE SUBJECT TO APPROVAL OF CONCERNED AUTHORITIES WHEREVER REQUIRED.
  5. FOR MINIMUM COVER REQUIREMENT AT PIPELINE CROSSING ROADS, RAILWAY TRACKS, RIVERS, MARSHY AREAS ETC., REFER STANDARDS / DRAWINGS & DESIGN BASIC.
  6. IN CASE AREA IS CLASSIFIED AS SEISMIC ZONE, TRENCH DIMENSION SHALL BE AS PER RELEVANT STANDARD.
  7. TRENCH CROSS SECTION SHALL VIEWED IN THE DIRECTION OF FLOW.
  8. WARNING MATE SHALL BE SUPPLIED AND INSTALL ALONG THE WHOLE ROUTE OF PIPELINE AS PER DWG NO.

| C1                                                                                                                                               | 16.02.26 | ISSUED FOR CLIENT REVIEW | AK                 | AS    | DK                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------|--------------------|-------|-----------------------|
| REV.                                                                                                                                             | DATE     | DESCRIPTION              | PREP.              | CHKD. | APPD.                 |
| CLIENT:                                                                                                                                          |          |                          |                    |       |                       |
|  <b>HPOIL GAS PRIVATE LIMITED</b>                           |          |                          |                    |       |                       |
| PMC:                                                                                                                                             |          |                          |                    |       |                       |
|  <b>VCS QUALITY SERVICES PVT. LTD.</b>                      |          |                          |                    |       |                       |
| PROJECT:                                                                                                                                         |          |                          |                    |       |                       |
| <b>LAYING &amp; CONSTRUCTION OF 8" &amp; 6" DIA U/G STEEL PIPELINE NETWORK AND ASSOCIATED WORK FACILITIES IN DIMAPUR DISTRICT OF NAGALAND GA</b> |          |                          |                    |       |                       |
| TITLE:                                                                                                                                           |          |                          |                    |       |                       |
| <b>TYPICAL DRAWING FOR SELECTED BACKFILL STATION APPROACH</b>                                                                                    |          |                          |                    |       |                       |
| SCALE:                                                                                                                                           |          | N.T.S.                   | TOTAL NO. OF SHTS: |       | 1 OF 1                |
| SIZE:                                                                                                                                            |          | A3                       | JOB NO.:           |       | C261162               |
|                                                                                                                                                  |          |                          | DRAWING NUMBER:    |       | C261162-00-PP-SD-2015 |
|                                                                                                                                                  |          |                          | REV.:              |       | C1                    |



## PARALLELISM TO HIGH VOLTAGE TRANSMISSION LINES



## MINIMUM DISTANCE FROM CENTERLINE OF PIPELINE TO POWER TRANSMISSION STRUCTURES

|                  | PARALLELISM                                | CROSSING                                                               |
|------------------|--------------------------------------------|------------------------------------------------------------------------|
| ELETRICAL SYSTEM | ELETRICAL SYSTEM<br>TO THE LINE AXIS ' d ' | MINIMUM DISTANCE<br>TO THE POLE ' d1 '<br>(NEAREST FOOTING) / EARTHING |
| UP TO 33 kV      | 5000                                       | 4000                                                                   |
| OVER 33 kV       | 10000                                      | 4000                                                                   |

[illegible]

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
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|       |       |     |
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1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. IN CASE THE MINIMUM DISTANCE IS NOT MET, THE LOCAL ELECTRICAL COMPANY HAS TO BE CONTACTED FOR APPROVAL.
3. STABILITY OF TIMBER POLE TO BE GUARANTEED DURING CONSTRUCTION.
4. CONSIDERATION SHOULD BE GIVEN TO LIGHTNING FAULT, CURRENT PROTECTION OF PIPELINE & SAFETY OF PERSONNEL.
5. IN CASE OF CROSSING OF HIGH VOLTAGE TRANSMISSION LINES, MIN. DISTANCE OF 3000 SHALL BE MAINTAINED FROM EARTHING.
6. SUITABLE MEASURE SHALL BE TAKEN FOR THE PROTECTION OF THE LINE.
7. CONCRETE SLAB/ NEOPRENE / MAT SHALL BE PROVIDED FOR OHL CROSSINGS FOR 33 KV AND ABOVE.
8. CONCRETE SLAB SHALL BE AS PER DRAWING, C221070-00-PP-SD-2017 OR NEOPRENE SHEET SHALL BE 8MM THK.
9. DIMENSION 'A' SHALL BE CALCULATED AS FOLLOWS:  
 $A = (D_1 + D_2 + \dots + D_n) + (n-1) \times 500$ , WHERE  $D_1, D_2, \dots, D_n$  IS THE OUTSIDE DIAMETER (INCLUDING COATING) OF PIPELINES IN MM IN THE SAME TRENCH AND 'n' IS NO. OF PIPELINES, IN CASE OFC/DUCT IS ALSO PRESENT DIMENSION 'A' SHALL BE INCREASED BY 200MM. OFC/DUCT SHALL BE LAID AT A DISTANCE OF 200MM FROM EXTREME PIPE AS PER TRENCH SECTION DRAWING.
10. FOR PIPELINE CROSSING OR LAYING PARALLEL TO H.T. LINE OF 420 KV SPECIAL PROVISION LIKE MITTIGATOR SHALL BE USE AS PER CP DESIGN.

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| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HI  |
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APR |



**VCS QUALITY SERVICES PVT. LTD**

**TITLE:**

## TYPICAL DRAWING FOR OVERHEAD POWER LINE CROSSING

**SCALE:**

|        |                    |        |
|--------|--------------------|--------|
| N.T.S. | TOTAL NO. OF SHTS: | 1 OF 1 |
|--------|--------------------|--------|

1 OF 1

**SIZE**

**JOB NO.**

**DRAWING NUMBER**

RE

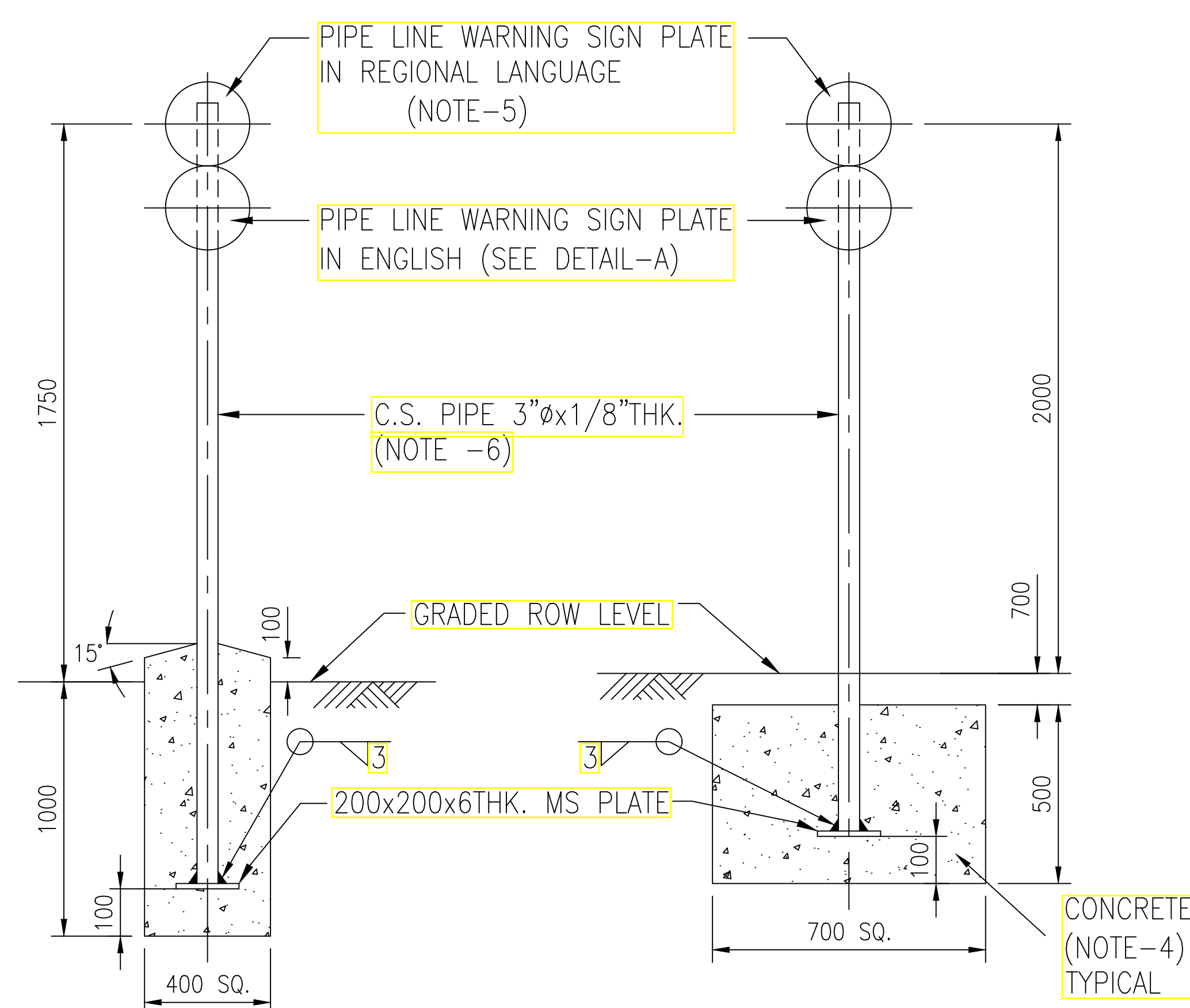
[illegible]

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[illegible]

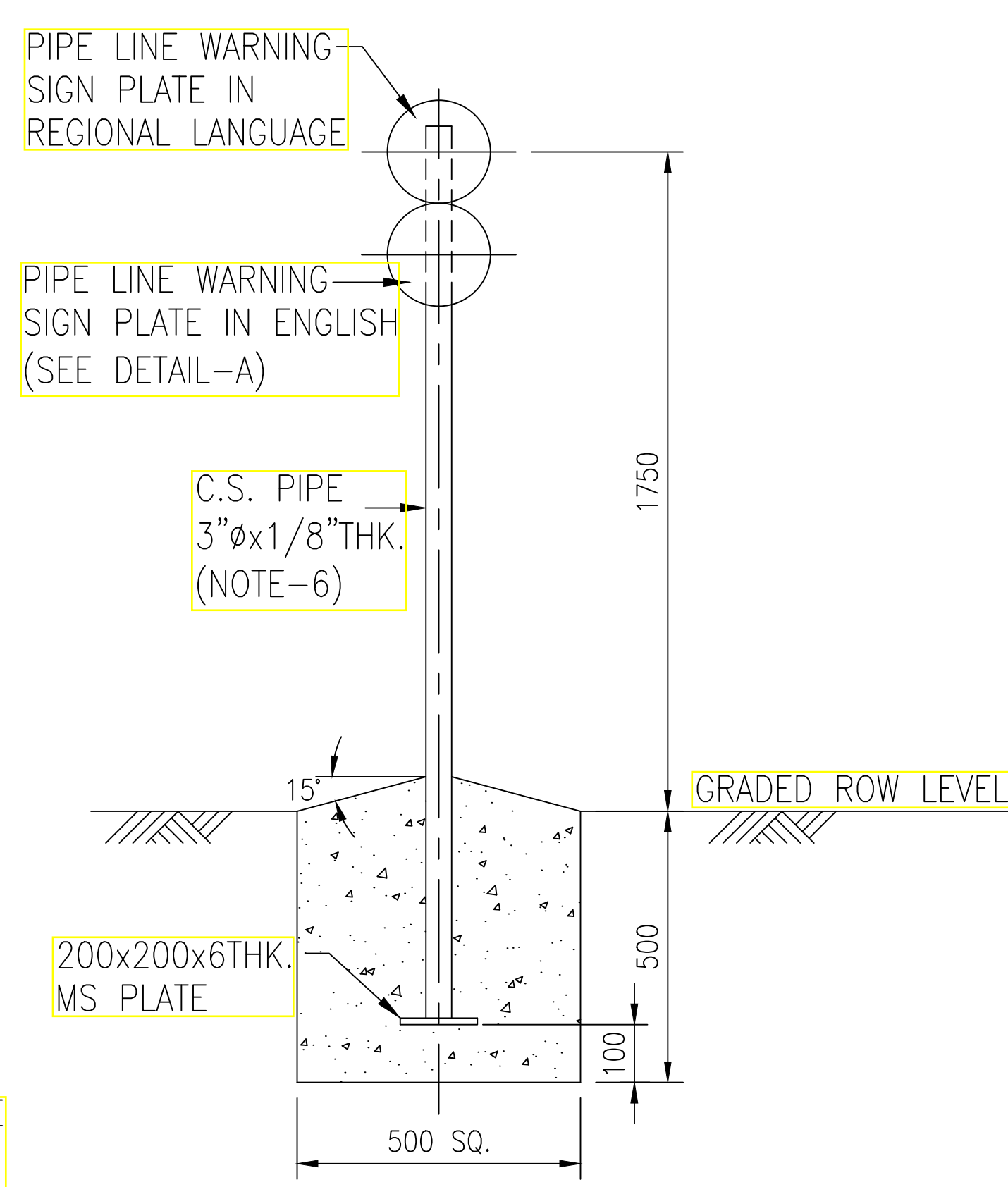
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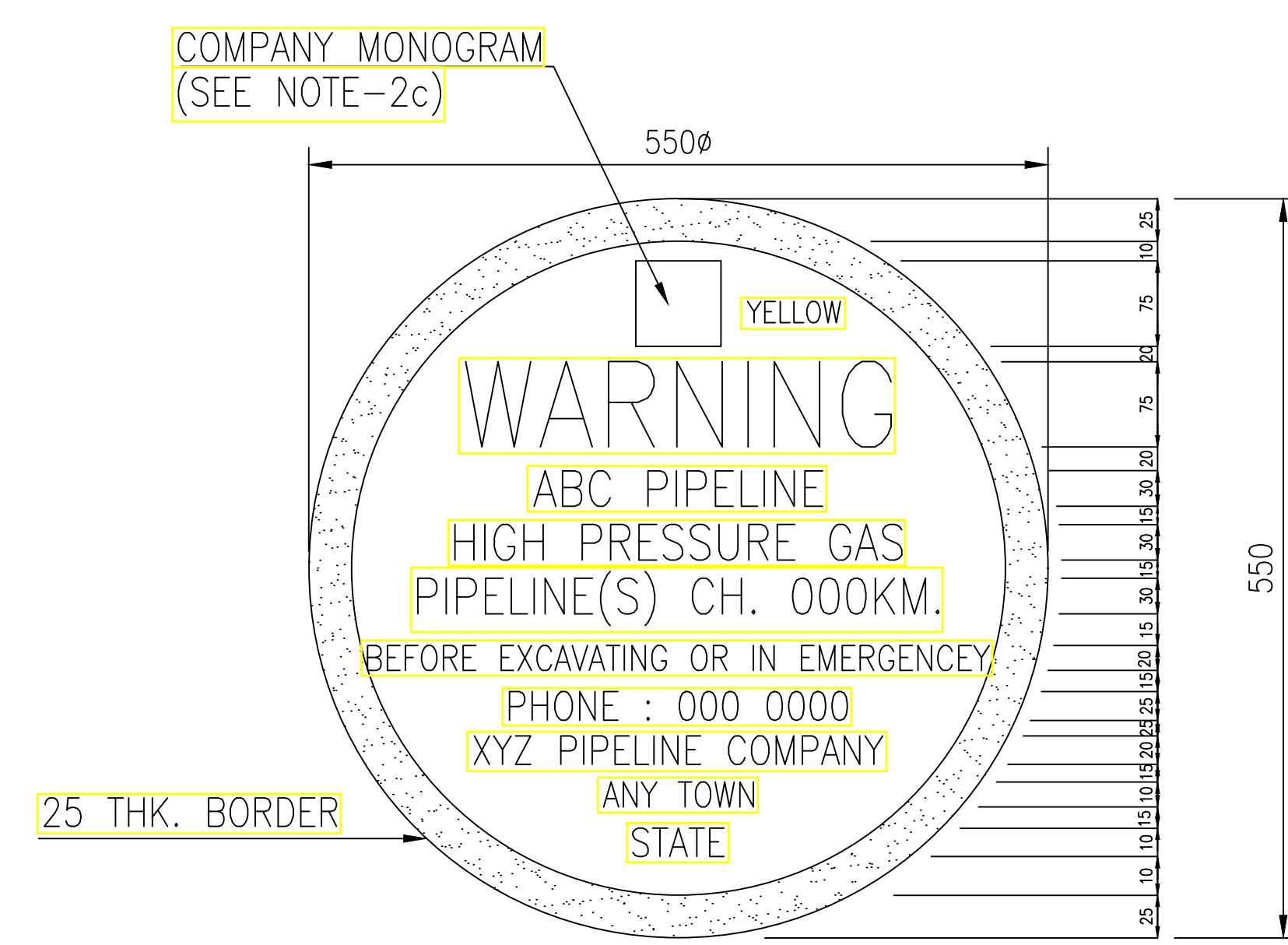


TYPE-I  
FOR NORMAL SOIL

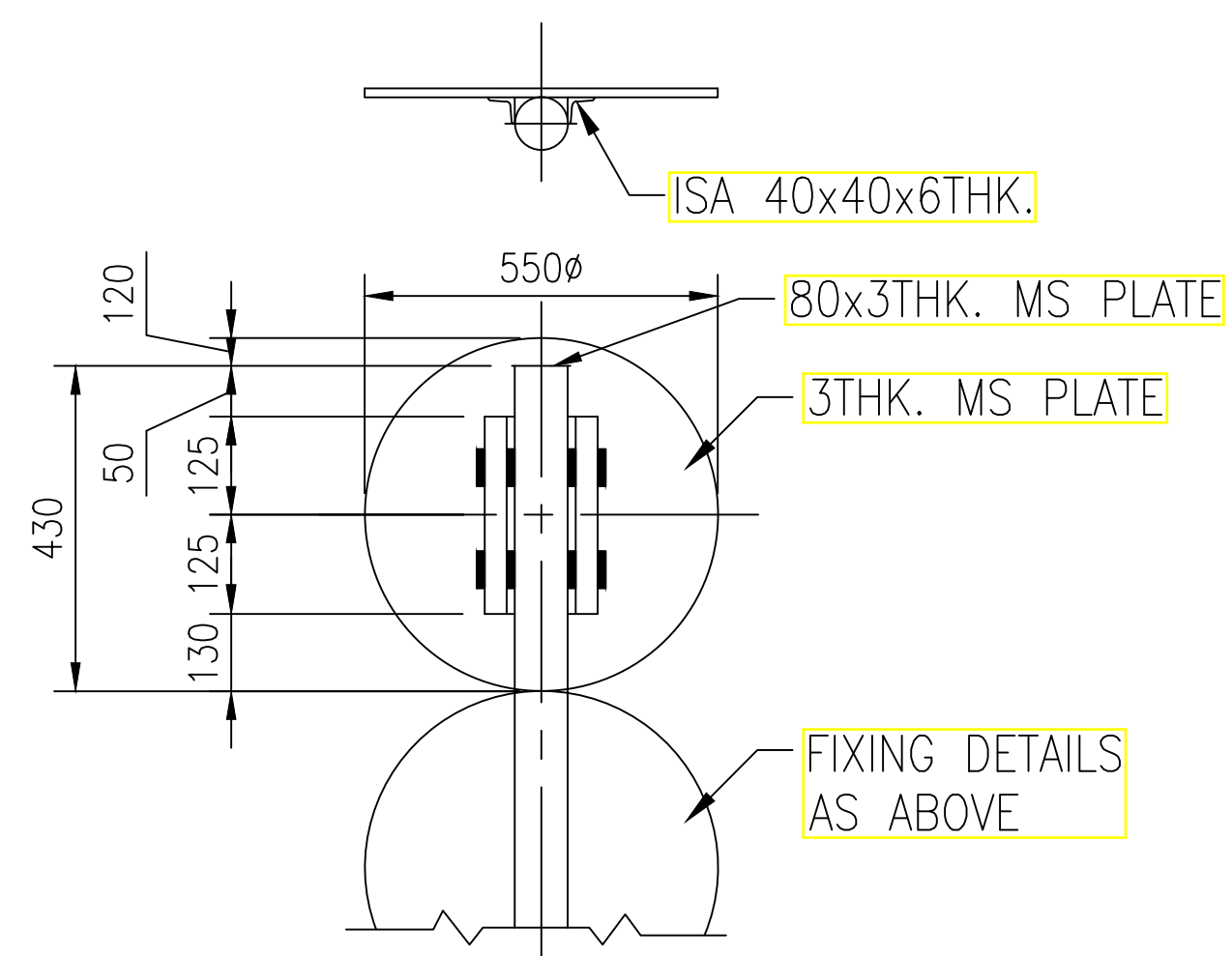
TYPE-II  
FOR DRIFTING SAND AREAS  
(NOTE-7)



TYPE-III  
FOR ROCKY AREAS



DETAIL-A



WARNING SIGN PLATE  
FIXING DETAILS

REFERENCE DRAWINGS / DOCUMENTS

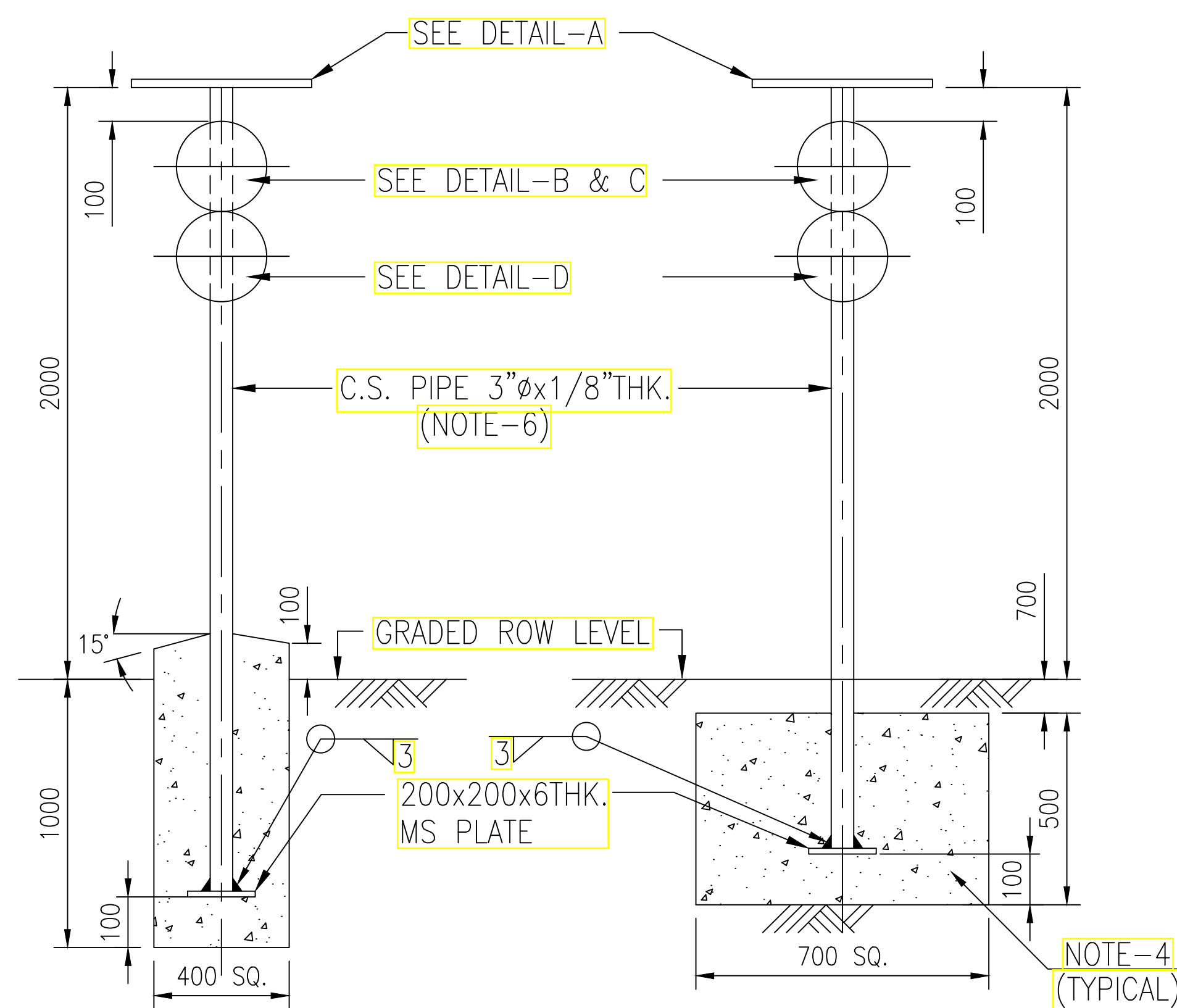
| S.NO. | TITLE | NO. |
|-------|-------|-----|
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|       |       |     |
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- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
  - SCHEME OF PAINTING & COLOURING.
    - UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE), : COAL TAR EPOXY MIN. 300 MICRON THK.
    - OVER GROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
    - COLOUR SCHEME FOR ABC PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
    - ALL LETTERS SHALL BE PAINTED BLACK EXCEPT 'WARNING' WHICH SHALL BE PAINTED RED.
    - POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
    - ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
  - LOCATION:
    - THE PIPE LINE WARNING SIGN SHALL BE INSTALLED IN ACCORDANCE WITH CONTRACT REQUIREMENTS AND AS DIRECTED BY OWNER IT SHALL BE INSTALLED TO THE LEFT OF THE PIPE CENTER LINE, VIEWING IN THE DIRECTION OF FLOW AT 1000MM FROM PIPELINE O.D. AND THE WARNING SIGN PLATE SHALL FACE THE UTILITY BEING CROSSED.
    - THE WARNING SIGN PLATE MAY BE MOUNTED ON VENT PIPES OR KM POST WHERE EVER POSSIBLE.
  - THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
  - SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY CONTRACTOR ON SIMILAR LINES AND APPROVED BY THE OWNER.
  - THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:  
PLATE - IS2062, Gr. A  
PIPE - IS - 1239
  - INTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE SLOPE.

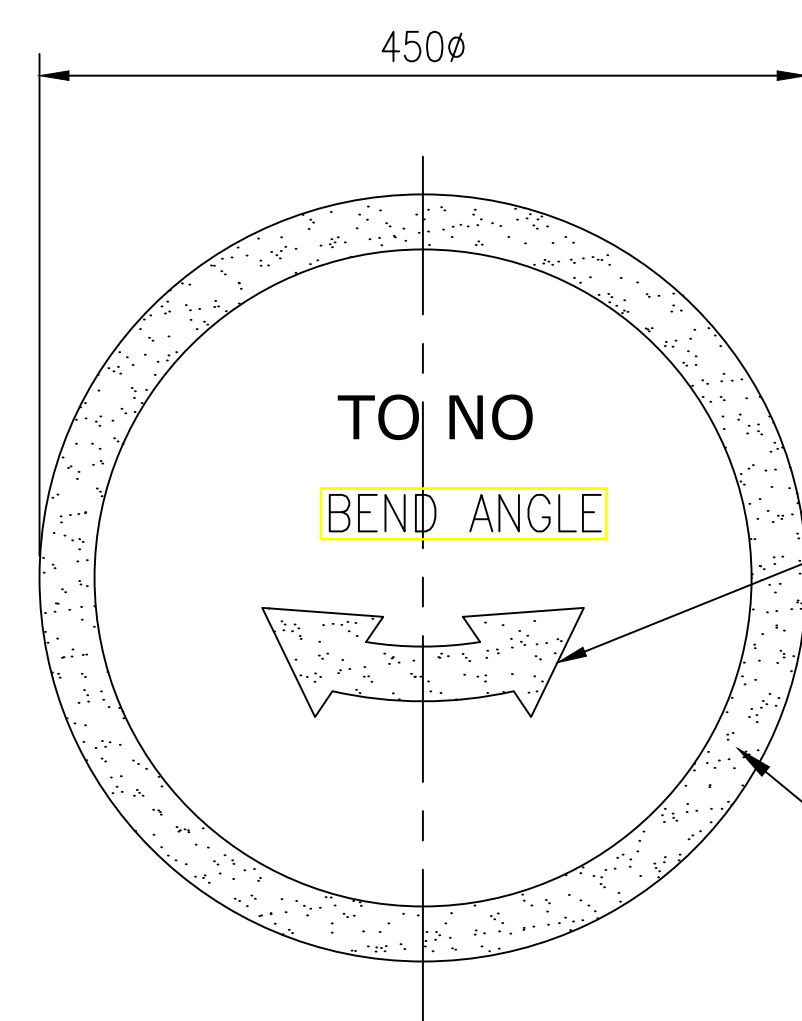
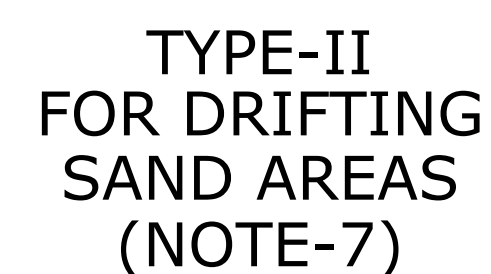
| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
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| 00                                        | 16.01.23 | ISSUED AS STD. DRAWING | PSS                | MC    | HK     |
|-------------------------------------------|----------|------------------------|--------------------|-------|--------|
| REV.                                      | DATE     | DESCRIPTION            | PREP.              | CHKD. | APPD.  |
| PMC:                                      |          |                        |                    |       |        |
| VCS QUALITY SERVICES PVT. LTD.            |          |                        |                    |       |        |
| TITLE:                                    |          |                        |                    |       |        |
| TYPICAL DRAWING FOR PIPELINE WARNING SIGN |          |                        |                    |       |        |
| SCALE:                                    |          | N.T.S.                 | TOTAL NO. OF SHTS: |       | 1 OF 1 |
| SIZE                                      | JOB NO.  | DRAWING NUMBER         |                    | REV.  |        |
| A3                                        | -----    | VCS-00-PP-SD-2004      |                    | 00    |        |

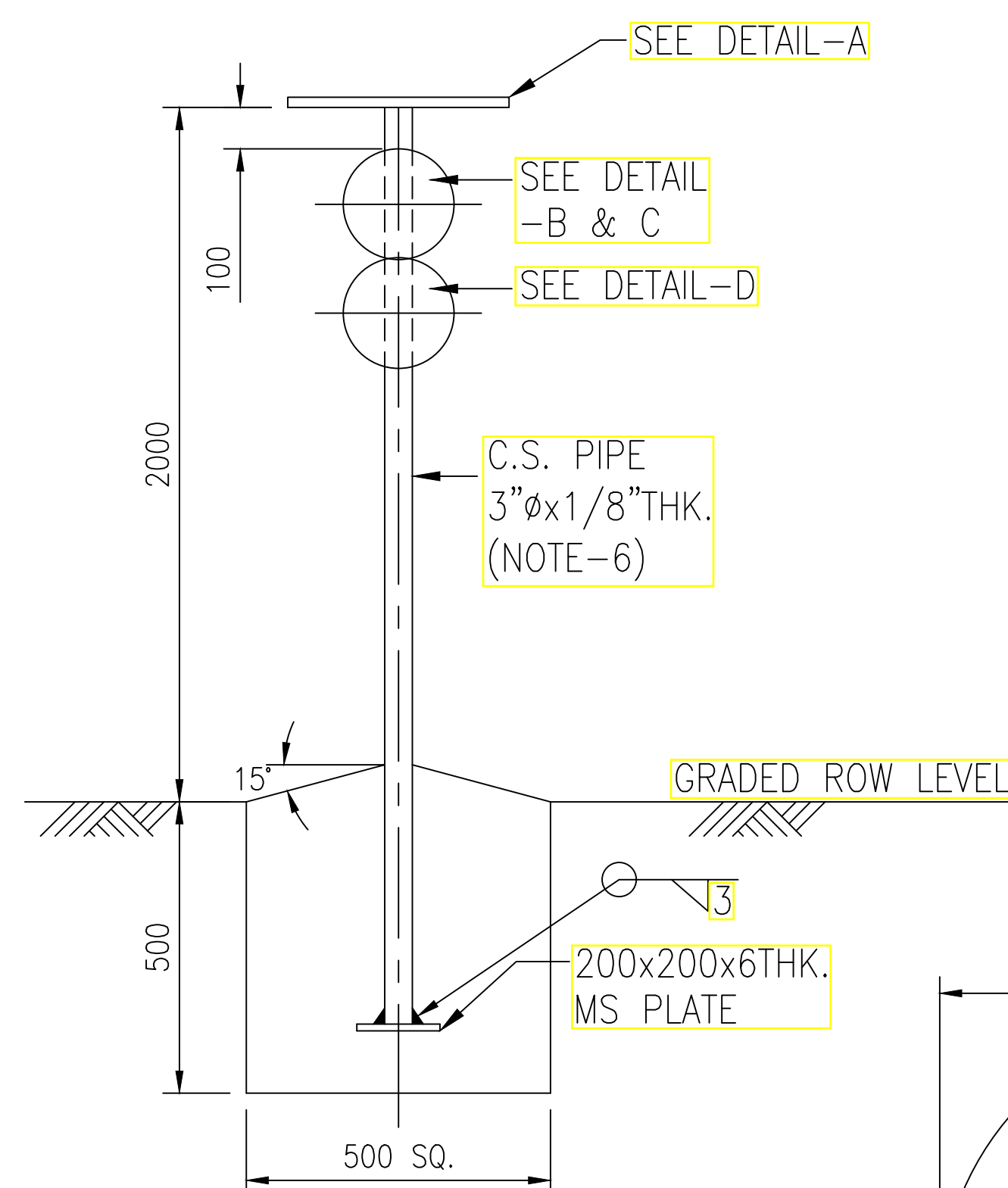




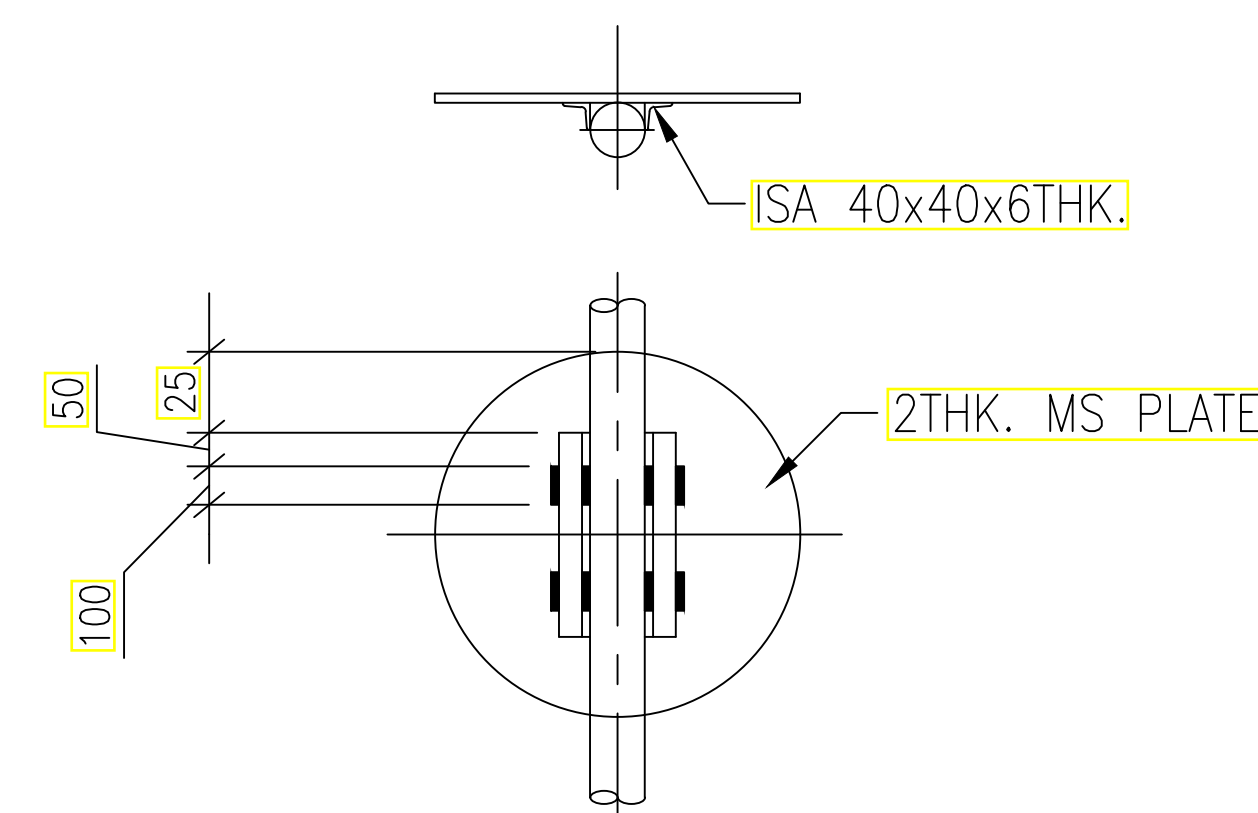
TYPE-I  
FOR NORMAL SOIL



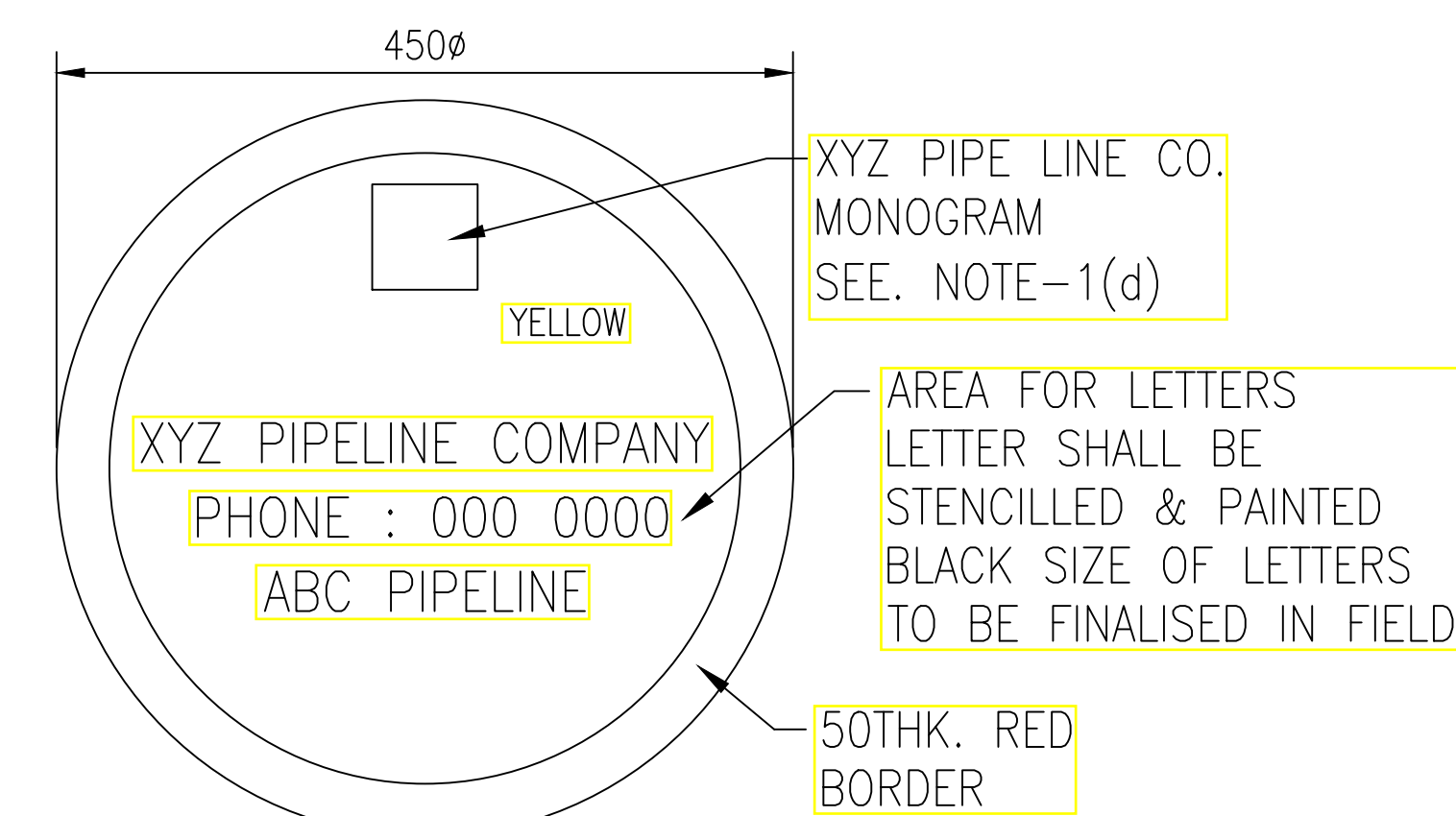
DETAIL-D



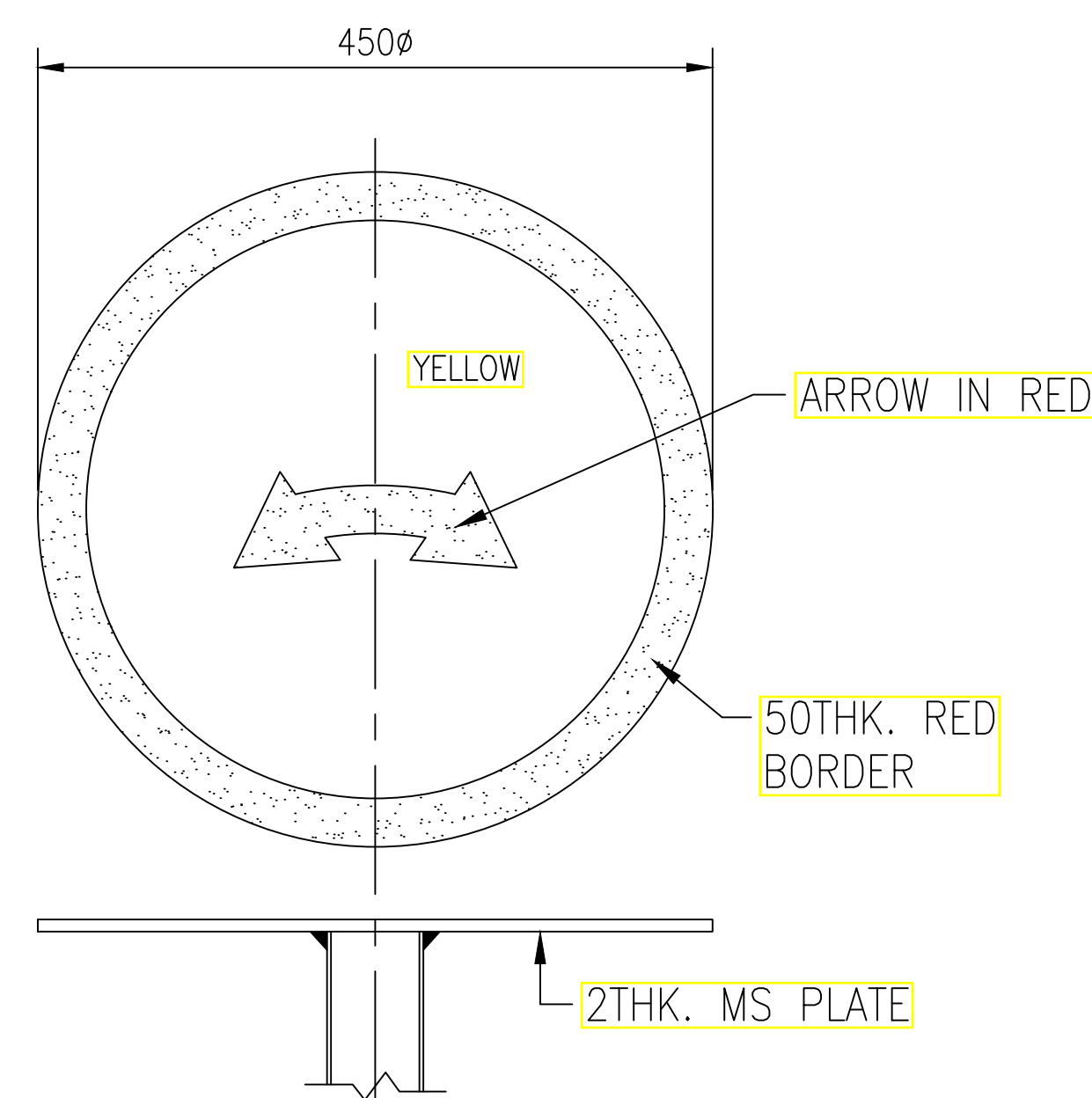
### TYPE-III FOR ROCKY AREAS



DETAIL - B



DETAIL-C



DETAIL-A

[illegible]

|                                       |              |  |   |            |   |
|---------------------------------------|--------------|--|---|------------|---|
|                                       | 3            |  | 2 |            | 1 |
| <b>REFERENCE DRAWINGS / DOCUMENTS</b> |              |  |   |            |   |
| <b>S.NO.</b>                          | <b>TITLE</b> |  |   | <b>NO.</b> |   |
|                                       |              |  |   |            |   |
|                                       |              |  |   |            |   |
|                                       |              |  |   |            |   |
|                                       |              |  |   |            |   |

**NOTES:-**

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. SCHEME OF PAINTING & COLOURING:-
  - (a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TAR EPOXY MIN. 300 MICRON THK.
  - (b) OVERGROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
  - (c) FIGURES SHALL BE STENCILED ON BOTH SIDES OF THE POSTS IN BLACK.
  - (d) COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
  - (e) POST SHALL BE PAINTED WITH 300 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
  - (f) ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW
3. LOCATION:
  - (a) DIRECTION MARKER SHALL BE INSTALLED AS PER SPECIFICATIONS AS DIRECTED IN APPROVED DRAWINGS AND AS DIRECTED BY OWNER.
  - (b) OWNER NAME PLATE SHALL FACE THE PIPELINE.
  - (c) DIRECTION MARKER SHALL BE INSTALLED 1000MM TO LEFT OF THE PIPE CENTER LINE/VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN LOCATION SKETCH.
4. THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
5. THE HEIGHT OF THE POST MAY BE VARIED TO SUIT THE FIELD REQUIREMENTS.
6. THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:  
PLATE - IS-2062, Gr. A  
PIPE - IS - 1239
7. INSTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE SLOPE.

|      |          |                        |       |       |       |
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| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |

PMC:

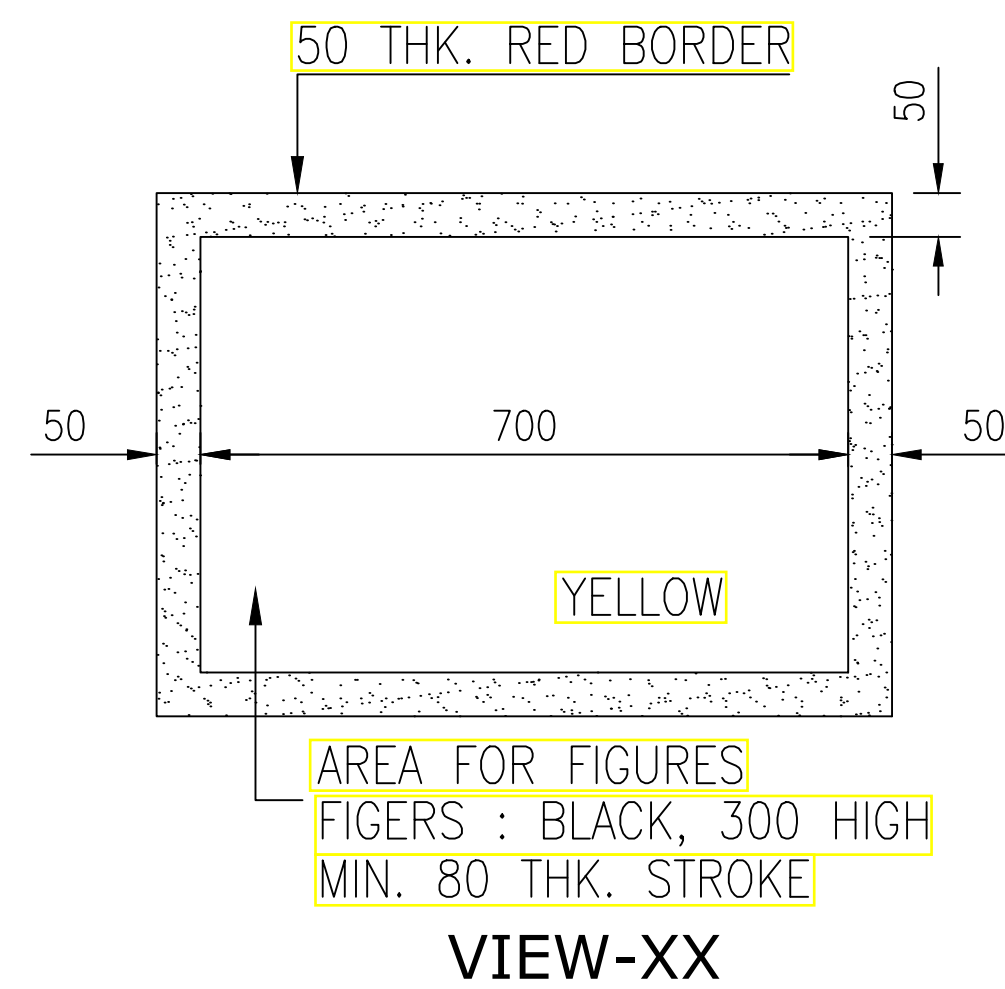
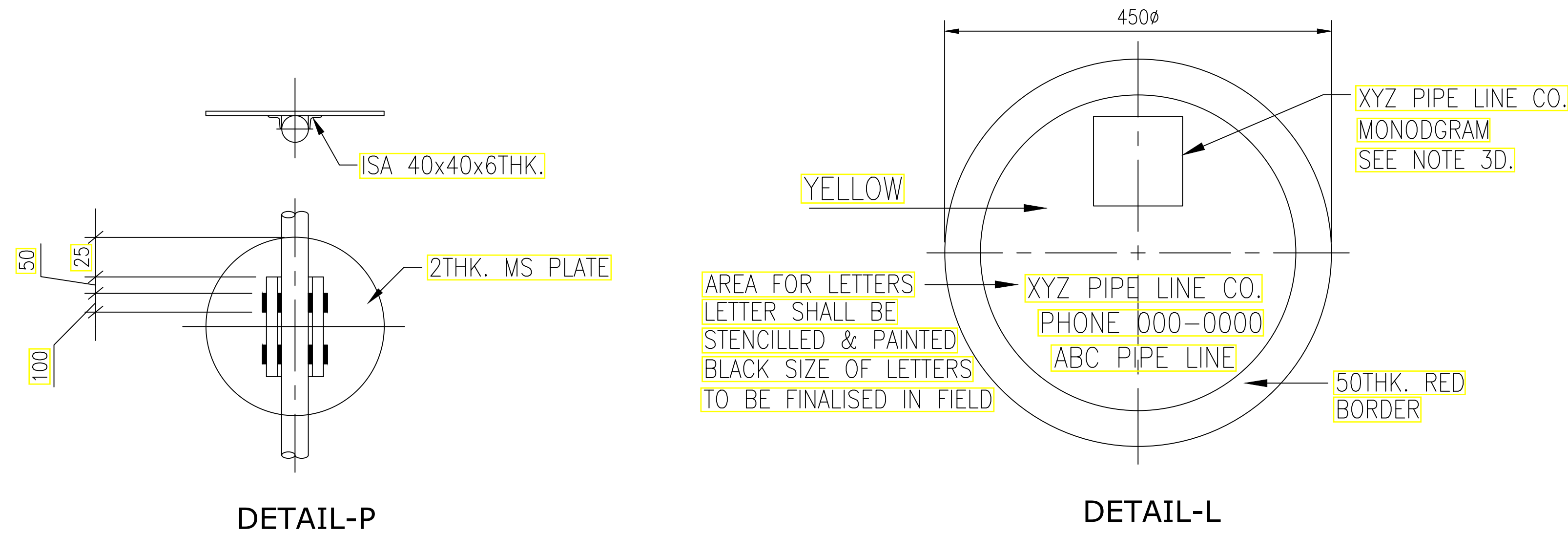
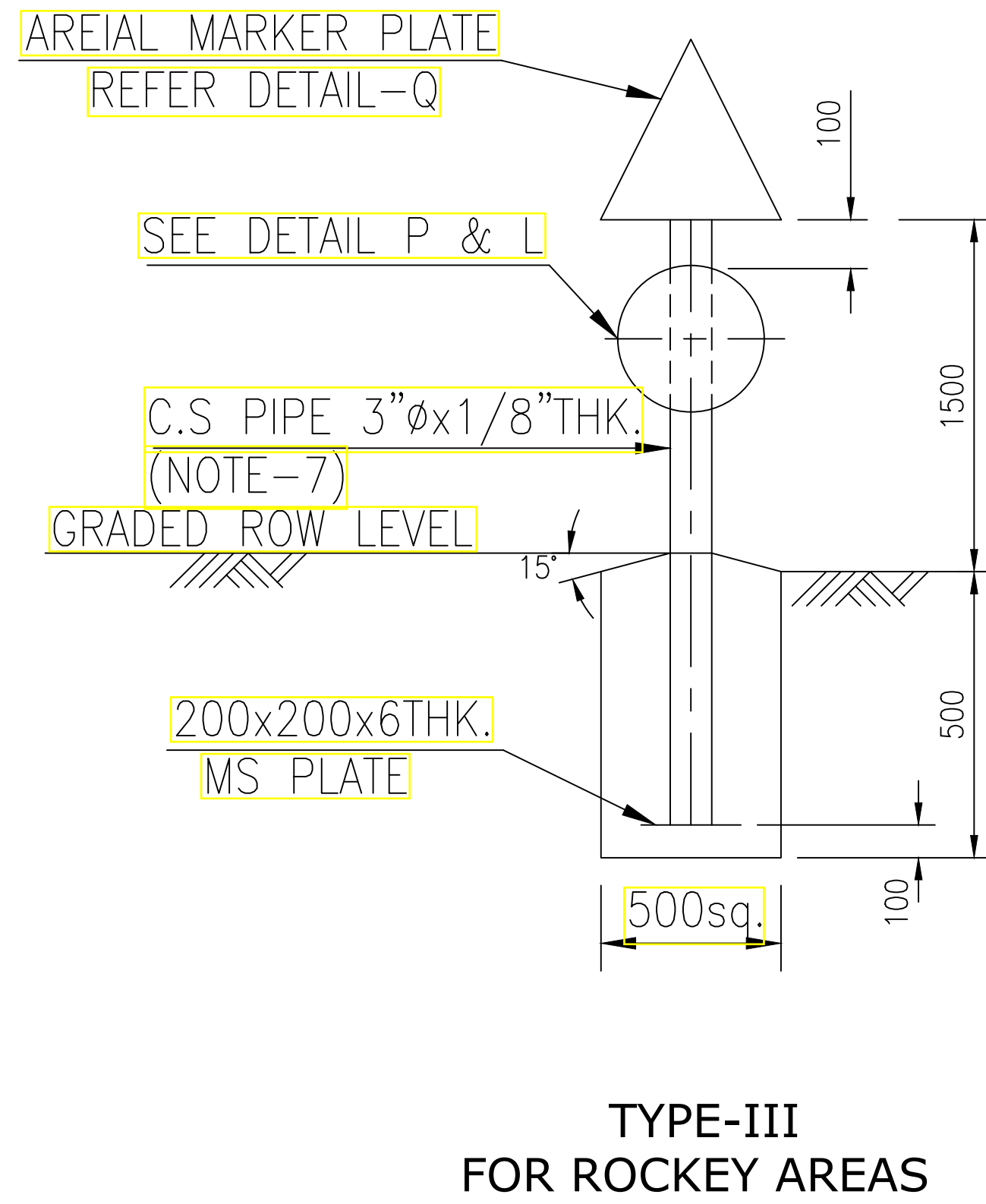
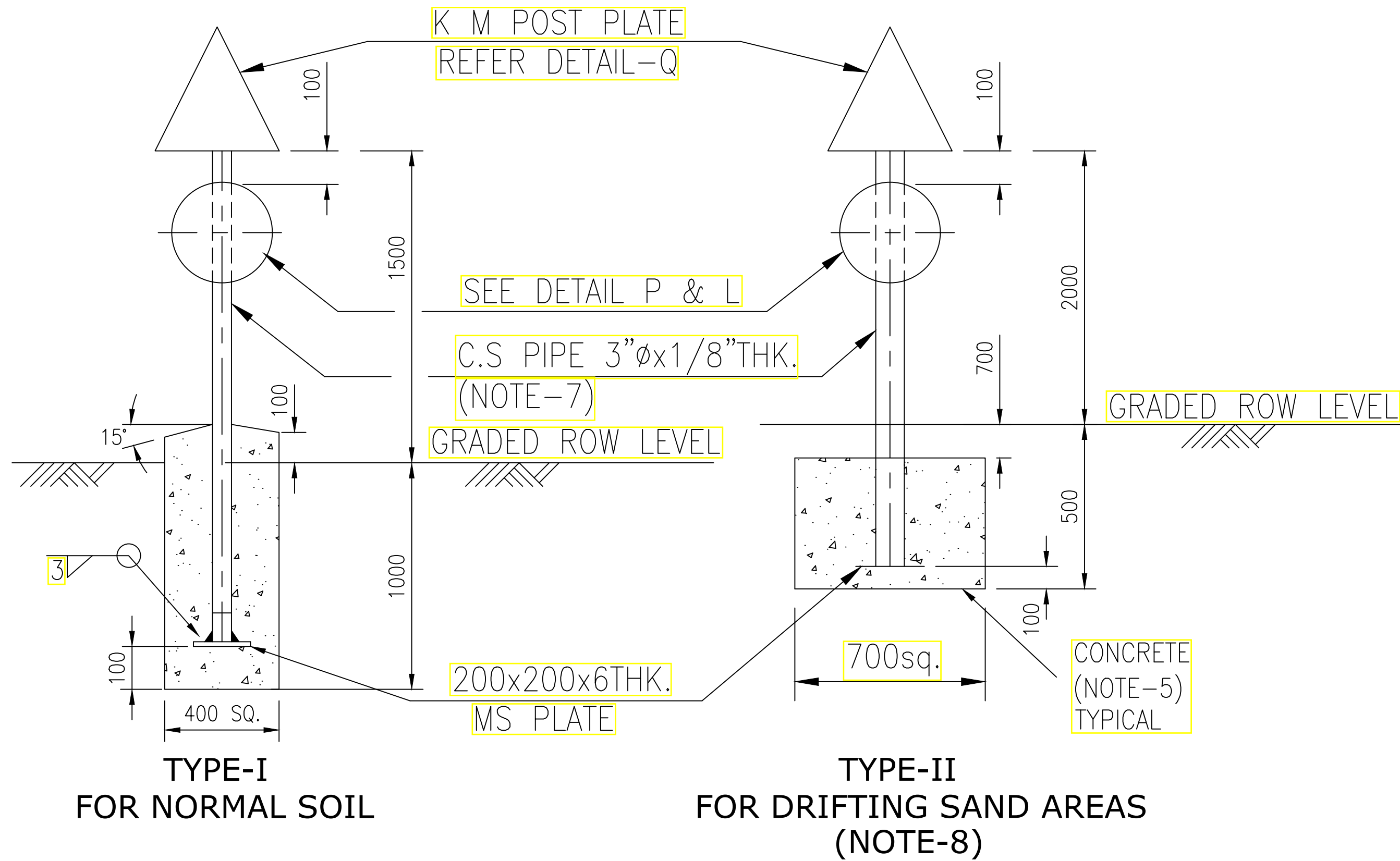
**VCS QUALITY SERVICES PVT. LTD.**

|        |                                         |
|--------|-----------------------------------------|
| TITLE: | TYPICAL DRAWING FOR<br>DIRECTION MARKER |
|--------|-----------------------------------------|

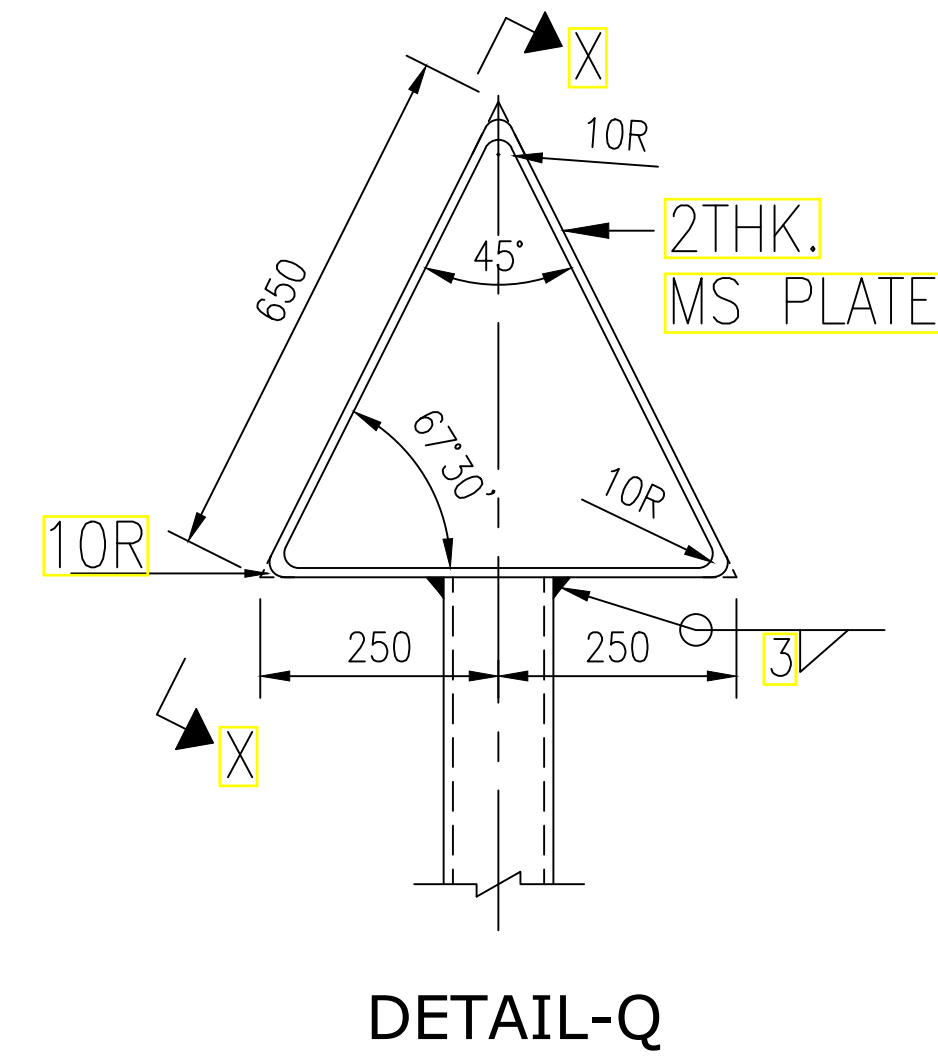
|        |        |                    |        |
|--------|--------|--------------------|--------|
| SCALE: | N.T.S. | TOTAL NO. OF SHTS: | 1 OF 1 |
|--------|--------|--------------------|--------|

|             |                |                          |            |
|-------------|----------------|--------------------------|------------|
| <b>SIZE</b> | <b>JOB NO.</b> | <b>DRAWING NUMBER</b>    | <b>REV</b> |
| <b>A3</b>   | <b>-----</b>   | <b>VCS-00-PP-SD-2005</b> | <b>00</b>  |





- REFERENCE DRAWINGS / DOCUMENTS**
- | S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |
- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
  - SCHEME OF PAINTING & COLOURING:-
  - (a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TER EPOXY MIN.300 MICRON THK.)
  - (b) OVER GROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
  - (c) FIGURES SHALL BE STENCILLED ON BOTH SIDES OF THE POSTS IN BLACK.
  - (d) COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
  - (e) POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
  - (f) ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
  - LOCATION:
    - (a) K.M. POST SHALL BE INSTALLED AT EVERY KILOMETERS AS PER REQUIREMENTS OF CONTRACT AND AS DIRECTED BY OWNER.
    - (b) OWNER NAME PLATE SHALL FACE THE PIPELINE.
    - (c) K.M. POST SHALL BE 1000MM TO THE LEFT OF THE PIPE CENTER LINE VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN SKETCH.
  - THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
  - THE HEIGHT OF THE K.M. POST MAY BE VARIED TO SUIT FIELD REQUIREMENTS.
  - THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:
    - PLATE - IS-2062, Gr. A
    - PIPE - IS - 1239
  - INSTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE.



| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
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| REFERENCE DRAWINGS / DOCUMENTS |       |     |  |  |
|--------------------------------|-------|-----|--|--|
| S.NO.                          | TITLE | NO. |  |  |
|                                |       |     |  |  |
|                                |       |     |  |  |
|                                |       |     |  |  |

**NOTES:-**

- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
- SCHEME OF PAINTING & COLOURING:-
- (a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TER EPOXY MIN.300 MICRON THK.)
- (b) OVER GROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
- (c) FIGURES SHALL BE STENCILLED ON BOTH SIDES OF THE POSTS IN BLACK.
- (d) COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
- (e) POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
- (f) ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
- LOCATION:
  - (a) K.M. POST SHALL BE INSTALLED AT EVERY KILOMETERS AS PER REQUIREMENTS OF CONTRACT AND AS DIRECTED BY OWNER.
  - (b) OWNER NAME PLATE SHALL FACE THE PIPELINE.
  - (c) K.M. POST SHALL BE 1000MM TO THE LEFT OF THE PIPE CENTER LINE VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN SKETCH.
- THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
- THE HEIGHT OF THE K.M. POST MAY BE VARIED TO SUIT FIELD REQUIREMENTS.
- THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:
  - PLATE - IS-2062, Gr. A
  - PIPE - IS - 1239
- INSTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE.

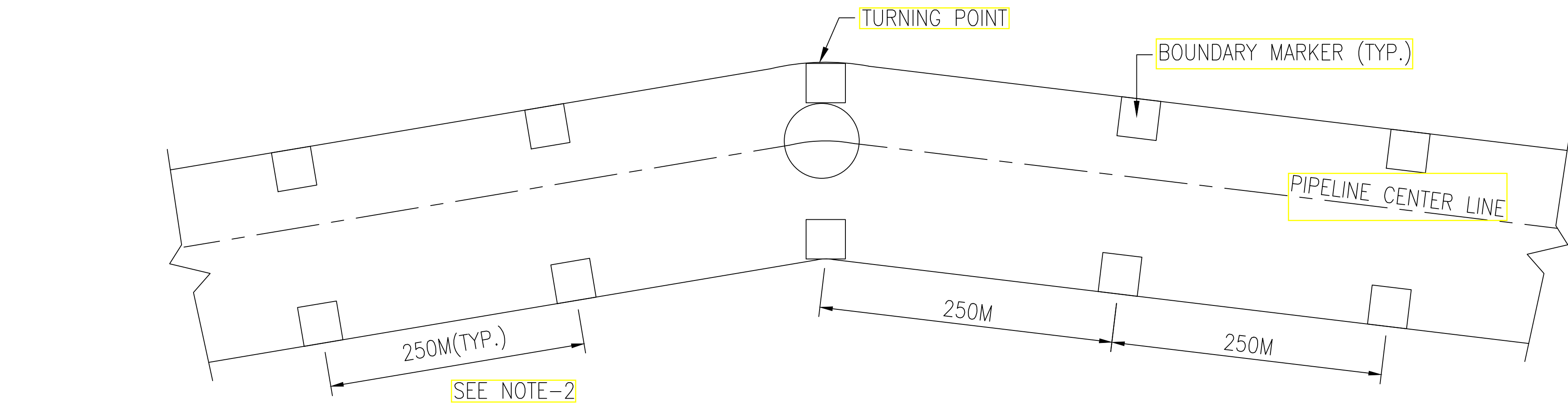
| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
|------|----------|------------------------|-------|-------|-------|
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |
|      |          |                        |       |       |       |
|      |          |                        |       |       |       |
|      |          |                        |       |       |       |

PMC:  **VCS QUALITY SERVICES PVT. LTD.**

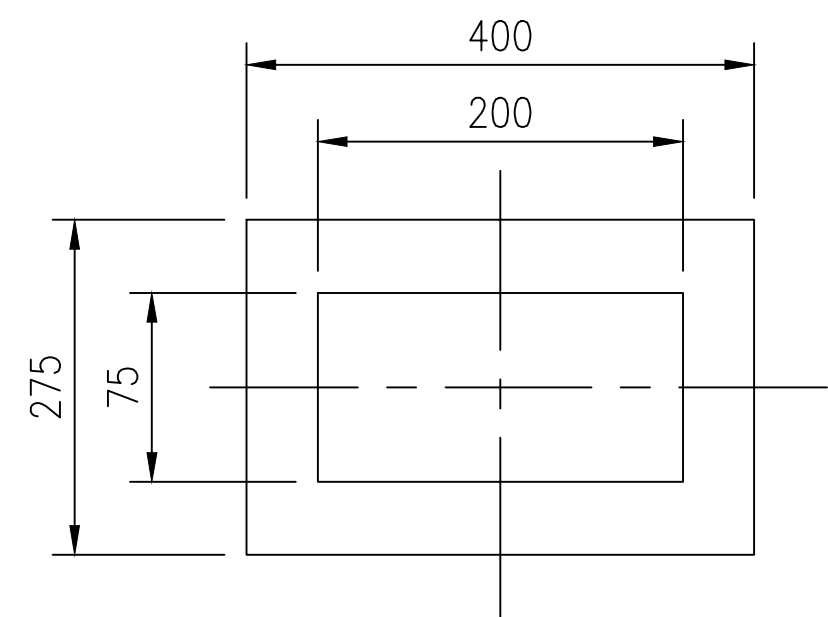
**TITLE:** TYPICAL DRAWING FOR TYPICAL K.M. POST MARKER

|        |         |                    |        |
|--------|---------|--------------------|--------|
| SCALE: | N.T.S.  | TOTAL NO. OF SHTS: | 1 OF 1 |
| SIZE   | JOB NO. | DRAWING NUMBER     | REV.   |
| A3     | -----   | VCS-00-PP-SD-2006  | 00     |

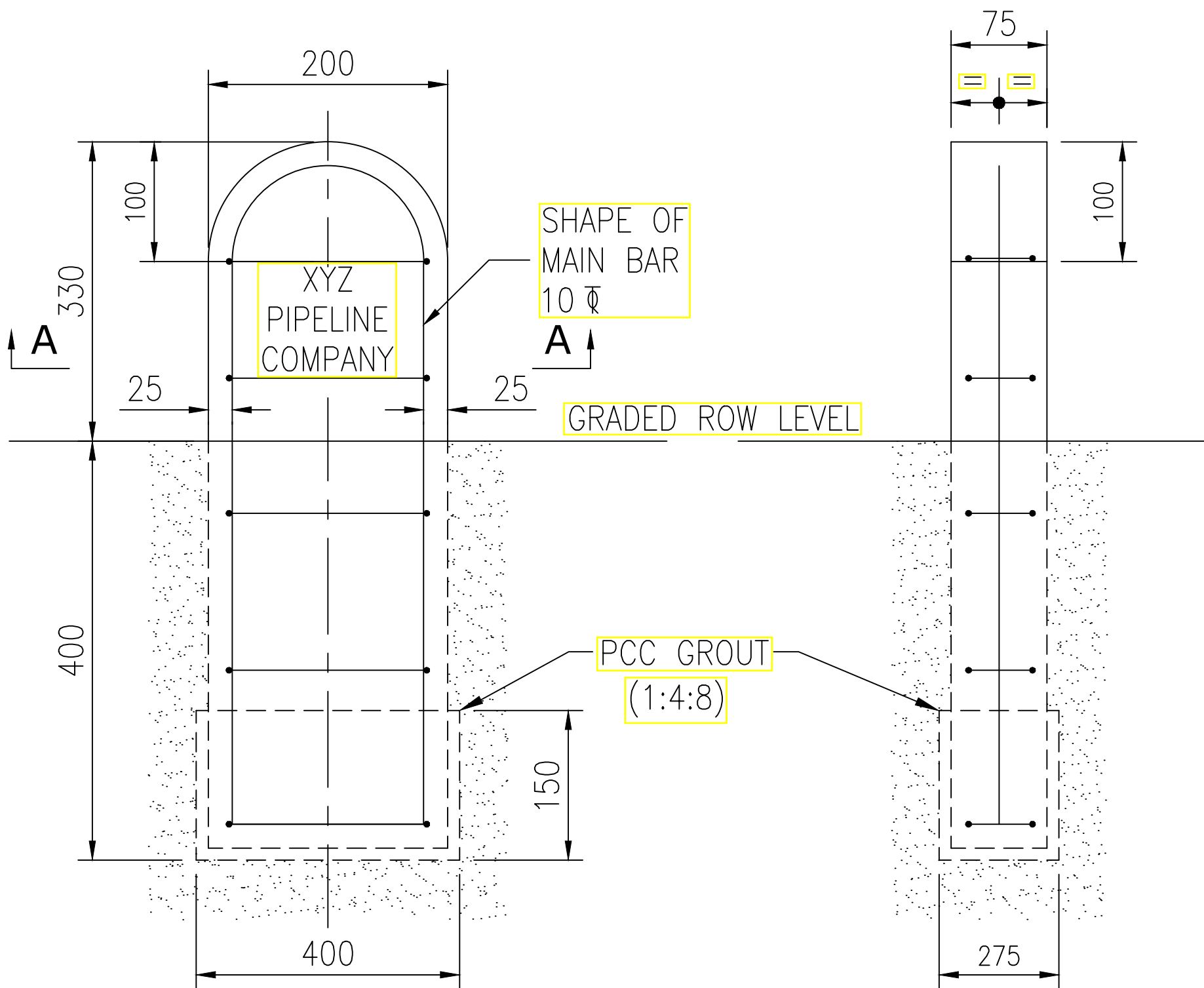




LOCATION PLAN OF BOUNDARY MARKER

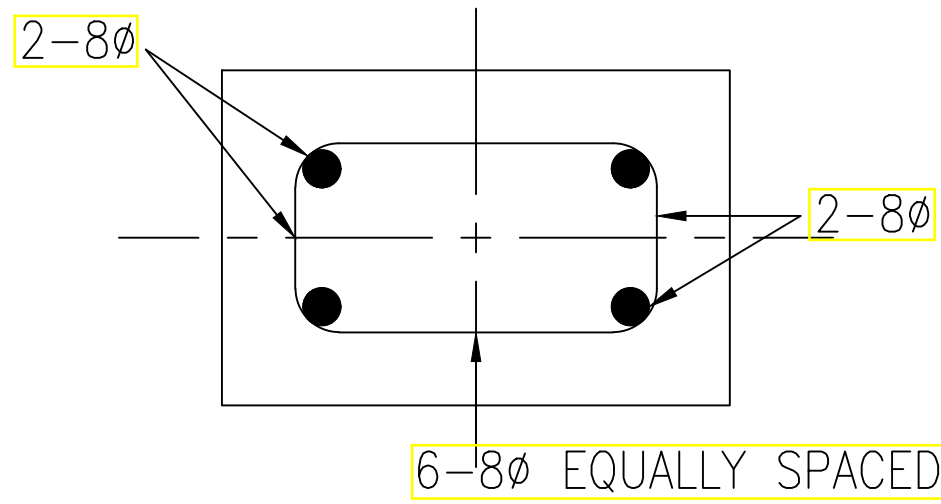


PLAN



ELEVATION

SIDE VIEW



SECTION A-A

REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. BOUNDARY MARKERS SHALL BE INSTALLED AT THE ROW LIMITS ON EITHER SIDE AT 250M CENTERS AND ALSO AT ALL TURNING POINTS AS PER SPECIFICATIONS AND AS DIRECTED BY OWNER. BOUNDARY MARKERS SHALL PREFERABLY BE PLACED ON FIELD BUNDS/UNCULTIVABLE AREAS.
3. ALL BOUNDARY MARKERS SHALL BE PRECAST AND INSCRIPTIONS SHALL BE ENGRAVED CENTRALLY IN THE MOULD ON THE FACE.
4. LETTERS SHALL BE 60MM HIGH AND 5MM DEEP.
5. INSCRIPTIONS SHALL FACE THE PIPE LINE.
6. CONCRETE FOR BOUNDARY MARKERS SHALL BE M20.
7. ABOVE GROUND PART OF BOUNDARY MARKERS SHALL BE PAINTED YELLOW WITH MIN. THREE COATS OF COMPANY APPROVED PROOF CEMENT PAINT AS PER IS-5410. INSCRIPTIONS SHALL BE PAINTED BLACK.

| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |
|------|----------|------------------------|-------|-------|-------|
| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |

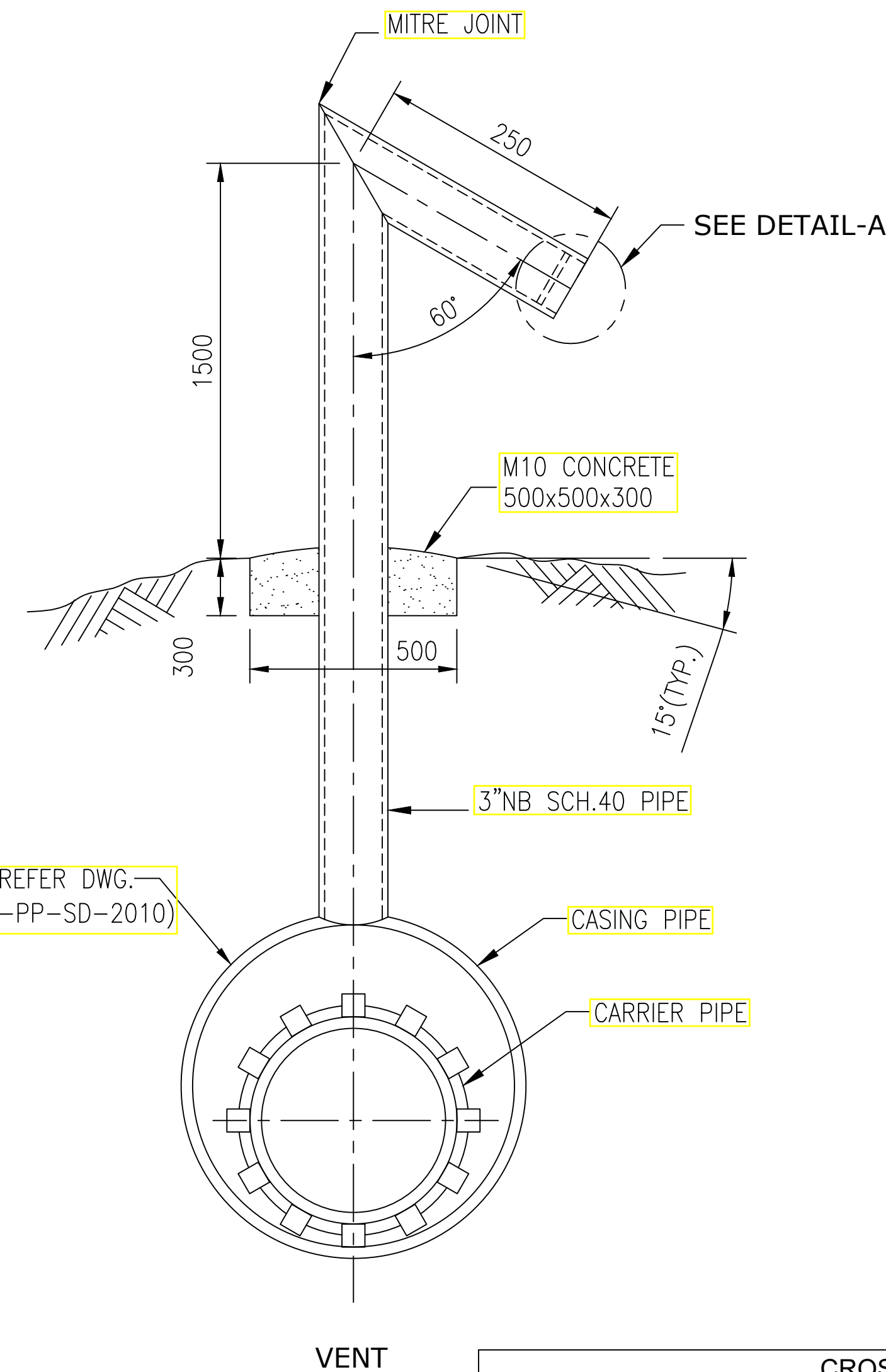
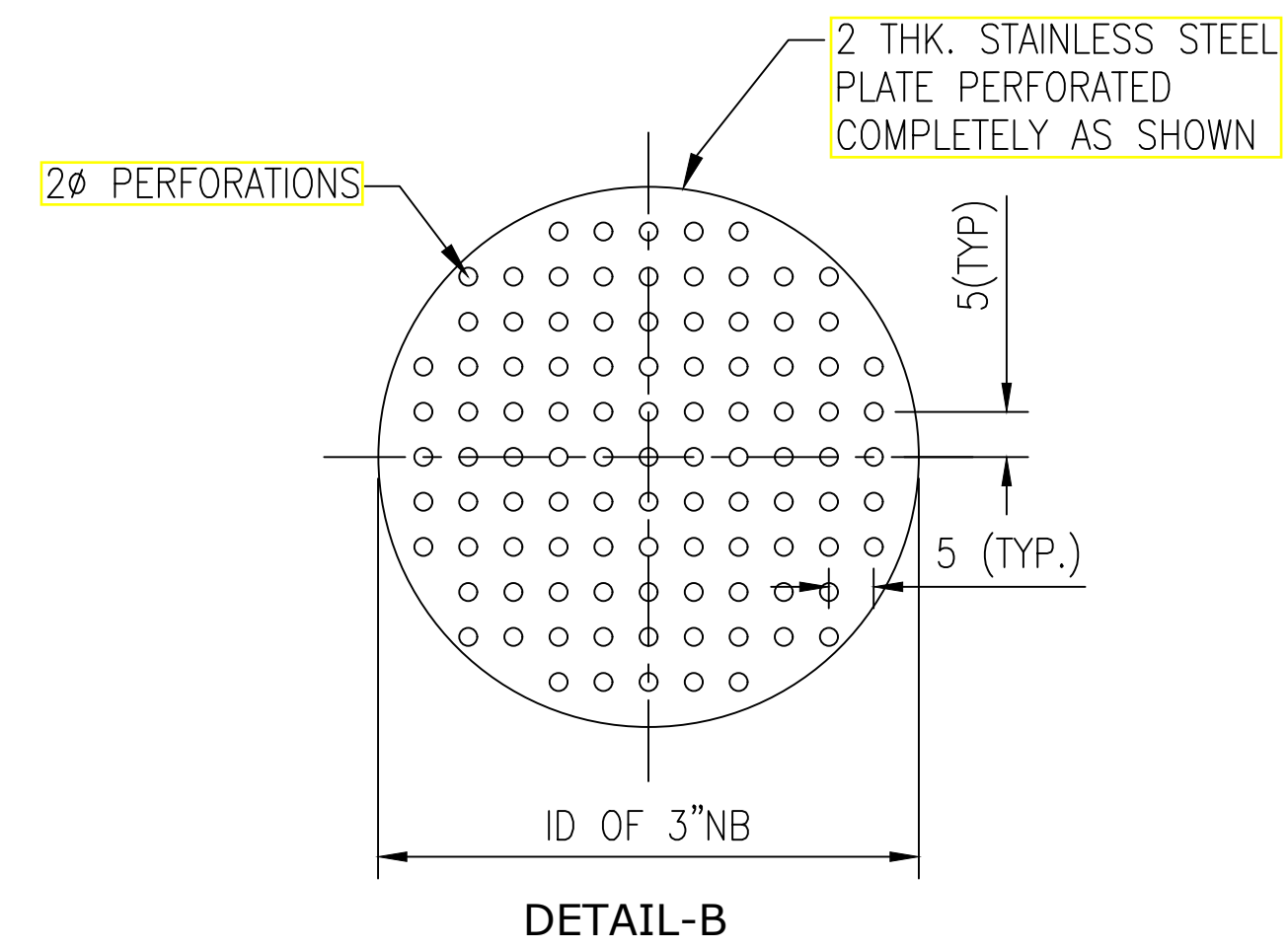
|      |                                |
|------|--------------------------------|
| PMC: | VCS QUALITY SERVICES PVT. LTD. |
|------|--------------------------------|

|        |                                        |
|--------|----------------------------------------|
| TITLE: | TYPICAL DRAWING FOR ROW BOUNDRY MARKER |
|--------|----------------------------------------|

|        |        |                    |        |
|--------|--------|--------------------|--------|
| SCALE: | N.T.S. | TOTAL NO. OF SHTS: | 1 OF 1 |
|--------|--------|--------------------|--------|

| SIZE | JOB NO. | DRAWING NUMBER    | REV. |
|------|---------|-------------------|------|
| A3   | -----   | VCS-00-PP-SD-2008 | 00   |





| REFERENCE DRAWINGS / DOCUMENTS |       |     |
|--------------------------------|-------|-----|
| S.NO.                          | TITLE | NO. |
|                                |       |     |
|                                |       |     |
|                                |       |     |

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. VENT AND DRAIN OFF TO FACE LEFT WHEN LOOKING IN DIRECTION OF CONSTRUCTION AND SHALL BE PARALLEL TO CROSSING.
3. VENT AND DRAIN OFF PIPE SHALL BE API 5L Gr. B, SCH.40 OR IS-1239.
4. PORTION OF VENT AND DRAIN OFF PIPES WHICH ARE UNDER GROUND OR WHICH MAY BE UNDER WATER ARE TO COATED WITH LIQUID EPOXY OF 500 MICRON THK. OF APPROVED QUALITY ABOVE GROUND PORTION SHALL BE AS PER PAINTING SPECIFICATION.

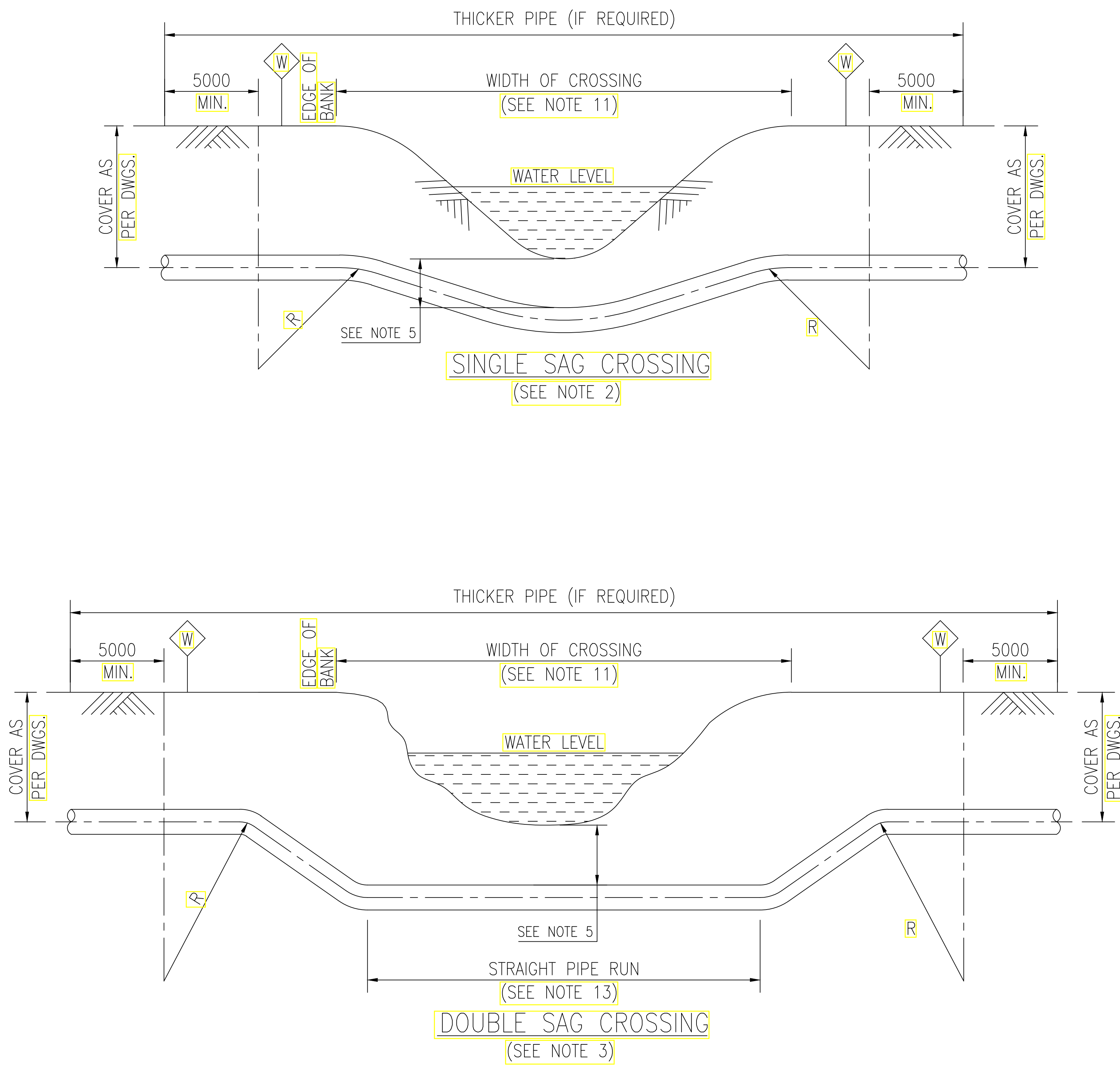
|     |                          |
|-----|--------------------------|
| OFC | OPTICAL FIBRE CABLE      |
| D   | OUTSIDE DIAMETER OF PIPE |

|      |          |                        |  |       |             |
|------|----------|------------------------|--|-------|-------------|
|      |          |                        |  |       |             |
|      |          |                        |  |       |             |
|      |          |                        |  |       |             |
|      |          |                        |  |       |             |
| 00   | 16.01.23 | ISSUED AS STD. DRAWING |  | PSS   | MC HK       |
| REV. | DATE     | DESCRIPTION            |  | PREP. | CHKD. APPD. |

[illegible]

|                                                                                                          |                |                           |             |
|----------------------------------------------------------------------------------------------------------|----------------|---------------------------|-------------|
| <b>PMC:</b>                                                                                              |                |                           |             |
| <b>TITLE:</b> <p style="text-align: center;">TYPICAL DRAWING FOR<br/>DETAIL OF CASING VENT AND DRAIN</p> |                |                           |             |
| <b>SCALE:</b>                                                                                            |                | <b>TOTAL NO. OF SHTS:</b> |             |
| <b>N.T.S.</b>                                                                                            |                | <b>1 OF 1</b>             |             |
| <b>SIZE</b>                                                                                              | <b>JOB NO.</b> | <b>DRAWING NUMBER</b>     | <b>REV.</b> |
| <b>A3</b>                                                                                                | <b>-----</b>   | <b>VCS-00-PP-SD-2009</b>  | <b>00</b>   |





REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |

- NOTES:-**
- ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
  - SINGLE SAG CROSSING SHALL NORMALLY BE USED WHERE THERE IS NO EVIDENCE OF EROSION OF BANKS AND SCOURING OR SHIFTING OF STREAM BOTTOM AND WHERE BED WIDTH DOES NOT PROHIBIT ITS USE.
  - DOUBLE SAG CROSSING SHALL BE USED WHERE THERE IS EVIDENCE OF EROSION OF BANKS. SCOURING OR SHIFTING OF STREAM BOTTOM.
  - IN DOUBLE SAG CROSSING, GENERALLY COLD FIELD BENDS SHALL BE USED. USE OF FACTORY MADE R=6D BEND SHALL BE MINIMIZED. R=6D BEND SHALL BE USED ONLY WITH PRIOR APPROVAL OF COMPANY.
  - UNLESS OTHERWISE SPECIFIED,THE MINIMUM COVER OVER THE PIPE MEASURED BELOW THE LOWEST BED LEVEL SHALL BE 1500MM.
  - THE TYPE AND EXTENT OF BUOYANCY CONTROL MEASURES SHALL BE AS PER SPECIFICATION AND AS DIRECTED BY COMPANY FOR INDIVIDUAL CROSSING AND SHALL BE SHOWN ON THE ALIGNMENT SHEETS.
  - THE FILL AT THE BANKS SHALL BE COMPACTED FIRMLY AND REINFORCED WITH SACKED EARTH, LEAN CONCRETE, RIP RAP OR BY OTHER MEANS AS DIRECTED BY COMPANY. ADDITIONAL BANK PROTECTION MEASURES AS PER SPECIFICATIONS SHALL BE ADOPTED WHEN THERE IS EVIDENCE OF EROSION AND SLUMPING OF BANKS OR WHEN THE BANKS ARE STEEP.
  - THE LOCATION OF CROSSING SHALL BE IN A LONG STRAIGHT STRETCH OF THE STREAM IF POSSIBLE.
  - EXACT POSITION AND ANGLE OF COLD BENDS SHALL BE DETERMINED IN FIELD.
  - AFTER INSTALLATION OF THE CROSSING, THE WATER COURSE SHALL BE RESTORED TO ITS ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF THE AUTHORITIES JURISDICTION OVER THE SAME. WHERE THE EXCAVATED MATERIAL IS UNSUITABLE , TRENCH SHALL BE BACKFILLED WITH MATERIAL APPROVED BY COMPANY.
  - WIDTH OF CROSSING SHALL BE THAT CORRESPONDING TO THE HIGHEST WATER LEVEL. THE HIGHEST WATER LEVEL SHALL BE DETERMINED BASED ON THE FOLLOWING:  
I) HISTORICAL RECORDS (TO THE EXTENT AVAILABLE)  
II) BANK CONDITION VIS-A-VIS EROSION, ETC.  
III) EVIDENCE OF EXTINCTION OF VEGETATION ALONG BANKS.  
IV) DISCUSSIONS WITH LOCAL PEOPLE.
  - THE NUMBER OF WARNING SIGNS SHALL BE:-  
(a) 1 (ONE) FOR CROSSINGS LESS THAN 15 M WIDTH AT UP STREAM BANK.  
(b) 2 (TWO) FOR CROSSINGS ABOVE 15 M WIDTH.
  - STRAIGHT LENGTH OF PIPE SHALL BE USED AT LEAST FOR THE ENTIRE WIDTH OF CROSSING.
  - CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS FOR EACH CROSSING AS AND WHEN DIRECTED BY COMPANY. CONTRACTOR SHALL PREPARE DETAILED DRAWINGS FOR INDIVIDUAL CROSSINGS FOR COMPANY APPROVAL BEFORE COMMITMENT OF CONSTRUCTION.

|      |          |                        |       |       |       |
|------|----------|------------------------|-------|-------|-------|
|      |          |                        |       |       |       |
|      |          |                        |       |       |       |
|      |          |                        |       |       |       |
| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |

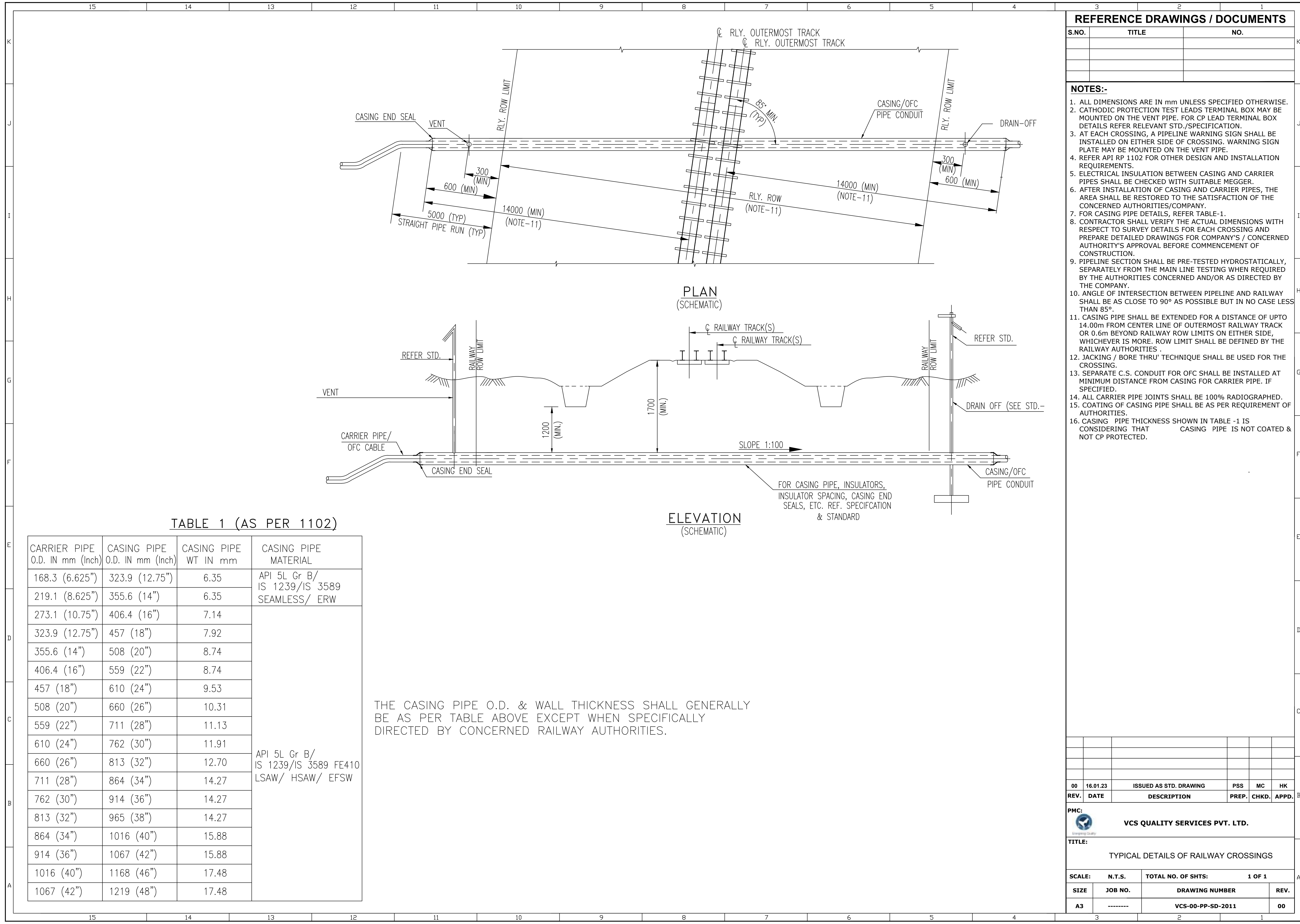
**PMC:**  
 **VCS QUALITY SERVICES PVT. LTD.**

**TITLE:**  
TYPICAL STREAM CROSSING

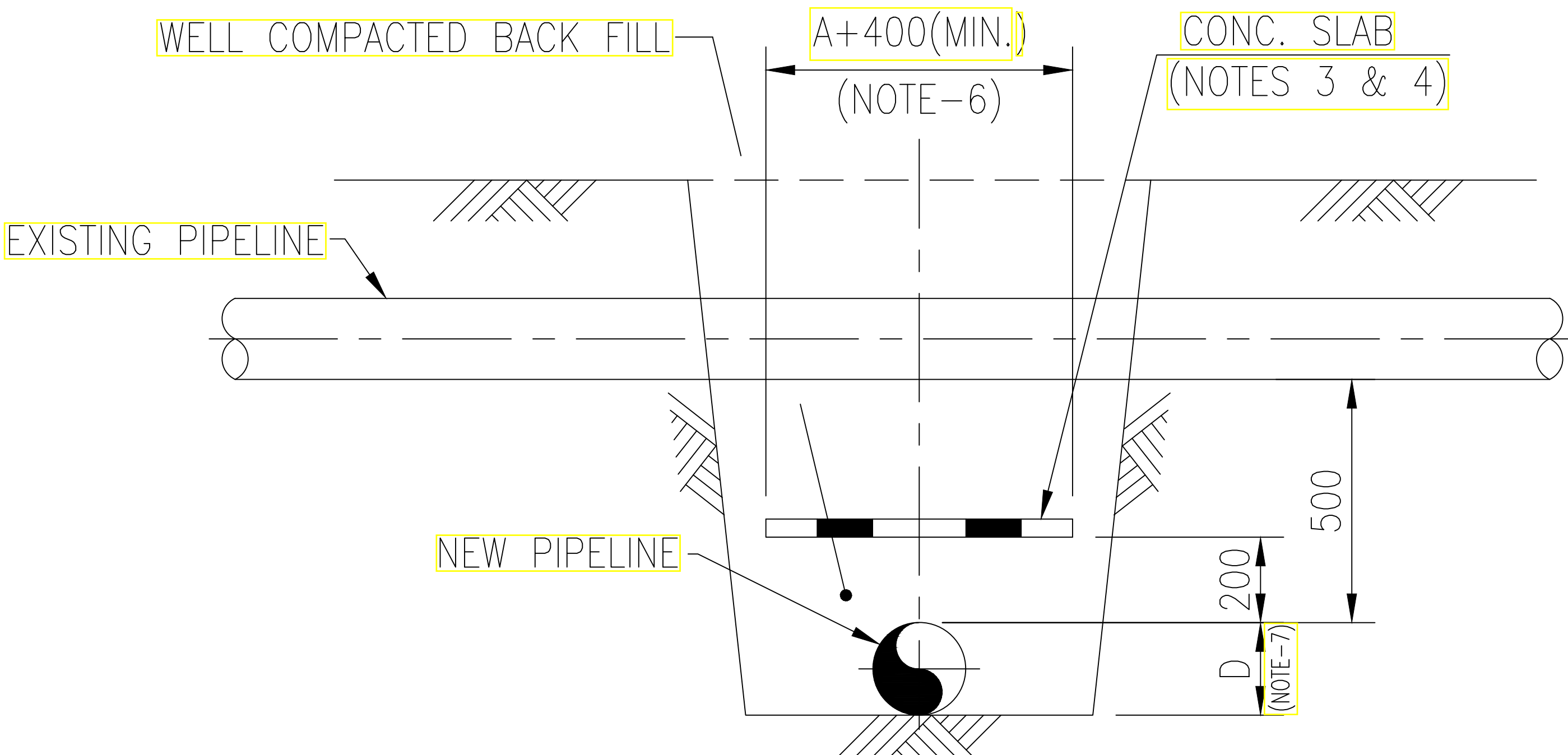
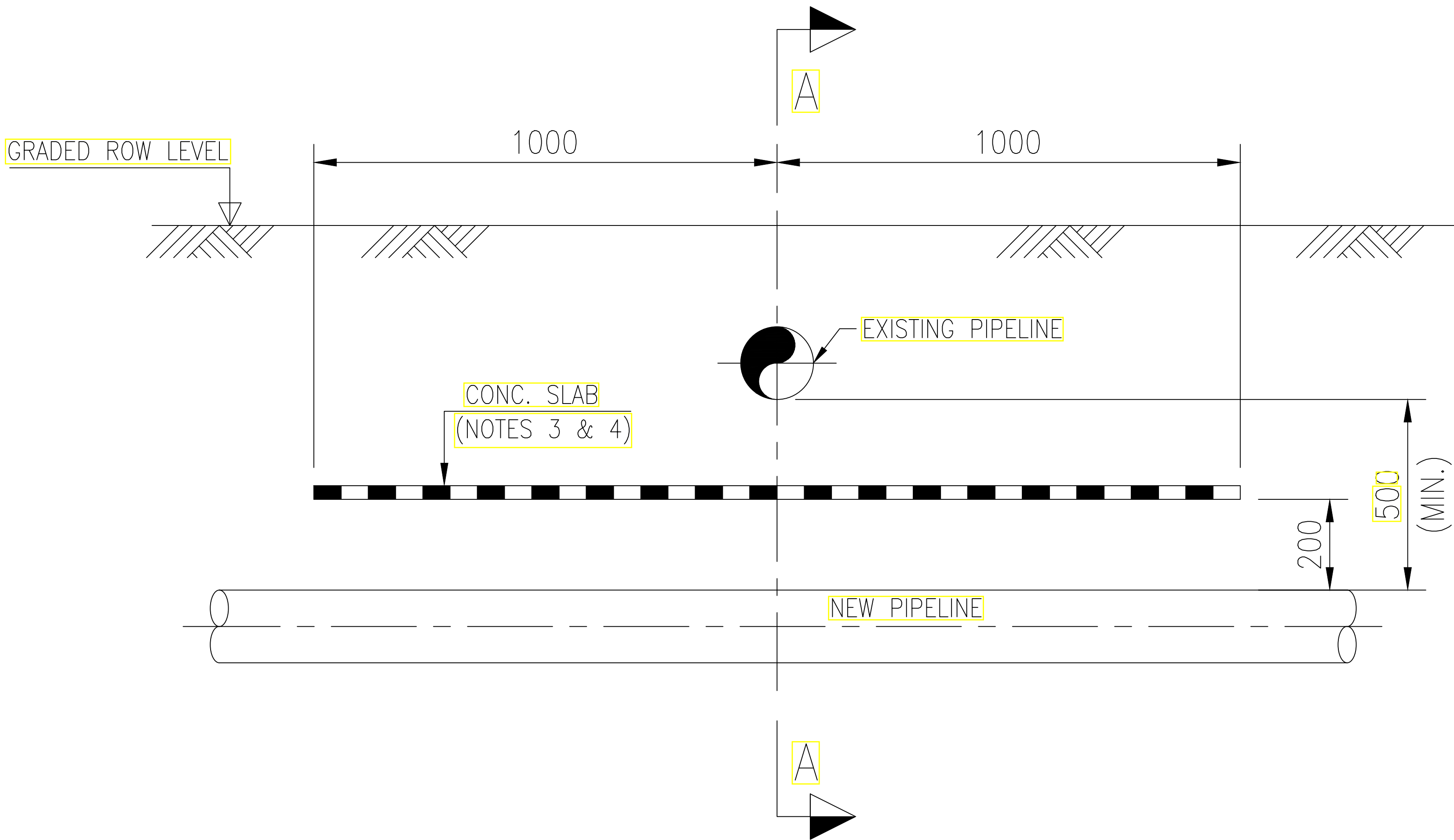
**SCALE:** N.T.S. **TOTAL NO. OF SHTS:** 1 OF 1

| SIZE | JOB NO. | DRAWING NUMBER    | REV. |
|------|---------|-------------------|------|
| A3   | -----   | VCS-00-PP-SD-2010 | 00   |









SECTION A-A

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
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|                 |          |                |           |                     |

PMC:

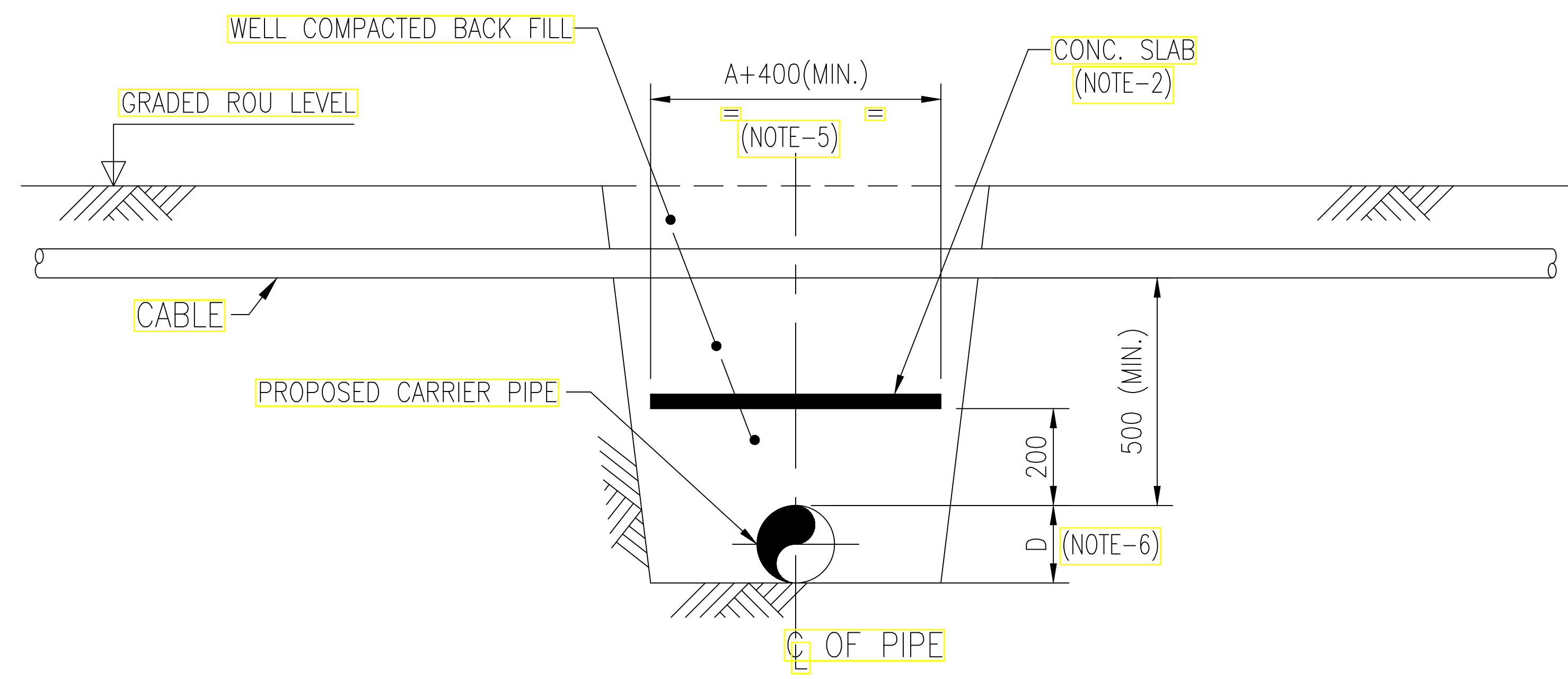
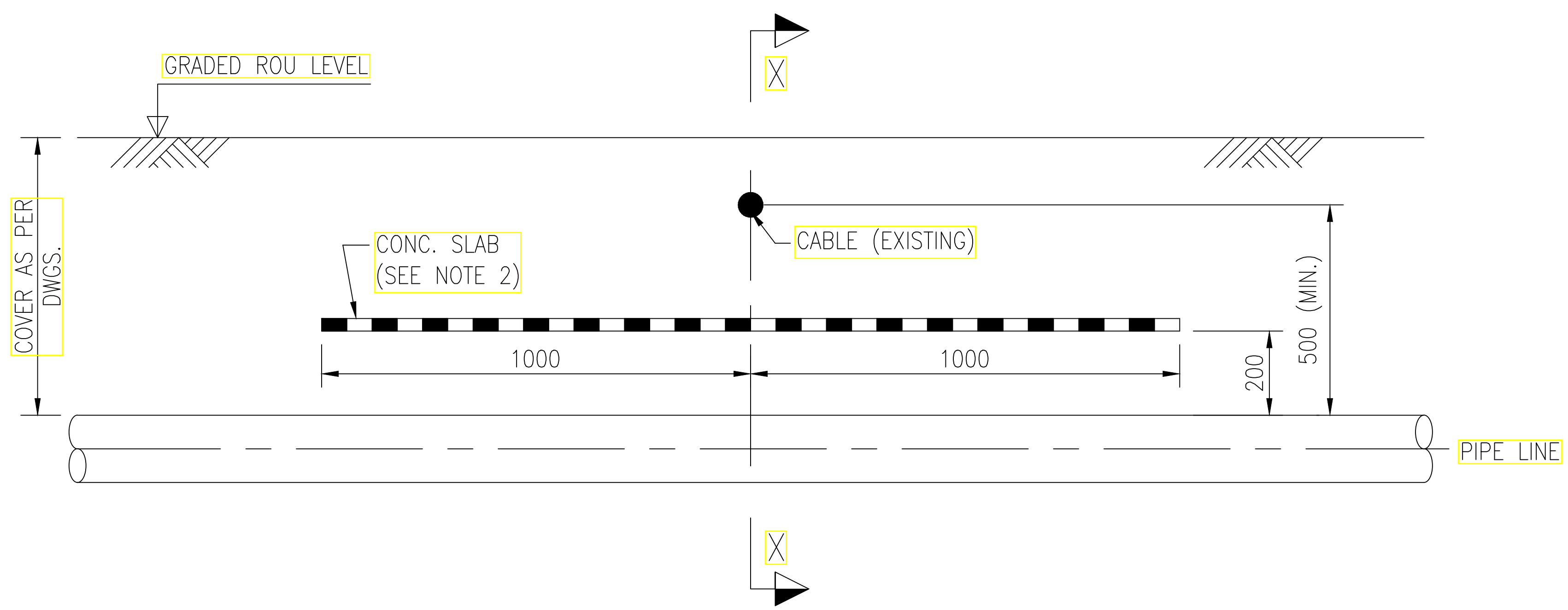
 **VCS QUALITY SERVICES PVT. LTD.**

TITLE:

TYPICAL DRAWING FOR EXISTING UNDERGROUND PIPE CROSSING

|        |         |                    |        |
|--------|---------|--------------------|--------|
| SCALE: | N.T.S.  | TOTAL NO. OF SHTS: | 1 OF 1 |
| SIZE   | JOB NO. | DRAWING NUMBER     | REV.   |
| A3     | -----   | VCS-00-PP-SD-2012  | 00     |





SECTION X-X

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |

| REFERENCE DRAWINGS / DOCUMENTS |                                   |                       |
|--------------------------------|-----------------------------------|-----------------------|
| S.NO.                          | TITLE                             | NO.                   |
| 1.                             | TYPICAL DRAWING FOR CONCRETE SLAB | C221070-00-PP-SD-2017 |
|                                |                                   |                       |
|                                |                                   |                       |

- NOTES:-**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
  2. REFER VCS-00-PP-SD-2017 FOR PRECAST RCC CONCRETE SLAB
  3. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED CLOSE TO THE CROSSING.
  4. IN CASE OF ARMOURED AC CABLE, C.P. BONDING IS TO BE PROVIDED BETWEEN PIPELINE AND CABLE ARMOUR. IN CASE OF UNARMOURED CABLE, ARRANGEMENT FOR SHIELDING (BY PROVIDING CASING ON EITHER SIDE OF THE PIPELINE OR CABLE) SHALL BE CONSIDERED.
  5. DIMENSION 'A' SHALL BE CALCULATED USING FORMULA  $A=(D1+D2+....Dn) + (n-1) \times 500$  WHERE D1, D2,.... Dn ARE THE DIAMETERS OF PIPELINES IN mm IN THE SAME TRENCH AND 'n' IS NO. OF PIPELINES IN SAME TRENCH.
  6. DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
  7. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
  8. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

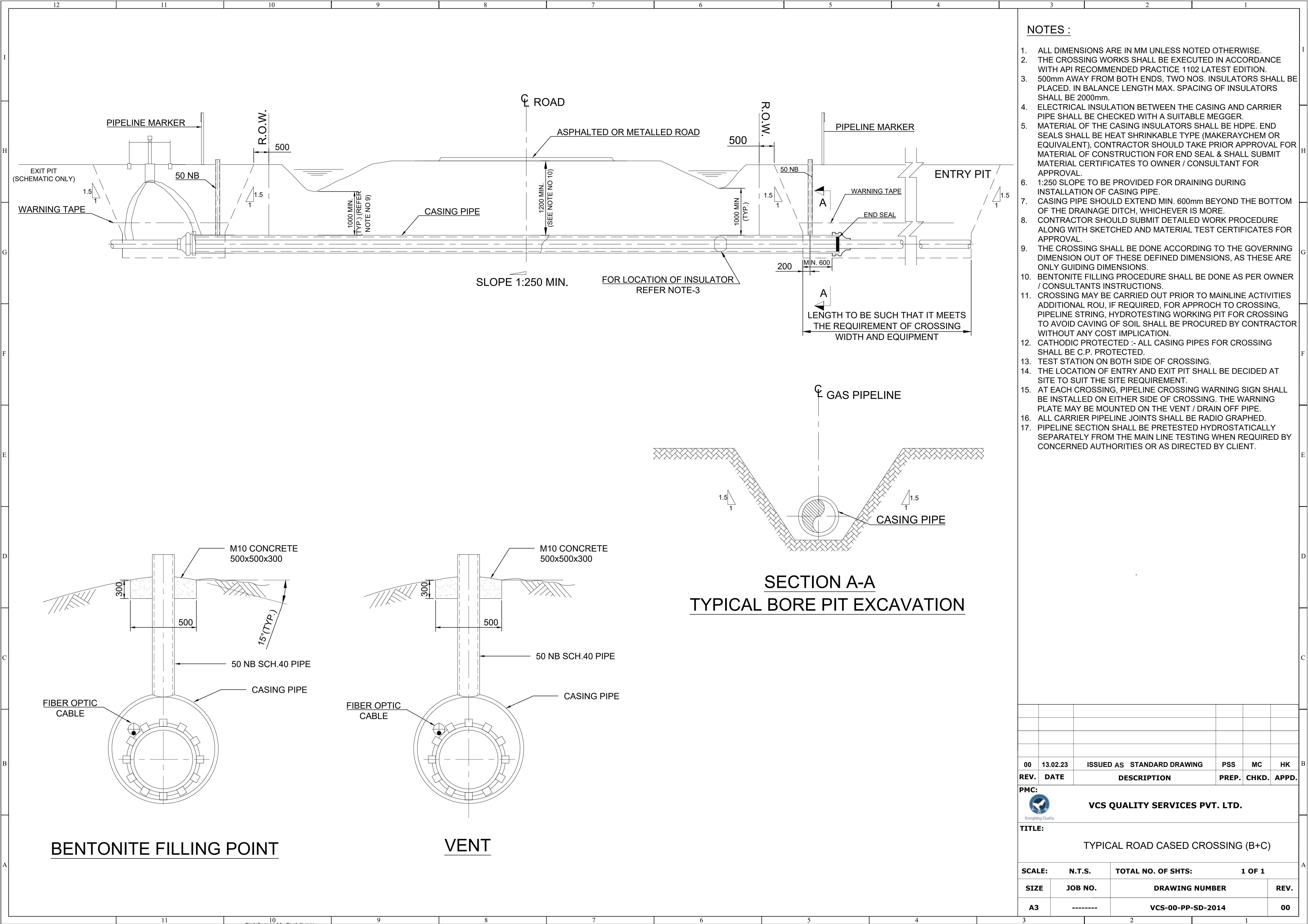
| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
|------|----------|------------------------|-------|-------|-------|
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |

PMC:  **VCS QUALITY SERVICES PVT. LTD.**

**TITLE:** TYPICAL DRAWING FOR UNDERGROUND CABLE CROSSING

|        |         |                    |        |
|--------|---------|--------------------|--------|
| SCALE: | N.T.S.  | TOTAL NO. OF SHTS: | 1 OF 1 |
| SIZE   | JOB NO. | DRAWING NUMBER     | REV.   |
| A3     | -----   | VCS-00-PP-SD-2013  | 00     |



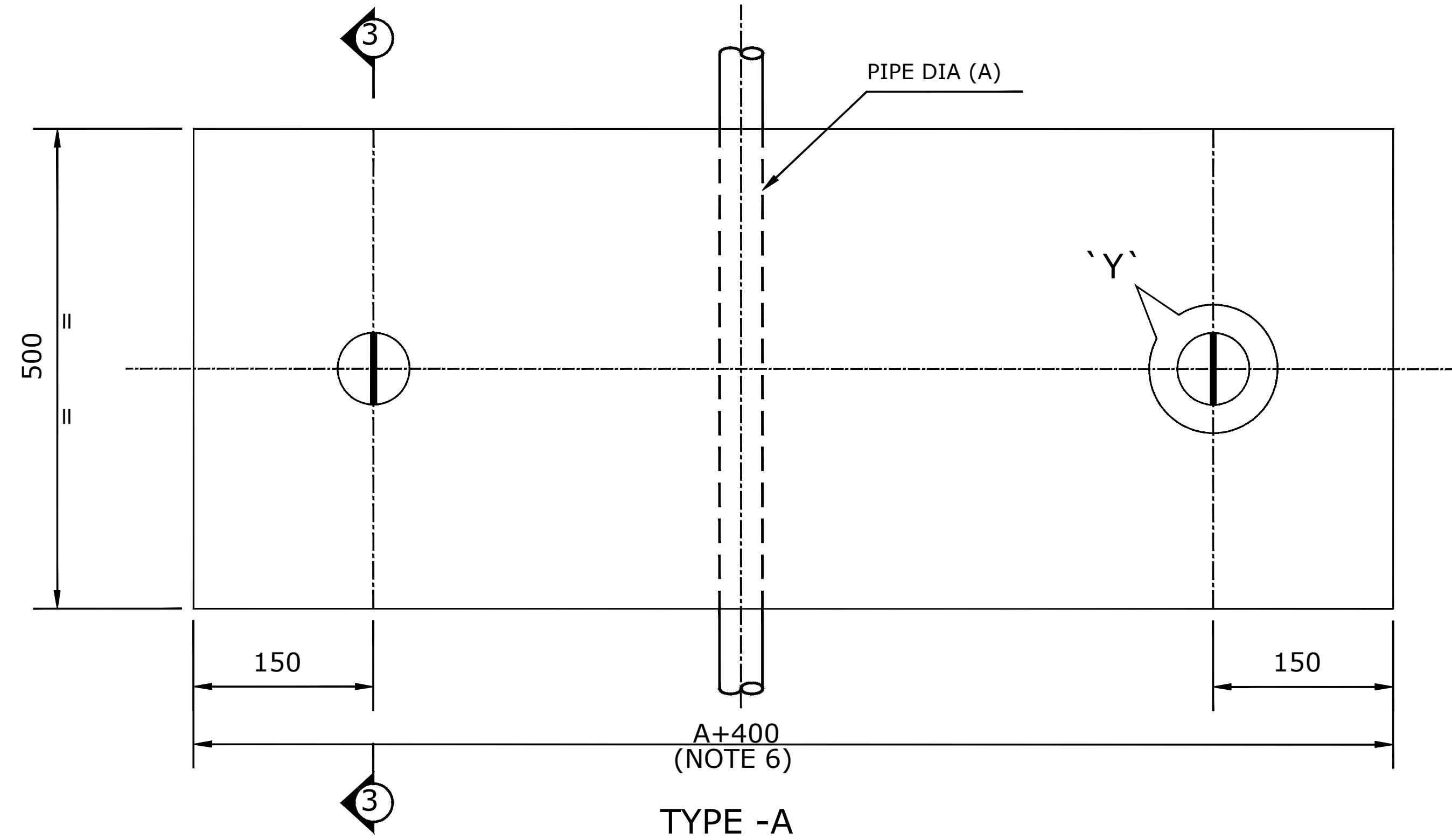


NOTES :

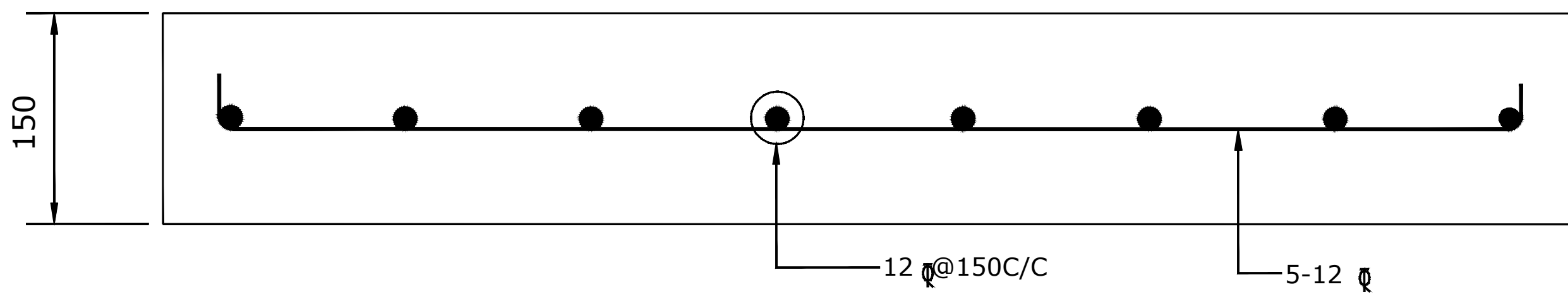
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. THE CROSSING WORKS SHALL BE EXECUTED IN ACCORDANCE WITH API RECOMMENDED PRACTICE 1102 LATEST EDITION.
3. 500mm AWAY FROM BOTH ENDS, TWO NOS. INSULATORS SHALL BE PLACED. IN BALANCE LENGTH MAX. SPACING OF INSULATORS SHALL BE 2000mm.
4. ELECTRICAL INSULATION BETWEEN THE CASING AND CARRIER PIPE SHALL BE CHECKED WITH A SUITABLE MEGGER.
5. MATERIAL OF THE CASING INSULATORS SHALL BE HDPE. END SEALS SHALL BE HEAT SHRINKABLE TYPE (MAKERAYCHEM OR EQUIVALENT), CONTRACTOR SHOULD TAKE PRIOR APPROVAL FOR MATERIAL OF CONSTRUCTION FOR END SEAL & SHALL SUBMIT MATERIAL CERTIFICATES TO OWNER / CONSULTANT FOR APPROVAL.
6. 1:250 SLOPE TO BE PROVIDED FOR DRAINING DURING INSTALLATION OF CASING PIPE.
7. CASING PIPE SHOULD EXTEND MIN. 600mm BEYOND THE BOTTOM OF THE DRAINAGE DITCH, WHICHEVER IS MORE.
8. CONTRACTOR SHOULD SUBMIT DETAILED WORK PROCEDURE ALONG WITH SKETCHED AND MATERIAL TEST CERTIFICATES FOR APPROVAL.
9. THE CROSSING SHALL BE DONE ACCORDING TO THE GOVERNING DIMENSION OUT OF THESE DEFINED DIMENSIONS, AS THESE ARE ONLY GUIDING DIMENSIONS.
10. BENTONITE FILLING PROCEDURE SHALL BE DONE AS PER OWNER / CONSULTANTS INSTRUCTIONS.
11. CROSSING MAY BE CARRIED OUT PRIOR TO MAINLINE ACTIVITIES ADDITIONAL ROU, IF REQUIRED, FOR APPROCH TO CROSSING, PIPELINE STRING, HYDROTESTING WORKING PIT FOR CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.
12. CATHODIC PROTECTED :- ALL CASING PIPES FOR CROSSING SHALL BE C.P. PROTECTED.
13. TEST STATION ON BOTH SIDE OF CROSSING.
14. THE LOCATION OF ENTRY AND EXIT PIT SHALL BE DECIDED AT SITE TO SUIT THE SITE REQUIREMENT.
15. AT EACH CROSSING, PIPELINE CROSSING WARNING SIGN SHALL BE INSTALLED ON EITHER SIDE OF CROSSING. THE WARNING PLATE MAY BE MOUNTED ON THE VENT / DRAIN OFF PIPE.
16. ALL CARRIER PIPELINE JOINTS SHALL BE RADIO GRAPHED.
17. PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES OR AS DIRECTED BY CLIENT.

|                                                                                                                      |          |             |                    |       |        |       |
|----------------------------------------------------------------------------------------------------------------------|----------|-------------|--------------------|-------|--------|-------|
|                                                                                                                      |          |             |                    |       |        |       |
|                                                                                                                      |          |             |                    |       |        |       |
|                                                                                                                      |          |             |                    |       |        |       |
|                                                                                                                      |          |             |                    |       |        |       |
| 00                                                                                                                   | 13.02.23 | ISSUED AS   | STANDARD DRAWING   | PSS   | MC     | HK    |
| REV.                                                                                                                 | DATE     | DESCRIPTION |                    | PREP. | CHKD.  | APPD. |
| PMC:                                                                                                                 |          |             |                    |       |        |       |
|  VCS QUALITY SERVICES PVT. LTD. |          |             |                    |       |        |       |
| TITLE:                                                                                                               |          |             |                    |       |        |       |
| TYPICAL ROAD CASED CROSSING (B+C)                                                                                    |          |             |                    |       |        |       |
| SCALE:                                                                                                               |          | N.T.S.      | TOTAL NO. OF SHTS: |       | 1 OF 1 |       |
| SIZE                                                                                                                 | JOB NO.  |             | DRAWING NUMBER     |       |        | REV.  |
| A3                                                                                                                   | -----    |             | VCS-00-PP-SD-2014  |       |        | 00    |

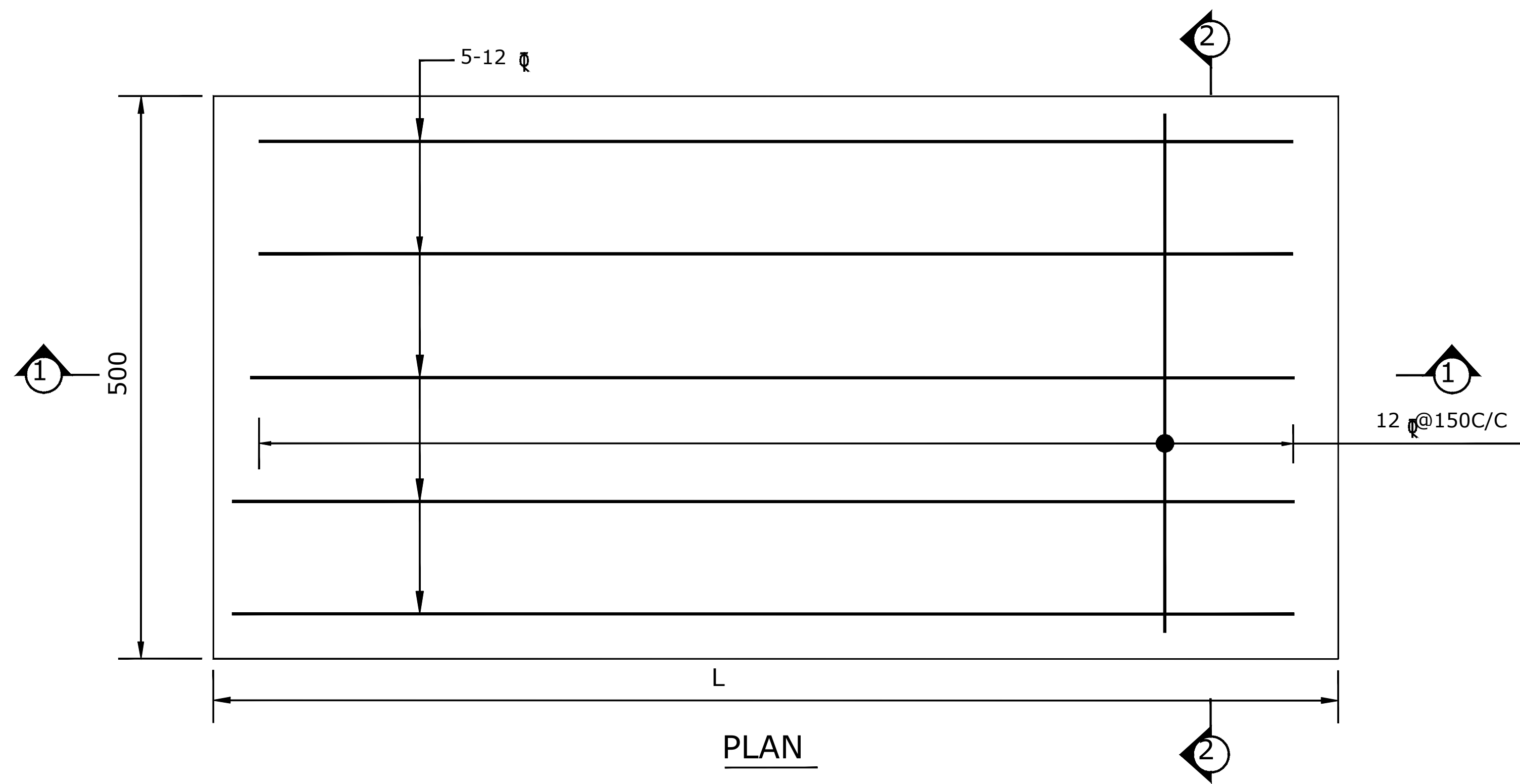




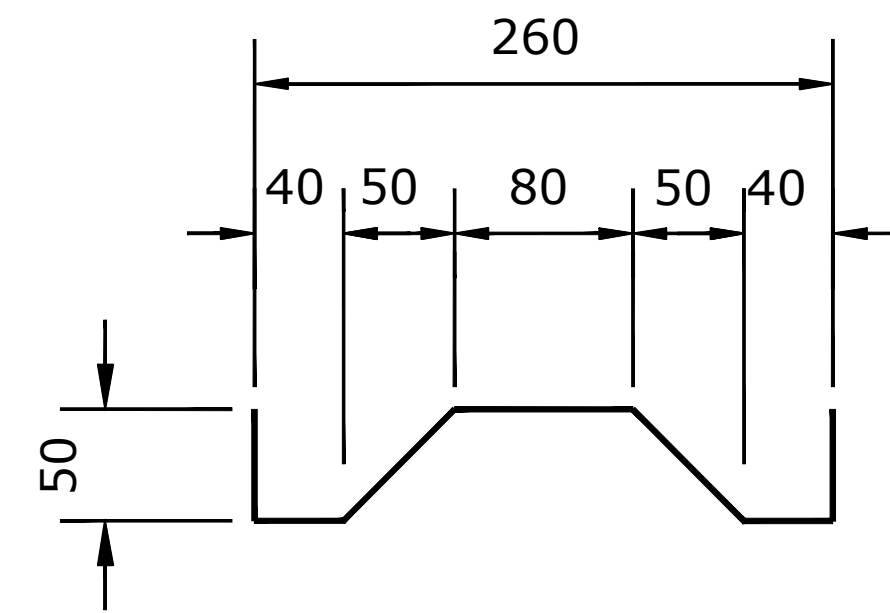
TYPE -A  
(WITH LIFTING HOOK TYPE )



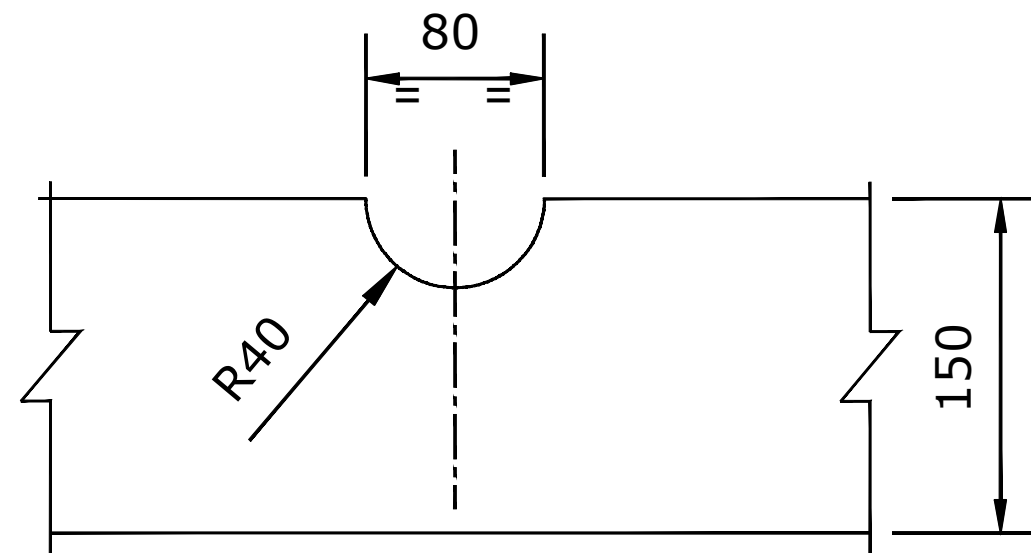
SECTION 1-1



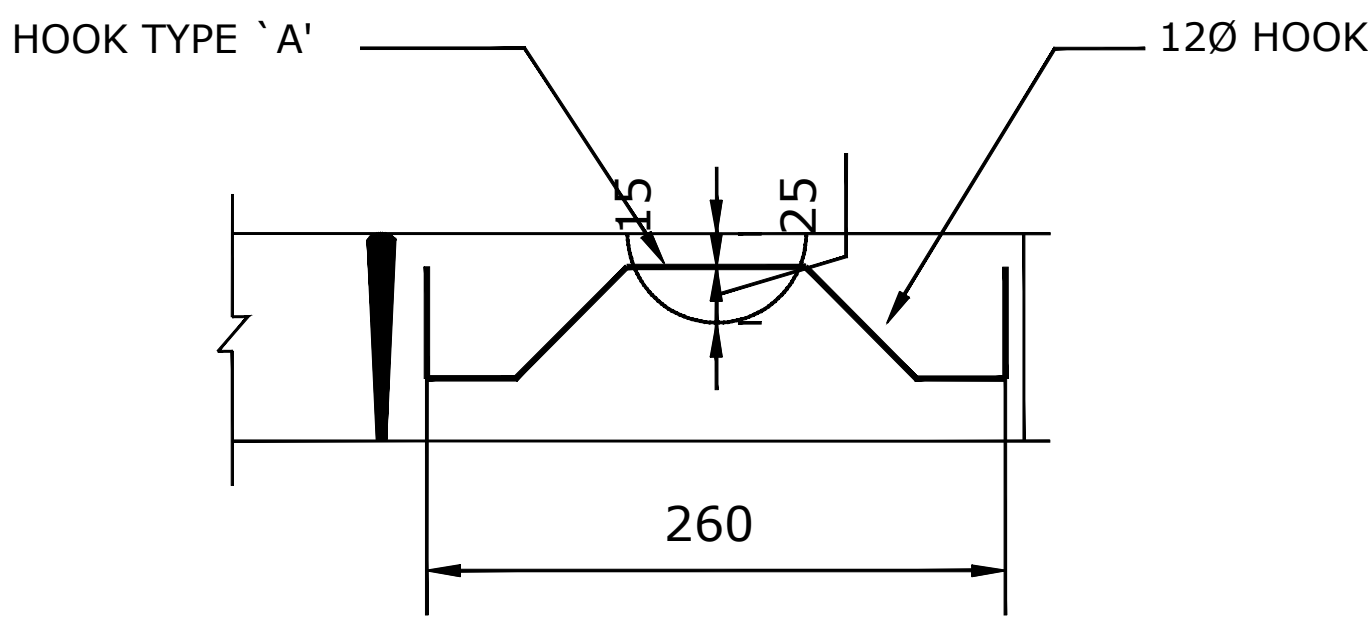
PLAN



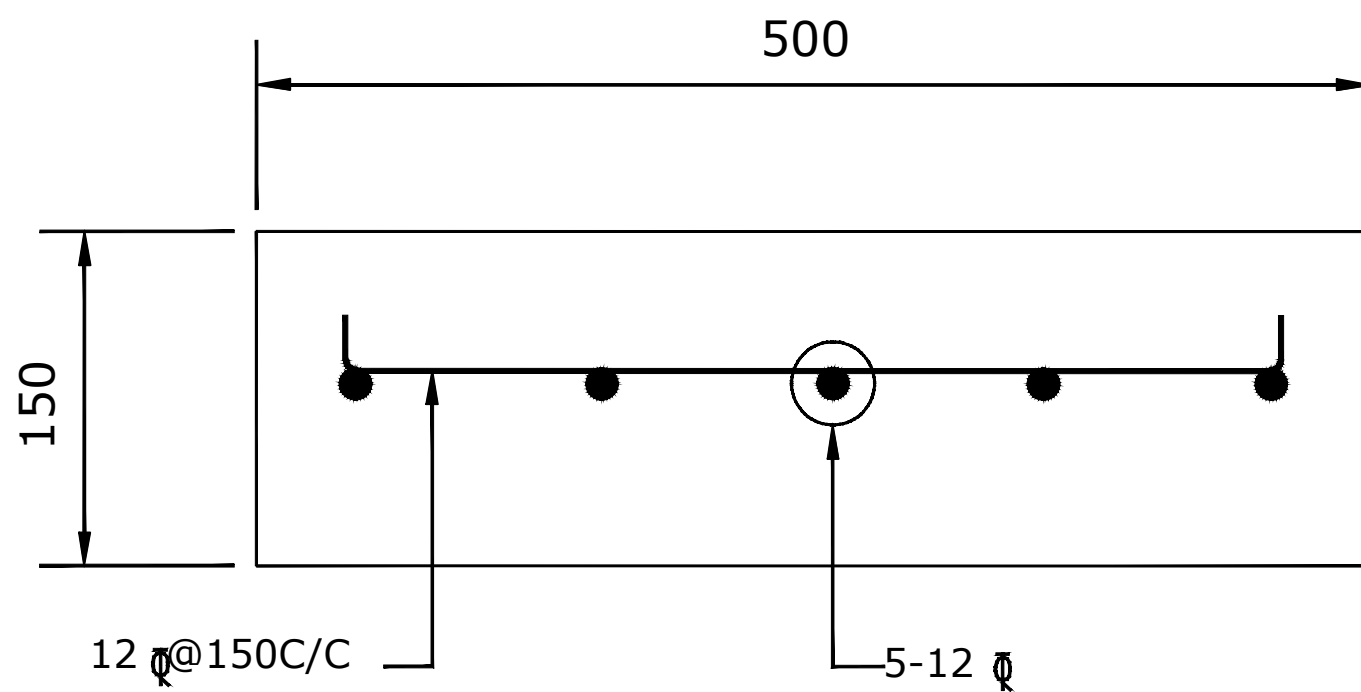
HOOK TYPE 'A'



DETAIL- 'Y'  
( TYP. )



SECTION 3-3



SECTION 2-2

| CROSSING DETAIL |          |                |           |                     |
|-----------------|----------|----------------|-----------|---------------------|
| Sr.No.          | CROSSING | PIPELINE ROUTE | WIDTH (M) | CONSTRUCTION METHOD |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |
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|                 |          |                |           |                     |
|                 |          |                |           |                     |
|                 |          |                |           |                     |

REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |
|       |       |     |

NOTES:-

- ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS ARE IN METRES.
- GRADE OF CONC MIX SHALL BE M-25 CONFORMING TO IS- 456.
- REINF SHALL BE HYSD BARS OF GRADE Fe 500 CONFORMING TO IS- 1786.
- THIS STANDARD SHALL NOT BE USED FOR VEHICULAR MOVEMENT AREAS
- TOTAL PROTECTION LENGTH ALONG THE PROPOSED PIPELINE SHALL BE AS PER SCOPE OF CONTRACT.
- DIMENSION "A" SHALL BE CALCULATED USING FORMULA  $A=(D1+D2Dn)+(n-1) \times 500$  WHERE D1,D2, DIAMETERS OF PIPELINES IN mm AND "n" IS NO. OF PIPELINES IN THE SAME TRENCH.

| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
|------|----------|------------------------|-------|-------|-------|
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |

PMC:  VCS QUALITY SERVICES PVT. LTD.

TITLE: TYPICAL DRAWING FOR CONCRETE SLAB

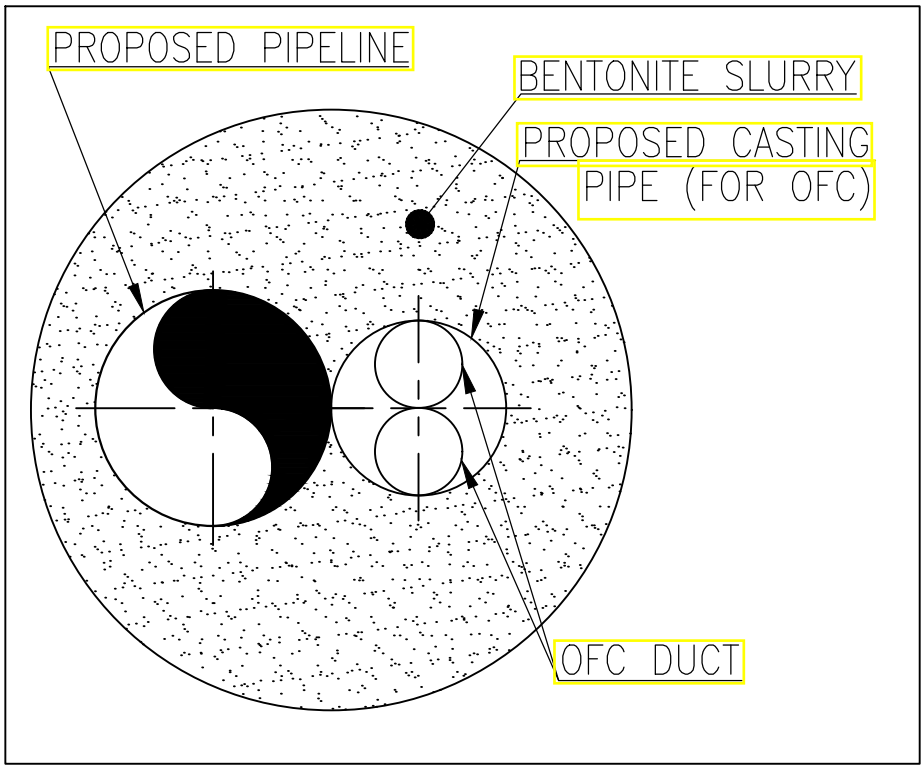
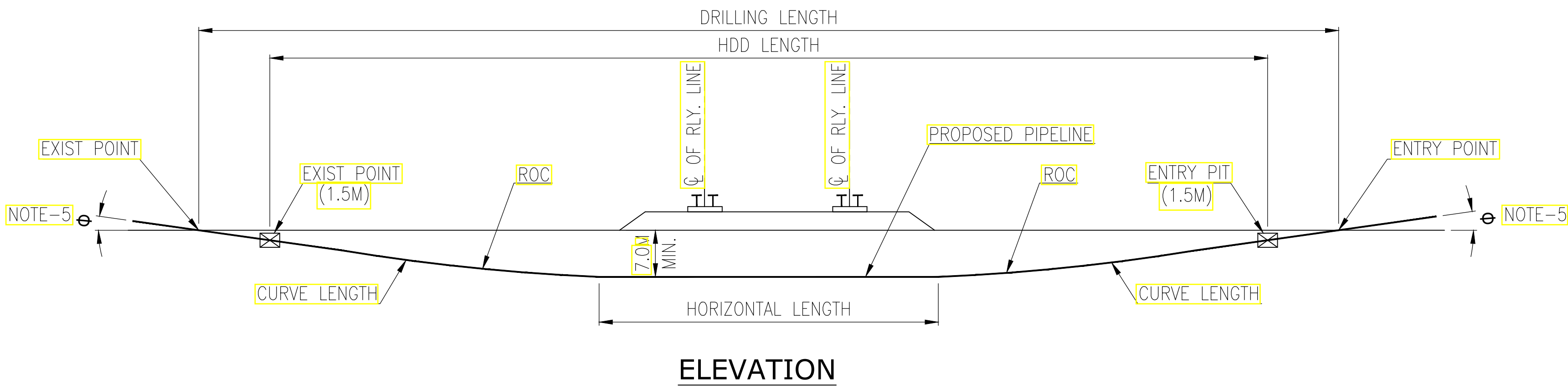
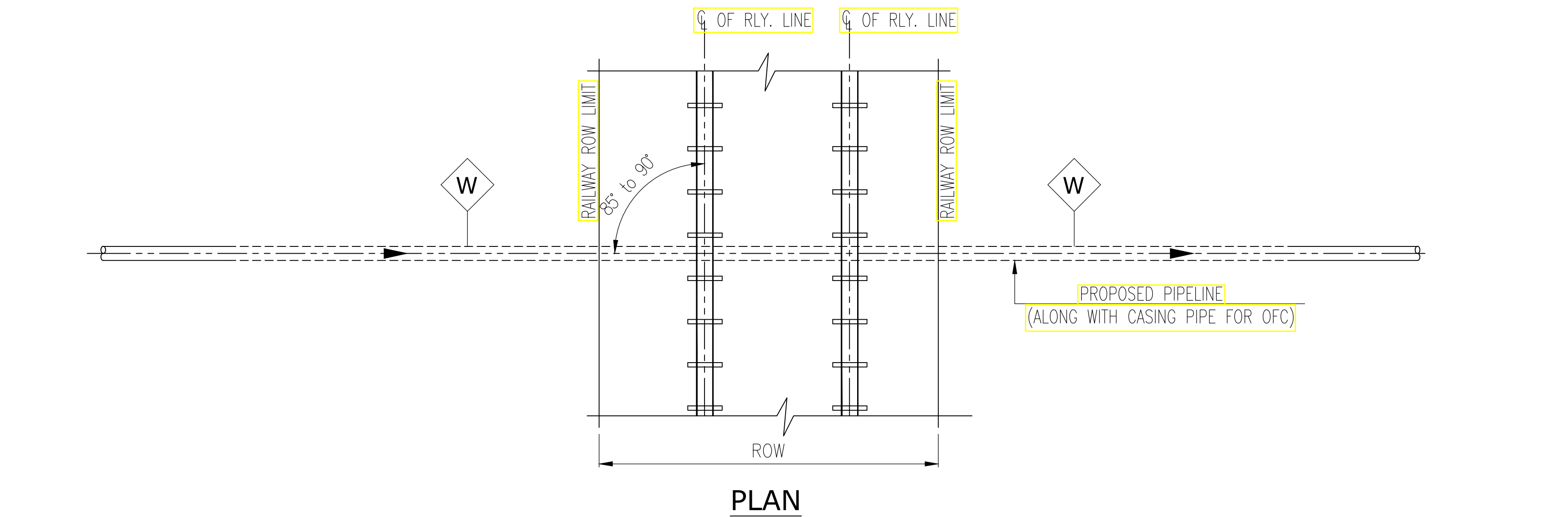
SCALE: N.T.S. TOTAL NO. OF SHTS: 1 OF 1

| SIZE | JOB NO. | DRAWING NUMBER    | REV. |
|------|---------|-------------------|------|
| A3   | -----   | VCS-00-PP-SD-2017 | 00   |



RAILWAY CROSSING DRAWING

(BY HDD - TRENCHLESS TECHNIQUE)



REFERENCE DRAWINGS / DOCUMENTS

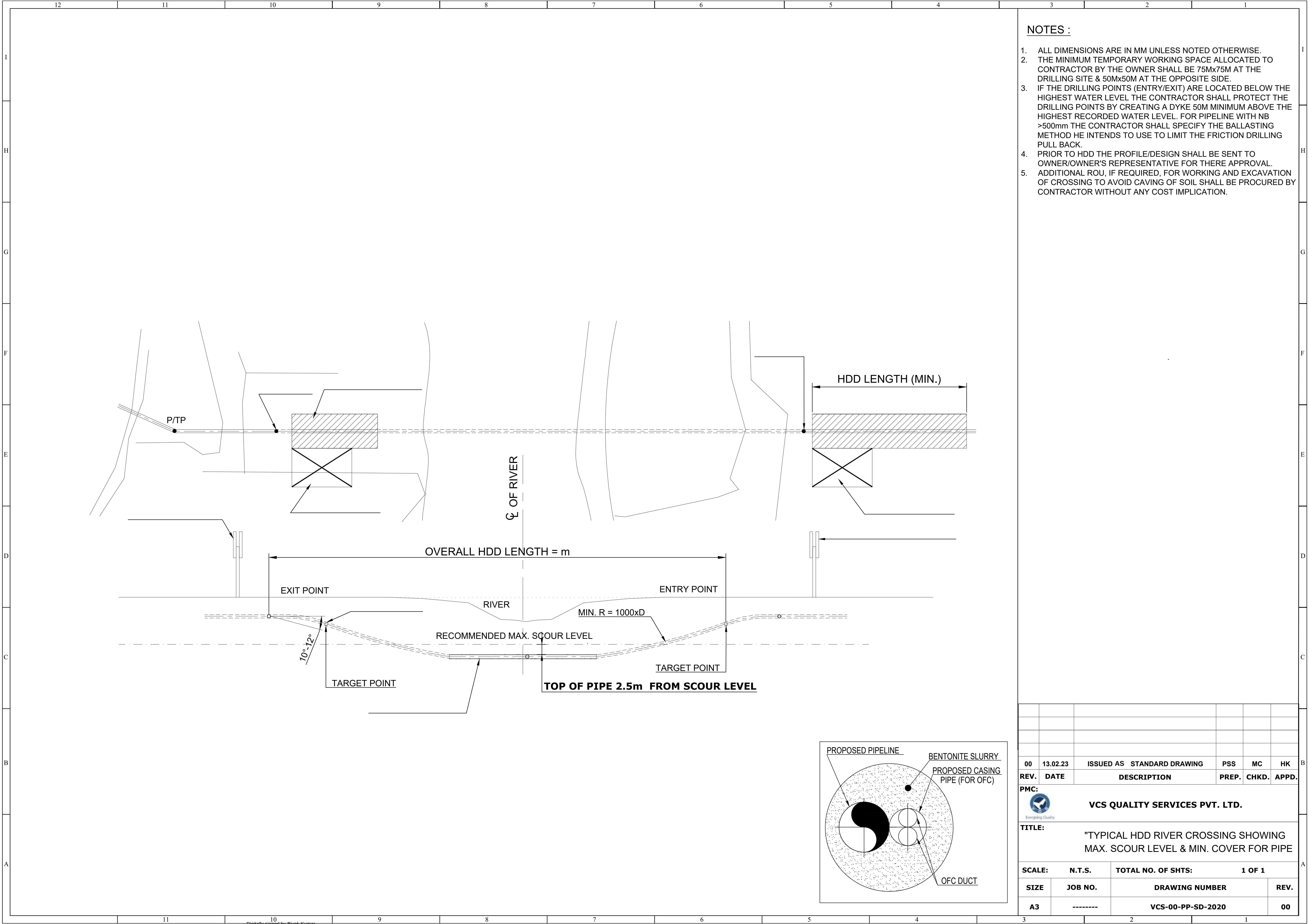
| S.NO. | TITLE | NO. |
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NOTES:-

- ALL DIMENSION ARE IN METERS.
- ENTRY / EXIT SIDE SHALL DEPEND ON SITE CONDITIONS.
- MINIMUM DEPTH OF COVER SHALL BE 7.0M IN RAILWAY ROW.
- HDD WITH BUNDLE PULLING.
- ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.
- THE NUMBER OF WARNING MARKER SHALL BE 2 NOS. FOR ALL RAILWAY CROSSING.
- REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
- CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSION WITH RESPECT TO SURVEY DETAIL FOR INDIVIDUAL CROSSING ENGINEER IN CHARGE APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
- ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
- PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.

|                                                    |          |                        |        |       |       |
|----------------------------------------------------|----------|------------------------|--------|-------|-------|
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|                                                    |          |                        |        |       |       |
| 00                                                 | 16.01.23 | ISSUED AS STD. DRAWING | PSS    | MC    | HK    |
| REV.                                               | DATE     | DESCRIPTION            | PREP.  | CHKD. | APPD. |
| PMC:                                               |          |                        |        |       |       |
| VCS QUALITY SERVICES PVT. LTD.                     |          |                        |        |       |       |
| TITLE:                                             |          |                        |        |       |       |
| TYPICAL DETAILS OF RAILWAY CROSSINGS BY HDD METHOD |          |                        |        |       |       |
| SCALE:                                             | N.T.S.   | TOTAL NO. OF SHTS:     | 1 OF 1 |       |       |
| SIZE                                               | JOB NO.  | DRAWING NUMBER         | REV.   |       |       |
| A3                                                 | -----    | VCS-00-PP-SD-2019      | 00     |       |       |



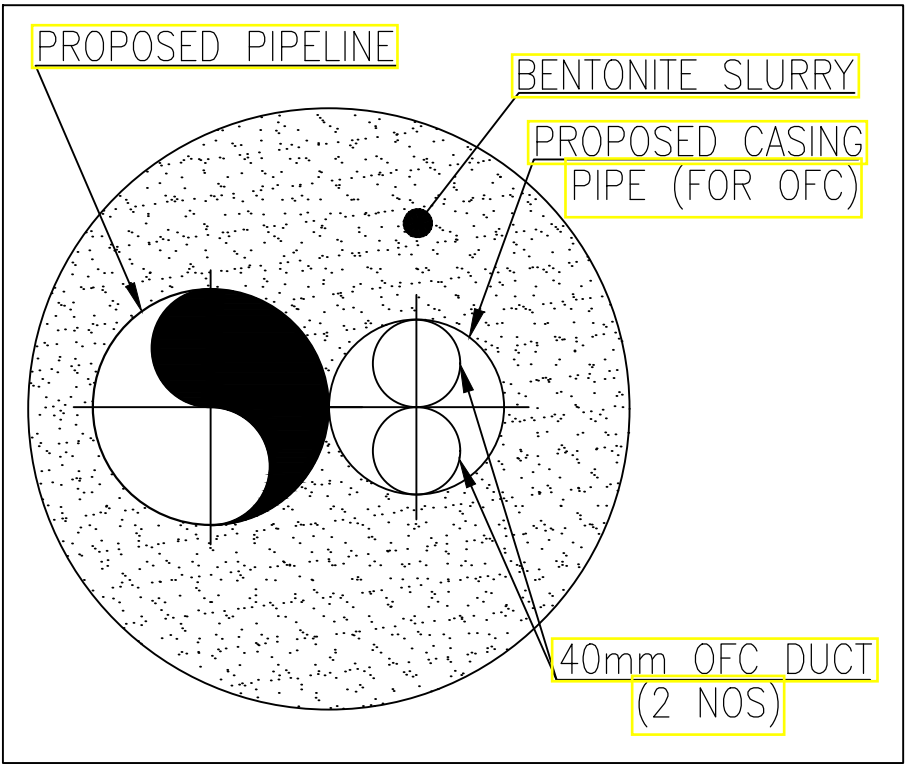
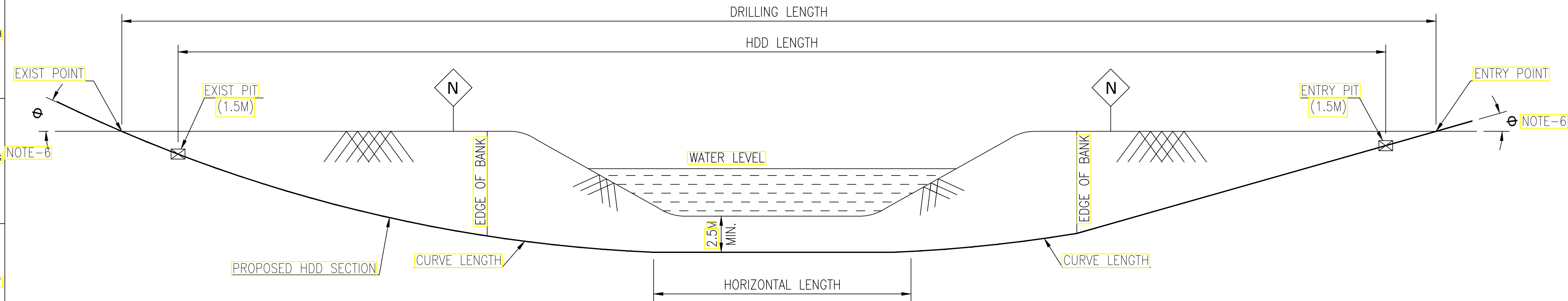


- NOTES :**
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
  2. THE MINIMUM TEMPORARY WORKING SPACE ALLOCATED TO CONTRACTOR BY THE OWNER SHALL BE 75Mx75M AT THE DRILLING SITE & 50Mx50M AT THE OPPOSITE SIDE.
  3. IF THE DRILLING POINTS (ENTRY/EXIT) ARE LOCATED BELOW THE HIGHEST WATER LEVEL THE CONTRACTOR SHALL PROTECT THE DRILLING POINTS BY CREATING A DYKE 50M MINIMUM ABOVE THE HIGHEST RECORDED WATER LEVEL. FOR PIPELINE WITH NB >500mm THE CONTRACTOR SHALL SPECIFY THE BALLASTING METHOD HE INTENDS TO USE TO LIMIT THE FRICTION DRILLING PULL BACK.
  4. PRIOR TO HDD THE PROFILE/DESIGN SHALL BE SENT TO OWNER/OWNER'S REPRESENTATIVE FOR THERE APPROVAL.
  5. ADDITIONAL ROU, IF REQUIRED, FOR WORKING AND EXCAVATION OF CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.

|                                                                                                                                       |          |             |                    |       |        |       |
|---------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|--------------------|-------|--------|-------|
|                                                                                                                                       |          |             |                    |       |        |       |
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| 00                                                                                                                                    | 13.02.23 | ISSUED AS   | STANDARD DRAWING   | PSS   | MC     | HK    |
| REV.                                                                                                                                  | DATE     | DESCRIPTION |                    | PREP. | CHKD.  | APPD. |
| PMC:                                                                                                                                  |          |             |                    |       |        |       |
| <div><b>VCS QUALITY SERVICES PVT. LTD.</b></div> |          |             |                    |       |        |       |
| TITLE: "TYPICAL HDD RIVER CROSSING SHOWING<br>MAX. SCOUR LEVEL & MIN. COVER FOR PIPE                                                  |          |             |                    |       |        |       |
| SCALE:                                                                                                                                |          | N.T.S.      | TOTAL NO. OF SHTS: |       | 1 OF 1 |       |
| SIZE                                                                                                                                  | JOB NO.  |             | DRAWING NUMBER     |       |        | REV.  |
| A3                                                                                                                                    | -----    |             | VCS-00-PP-SD-2020  |       |        | 00    |

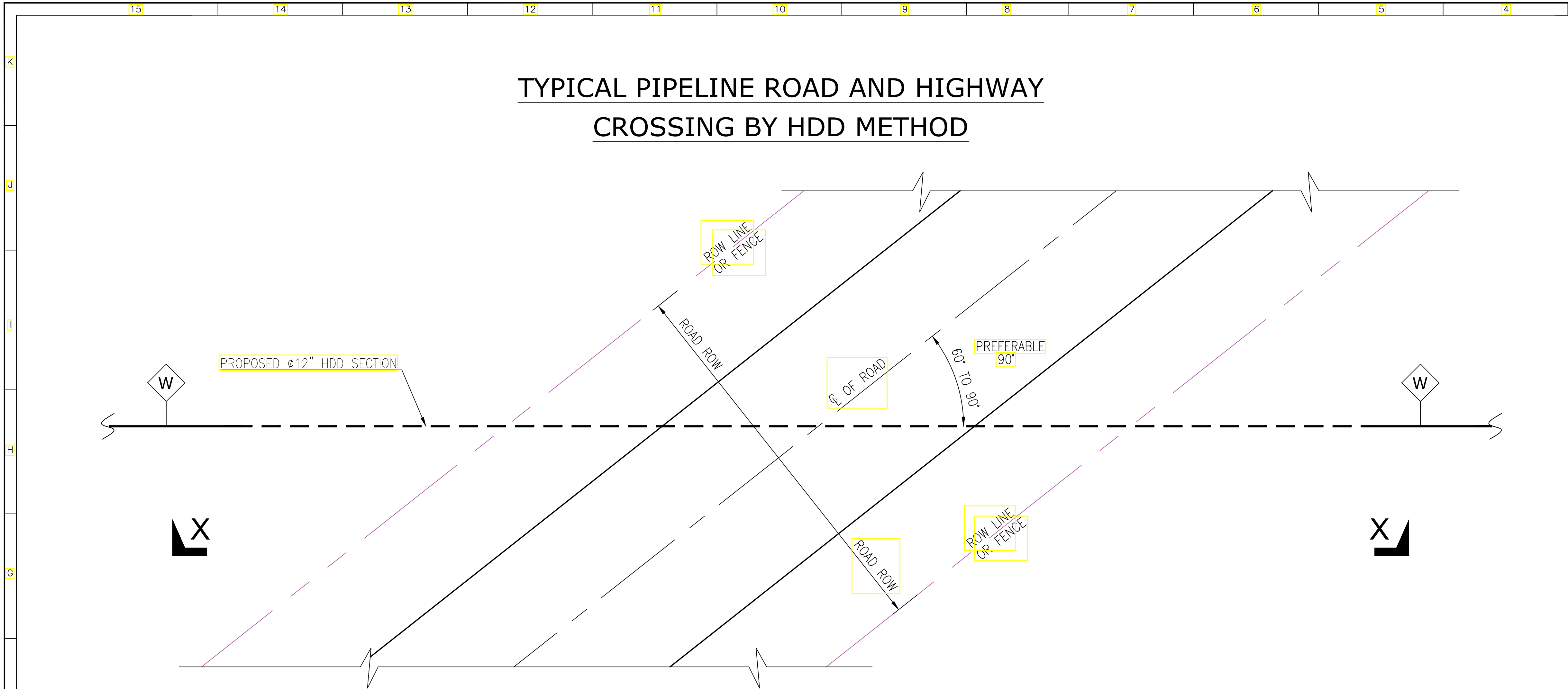


TYPICAL DETAIL FOR RIVER  
CROSSING BY HDD METHOD

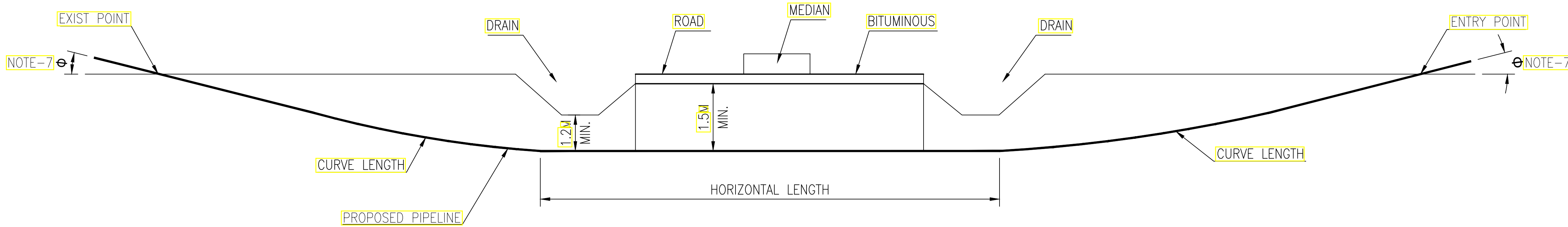


| REFERENCE DRAWINGS / DOCUMENTS                                                                                                                                |          |                        |       |        |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------|-------|--------|-------|
| S.NO.                                                                                                                                                         | TITLE    |                        |       | NO.    |       |
|                                                                                                                                                               |          |                        |       |        |       |
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|                                                                                                                                                               |          |                        |       |        |       |
|                                                                                                                                                               |          |                        |       |        |       |
| NOTES:-                                                                                                                                                       |          |                        |       |        |       |
| 1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.                                                                                                           |          |                        |       |        |       |
| 2. THE MINIMUM COVER OVER SHALL BE USED ONLY WITH PRIOR APPROVAL OF COMPANY.                                                                                  |          |                        |       |        |       |
| (a) DEPTH OF COVER SHALL BE MINIMUM 2.5 M FROM SCOUR LEVEL                                                                                                    |          |                        |       |        |       |
| 3. THE LOCATION OF CROSSING SHALL BE IN A LONG STRAIGHT STRETCH OF THE STREAM IF POSSIBLE.                                                                    |          |                        |       |        |       |
| 4. WIDTH OF CROSSING SHALL BE THAT CORRESPONDING TO THE HIGHEST WATER LEVEL. THE HIGHEST WATER LEVEL SHALL BE DETERMIND BY CONTRACTOR BASED ON THE FOLLOWING. |          |                        |       |        |       |
| (a) BANK CONDITION VIS-A-VIS EROSION ETC.                                                                                                                     |          |                        |       |        |       |
| (b) EVIDENCE OF EXTIRINCTION OF VEGETATION ALONG BANKS.                                                                                                       |          |                        |       |        |       |
| (c) DISCUSSIONS WITH LOCAL PEOPLE.                                                                                                                            |          |                        |       |        |       |
| (D) HISTORICAL RECORDS (TO THE EXEUNT AVAILABLE).                                                                                                             |          |                        |       |        |       |
| 5. THE NUMBER OF WARNING MARKER SHALL BE                                                                                                                      |          |                        |       |        |       |
| (a) 1(ONE) FOR CROSSING LESS THAN 15M WIDTH AT UPSTREAM BANK.                                                                                                 |          |                        |       |        |       |
| (b) 2(TWO) FOR CROSSING ABOVE 15M WIDTH.                                                                                                                      |          |                        |       |        |       |
| 6. ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.                                                                                                   |          |                        |       |        |       |
| 7. PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.                               |          |                        |       |        |       |
| 8. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.                                                                                                                 |          |                        |       |        |       |
|                                                                                                                                                               |          |                        |       |        |       |
|                                                                                                                                                               |          |                        |       |        |       |
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| 00                                                                                                                                                            | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC     | HK    |
| REV.                                                                                                                                                          | DATE     | DESCRIPTION            | PREP. | CHKD.  | APPD. |
| PMC:                                                                                                                                                          |          |                        |       |        |       |
|  VCS QUALITY SERVICES PVT. LTD.                                          |          |                        |       |        |       |
| TITLE:                                                                                                                                                        |          |                        |       |        |       |
| TYPICAL DETAIL FOR RIVER CROSSING BY HDD METHOD                                                                                                               |          |                        |       |        |       |
| SCALE:                                                                                                                                                        | N.T.S.   | TOTAL NO. OF SHTS:     |       | 1 OF 1 |       |
| SIZE                                                                                                                                                          | JOB NO.  | DRAWING NUMBER         |       |        | REV.  |
| A3                                                                                                                                                            | -----    | VCS-00-PP-SD-2020      |       |        | 00    |

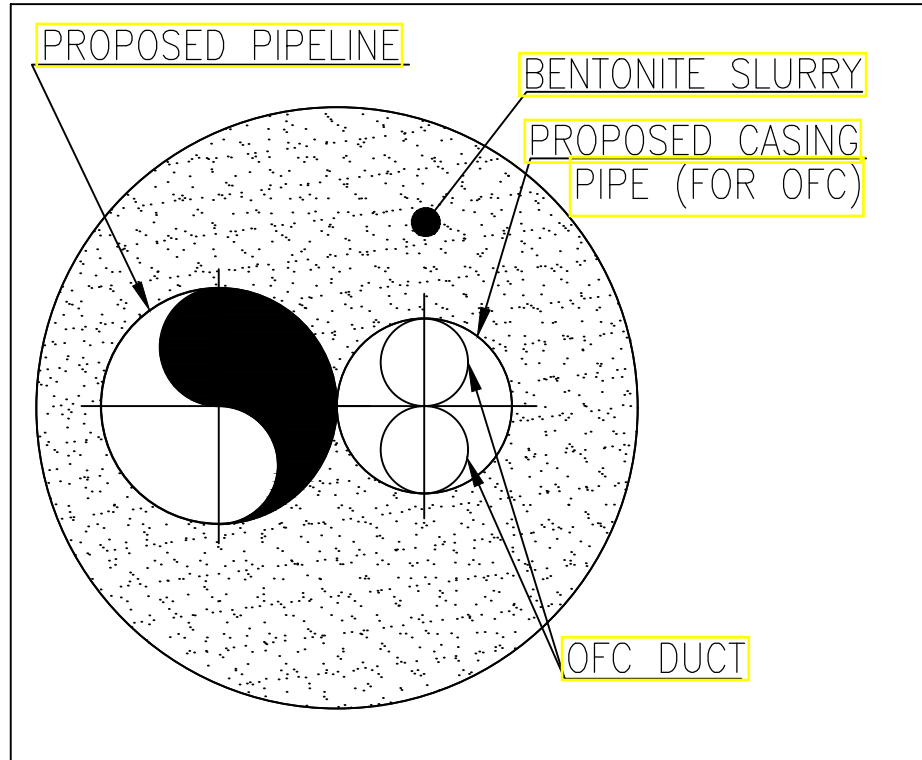




PLAN



VIEW X-X



REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |
|       |       |     |
|       |       |     |

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. ROAD HIGHWAY CROSSING SHALL BE RESTORED TO ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF OWNER AND CONCERNED AUTHORITIES HAVING JURISDICTION.
3. REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
4. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE ROAD / HIGHWAY SHALL BE AS CLOSE TO 90° AS POSSIBLE.
5. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSION WITH RESPECT TO SURVEY DETAIL FOR INDIVIDUAL CROSSING ENGINEER IN CHARGE APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
6. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
7. ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.
9. PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.
10. THE NUMBER OF WARNING MARKER SHALL BE 2 NOS. FOR NATIONAL HIGHWAY AND 1 NO FOR OTHER ROAD.

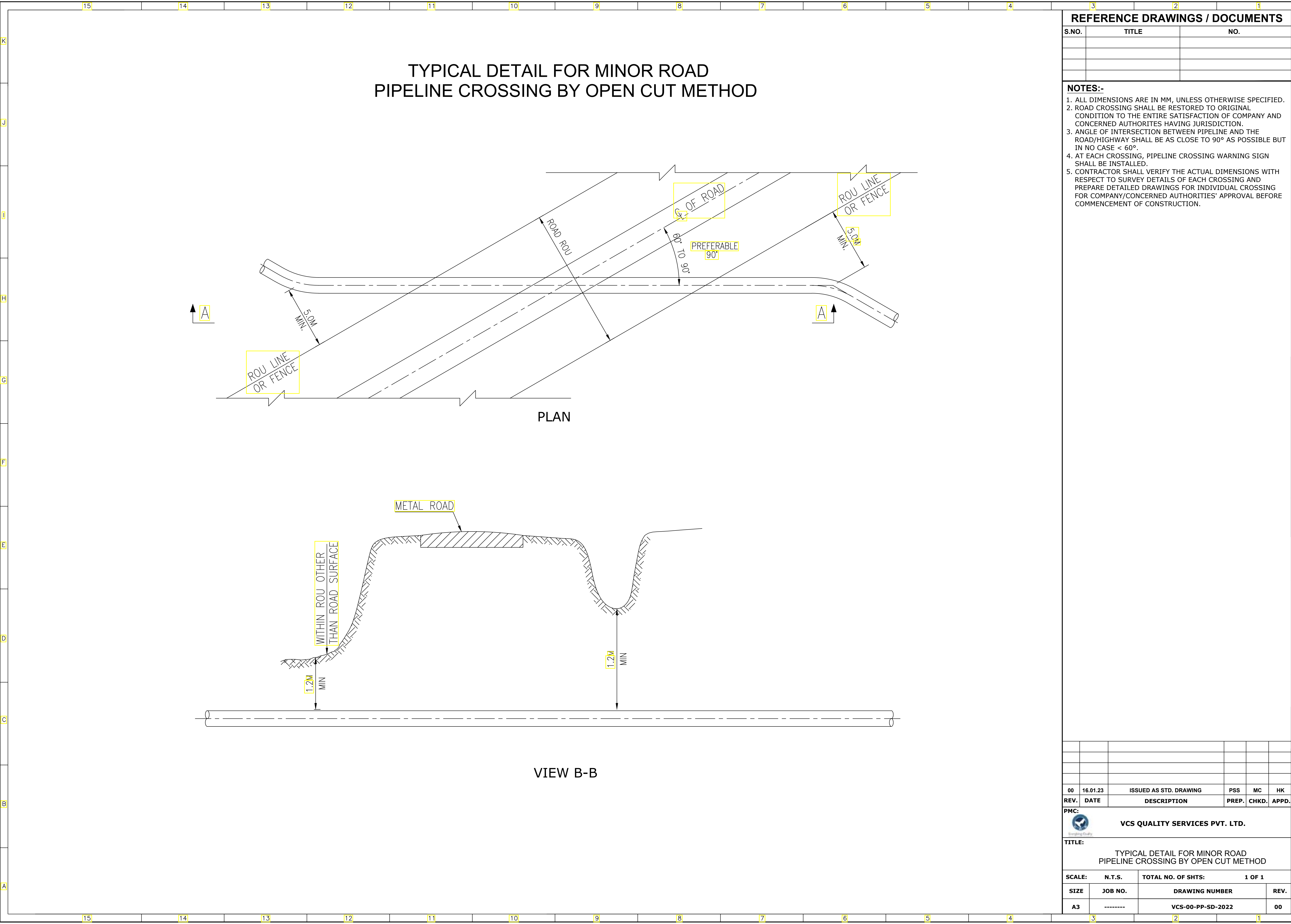
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|      |          |                        |       |       |       |
|      |          |                        |       |       |       |
| 00   | 16.01.23 | ISSUED AS STD. DRAWING | PSS   | MC    | HK    |
| REV. | DATE     | DESCRIPTION            | PREP. | CHKD. | APPD. |

PMC:  
 **VCS QUALITY SERVICES PVT. LTD.**

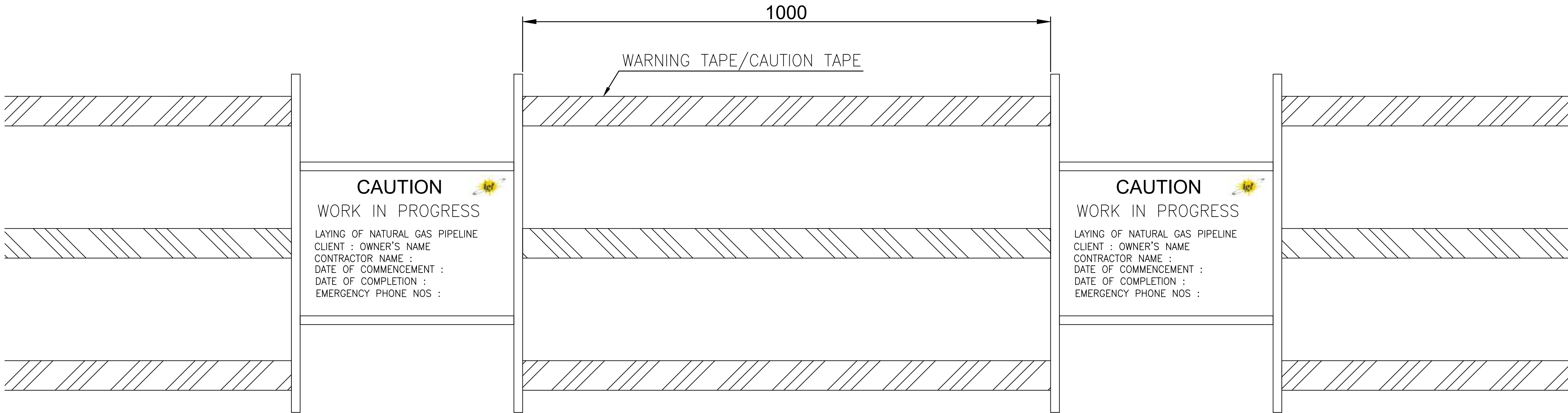
TITLE:  
TYPICAL DETAIL FOR PIPELINE ROAD AND HIGHWAY CROSSING BY HDD METHOD

|        |         |                    |        |
|--------|---------|--------------------|--------|
| SCALE: | N.T.S.  | TOTAL NO. OF SHTS: | 1 OF 1 |
| SIZE   | JOB NO. | DRAWING NUMBER     | REV.   |
| A3     | -----   | VCS-00-PP-SD-2021  | 00     |









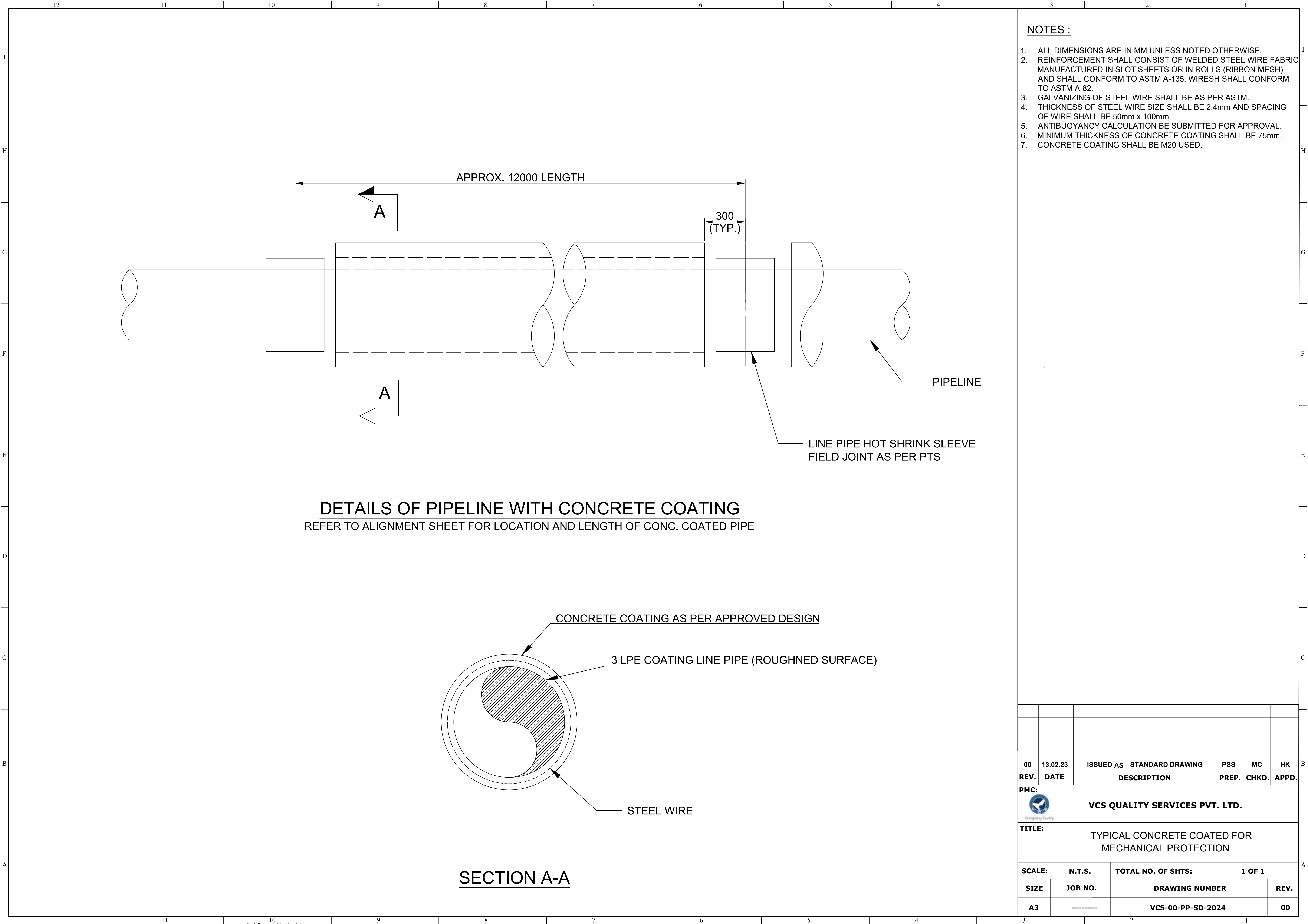
SCHEMATIC LAYOUT OF CAUTION BOARDS AND BARRICADDING

**NOTES:-**

- 1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2. TO THE CAUTION BOARDS REFER DRAWING NO. VCS-00-PP-SD-2026.

|                                                                                       |          |                                |                    |       |        |       |
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| 00                                                                                    | 13.02.23 | ISSUED AS                      | STANDARD DRAWING   | PSS   | MC     | HK    |
| REV.                                                                                  | DATE     | DESCRIPTION                    |                    | PREP. | CHKD.  | APPD. |
| PMC:                                                                                  |          |                                |                    |       |        |       |
|  |          | VCS QUALITY SERVICES PVT. LTD. |                    |       |        |       |
| TITLE:                                                                                |          |                                |                    |       |        |       |
| TYPICAL DETAIL FOR BARRICADING                                                        |          |                                |                    |       |        |       |
| SCALE:                                                                                |          | N.T.S.                         | TOTAL NO. OF SHTS: |       | 1 OF 1 |       |
| SIZE                                                                                  | JOB NO.  |                                | DRAWING NUMBER     |       |        | REV.  |
| A3                                                                                    | -----    |                                | VCS-00-PP-SD-2023  |       |        | 00    |





- NOTES :
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
  2. REINFORCEMENT SHALL CONSIST OF WELDED STEEL WIRE FABRIC MANUFACTURED IN SLOT SHEETS OR IN ROLLS (RIBBON MESH) AND SHALL CONFORM TO ASTM A-135. WIRESH SHALL CONFORM TO ASTM A-82.
  3. GALVANIZING OF STEEL WIRE SHALL BE AS PER ASTM.
  4. THICKNESS OF STEEL WIRE SIZE SHALL BE 2.4mm AND SPACING OF WIRE SHALL BE 50mm x 100mm.
  5. ANTIBUOYANCY CALCULATION BE SUBMITTED FOR APPROVAL.
  6. MINIMUM THICKNESS OF CONCRETE COATING SHALL BE 75mm.
  7. CONCRETE COATING SHALL BE M20 USED.

|                                                                                                                                 |          |                            |       |       |       |
|---------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------|-------|-------|-------|
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| 00                                                                                                                              | 13.02.23 | ISSUED AS STANDARD DRAWING | PSS   | MC    | HK    |
| REV.                                                                                                                            | DATE     | DESCRIPTION                | PREP. | CHKD. | APPD. |
| PMC:                                                                                                                            |          |                            |       |       |       |
| <div> VCS QUALITY SERVICES PVT. LTD.</div> |          |                            |       |       |       |
| TITLE: TYPICAL CONCRETE COATED FOR MECHANICAL PROTECTION                                                                        |          |                            |       |       |       |
| SCALE: N.T.S.                                                                                                                   |          | TOTAL NO. OF SHTS: 1 OF 1  |       |       |       |
| SIZE                                                                                                                            | JOB NO.  | DRAWING NUMBER             |       |       | REV.  |
| A3                                                                                                                              | -----    | VCS-00-PP-SD-2024          |       |       | 00    |

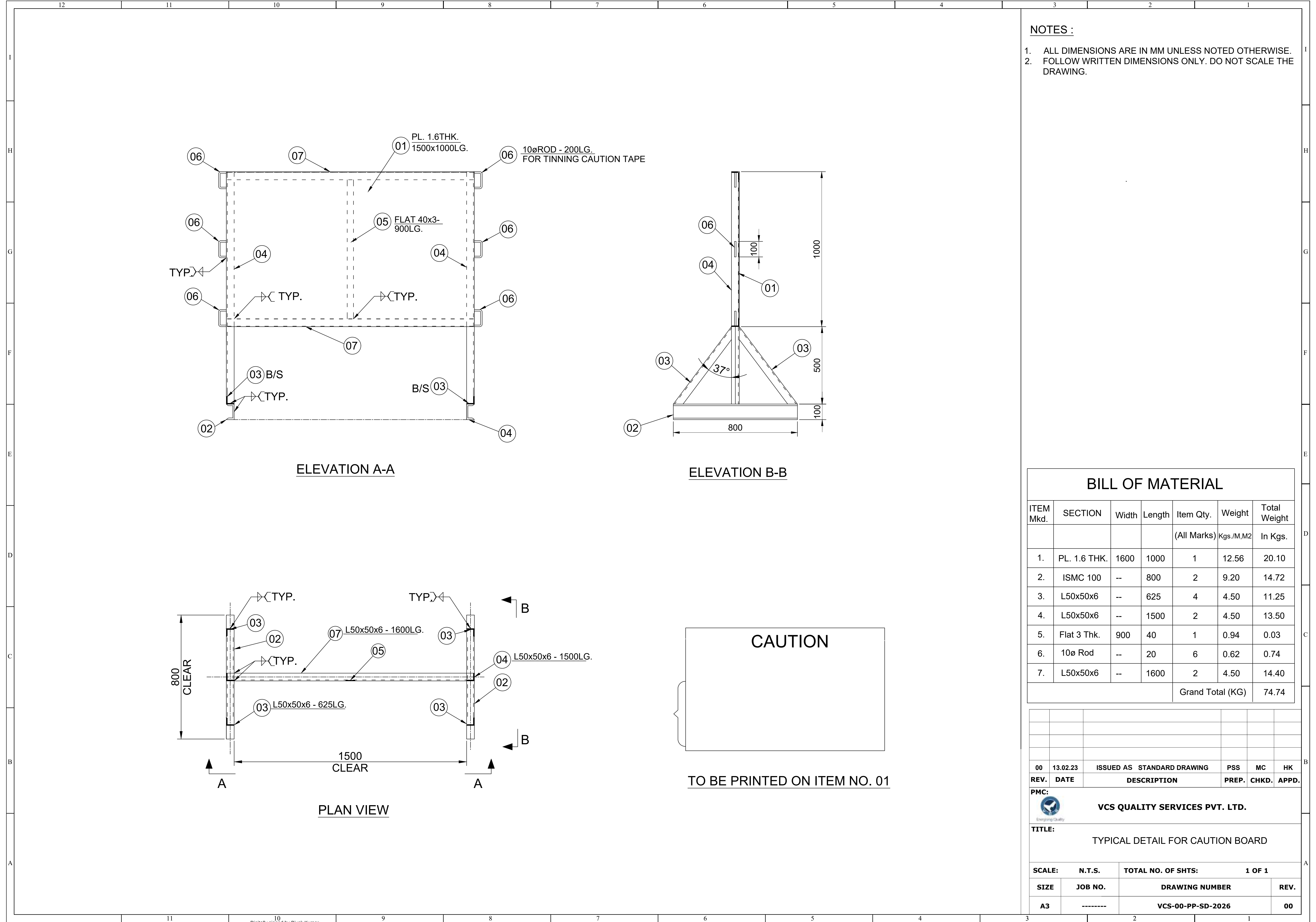




- NOTES:**
- 1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
  - 2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWING.

|                                                                                       |          |                                |                    |       |        |       |
|---------------------------------------------------------------------------------------|----------|--------------------------------|--------------------|-------|--------|-------|
|                                                                                       |          |                                |                    |       |        |       |
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| 00                                                                                    | 13.02.23 | ISSUED AS    STANDARD DRAWING  |                    | PSS   | MC     | HK    |
| REV.                                                                                  | DATE     | DESCRIPTION                    |                    | PREP. | CHKD.  | APPD. |
| PMC:                                                                                  |          |                                |                    |       |        |       |
|  |          | VCS QUALITY SERVICES PVT. LTD. |                    |       |        |       |
| TITLE:                                                                                |          |                                |                    |       |        |       |
| TYPICAL DETAIL FOR PLATE MARKER                                                       |          |                                |                    |       |        |       |
| SCALE:                                                                                |          | N.T.S.                         | TOTAL NO. OF SHTS: |       | 1 OF 1 |       |
| SIZE                                                                                  | JOB NO.  |                                | DRAWING NUMBER     |       |        | REV.  |
| A3                                                                                    | -----    |                                | VCS-00-PP-SD-2025  |       |        | 00    |







M/s. VCS QUALITY SERVICES  
PVT. LTD.

SPECTACLE BLIND  
FLANGE

DRAWING NO.

SD-PI-001

SHEET NO.

1 OF 1

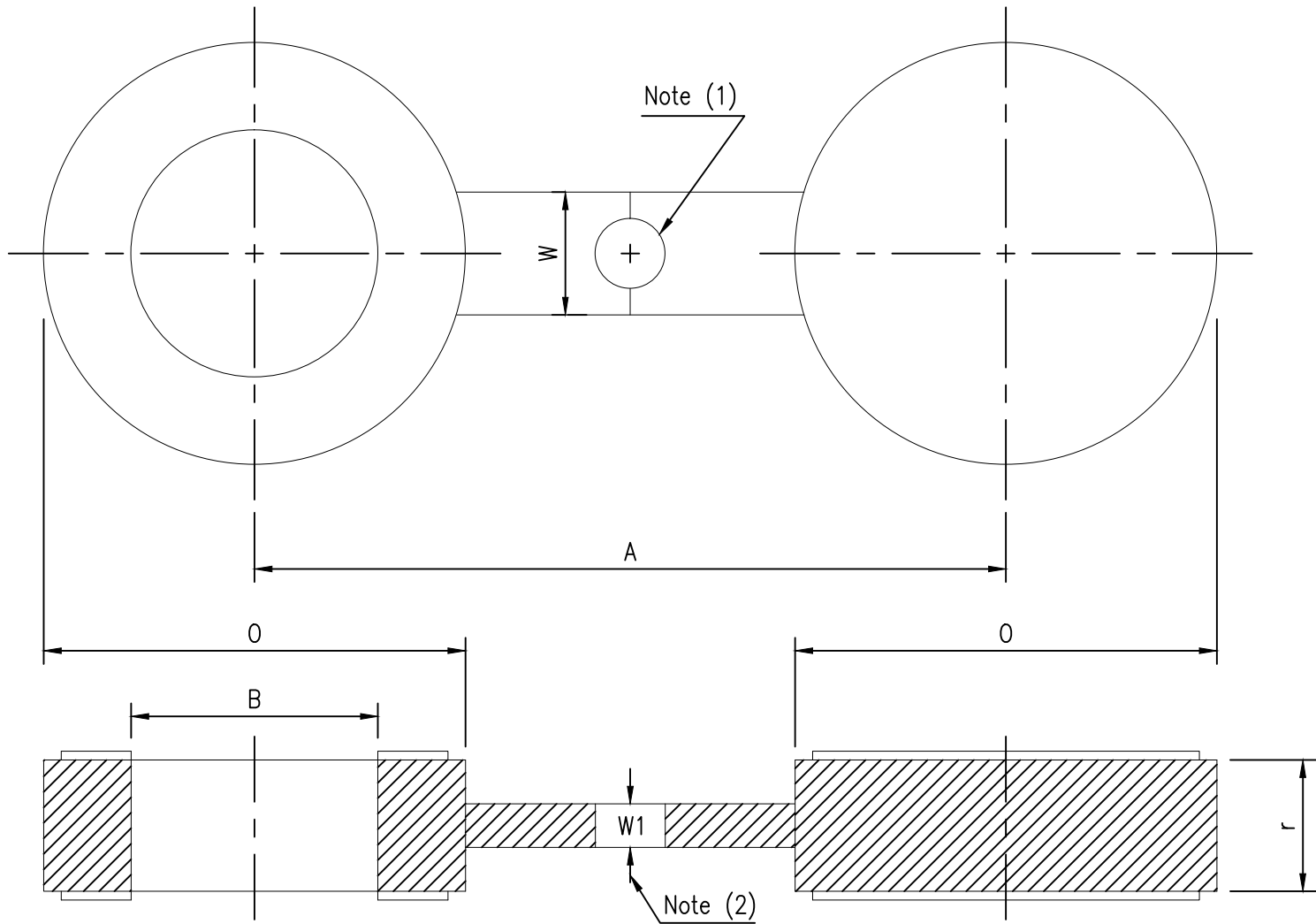


TABLE-4 DIMENSIONS OF CLASS 600 RAISED FACE FIGURE 8 BLANKS

| NPS | INSIDE<br>DIAMETER<br>B, in. | OUTSIDE<br>DIAMETER<br>O, in. | CENTERLINE<br>DIMENSION<br>A, in. | THICKNESS<br>r, in. | WEB WIDTH<br>W, in. |
|-----|------------------------------|-------------------------------|-----------------------------------|---------------------|---------------------|
| 1/2 | 0.62                         | 2.00                          | 2.62                              | 0.25                | 1.50                |
| 3/4 | 0.82                         | 2.50                          | 3.25                              | 0.25                | 1.50                |
| 1   | 1.05                         | 2.75                          | 3.50                              | 0.25                | 2.25                |
| 1¼  | 1.44                         | 3.12                          | 3.98                              | 0.38                | 2.25                |
| 1½  | 1.68                         | 3.62                          | 4.50                              | 0.38                | 2.62                |
| 2   | 2.16                         | 4.25                          | 5.00                              | 0.38                | 2.25                |
| 2½  | 2.64                         | 5.00                          | 5.88                              | 0.50                | 2.62                |
| 3   | 3.26                         | 5.75                          | 6.62                              | 0.50                | 2.62                |
| 3½  | 3.76                         | 6.25                          | 7.25                              | 0.62                | 3.00                |
| 4   | 4.26                         | 7.50                          | 8.50                              | 0.62                | 3.00                |
| 5   | 5.30                         | 9.38                          | 10.50                             | 0.75                | 3.38                |
| 6   | 6.36                         | 10.38                         | 11.50                             | 0.88                | 3.38                |
| 8   | 8.33                         | 12.50                         | 13.75                             | 1.12                | 3.75                |
| 10  | 10.42                        | 15.62                         | 17.00                             | 1.38                | 4.12                |
| 12  | 12.39                        | 17.88                         | 19.25                             | 1.62                | 4.12                |
| 14  | 13.62                        | 19.25                         | 20.75                             | 1.75                | 4.50                |
| 16  | 16.62                        | 22.12                         | 23.75                             | 2.00                | 4.88                |
| 18  | 17.62                        | 24.00                         | 25.75                             | 2.12                | 5.25                |
| 20  | 19.58                        | 26.75                         | 28.50                             | 2.50                | 5.25                |
| 24  | 23.50                        | 31.00                         | 33.00                             | 2.88                | 6.00                |

NOTES:

- (1) Hole size (where required due to bolt spacing) shall be the same as the flange bolt hole.  
and located such that it will not interfere with bolting between two flanges.
- (2) The thickness of the web (or tie bar) dimension W1 shall be 0.25 in. minimum.

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



M/s. VCS QUALITY SERVICES  
PVT. LTD.

ANCHOR FOR BARE PIPE  
SIZE 2" THRU 24"  
TYPE-G5 (FOR OFFSITE)

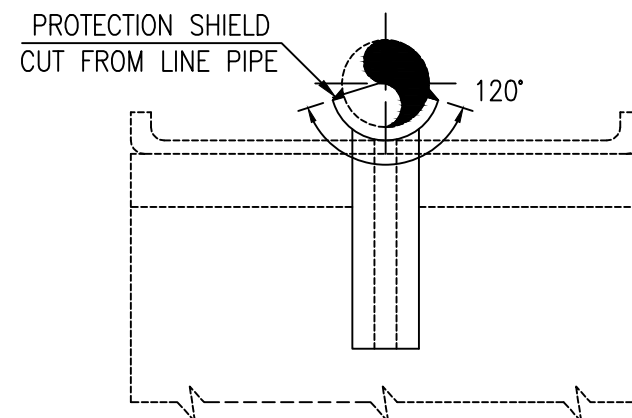
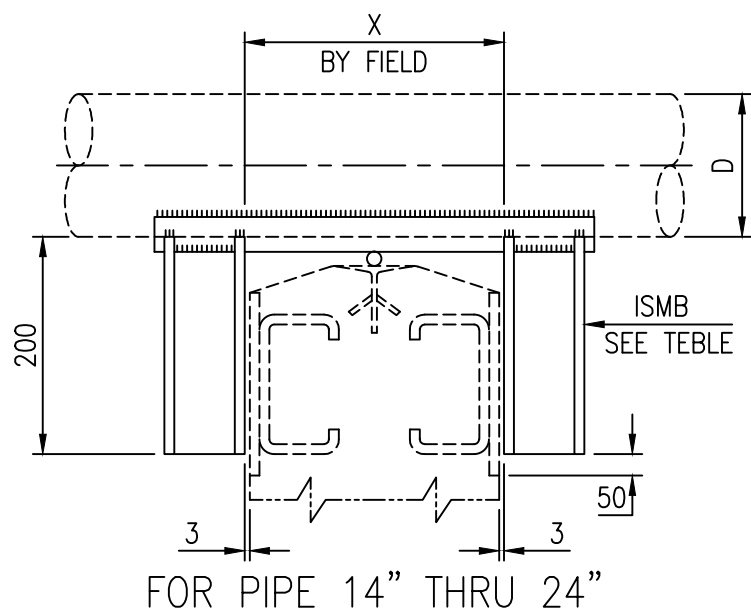
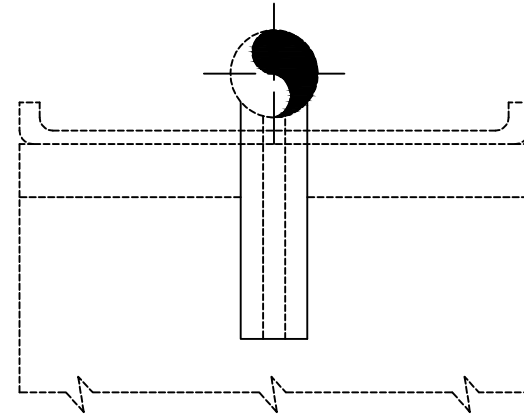
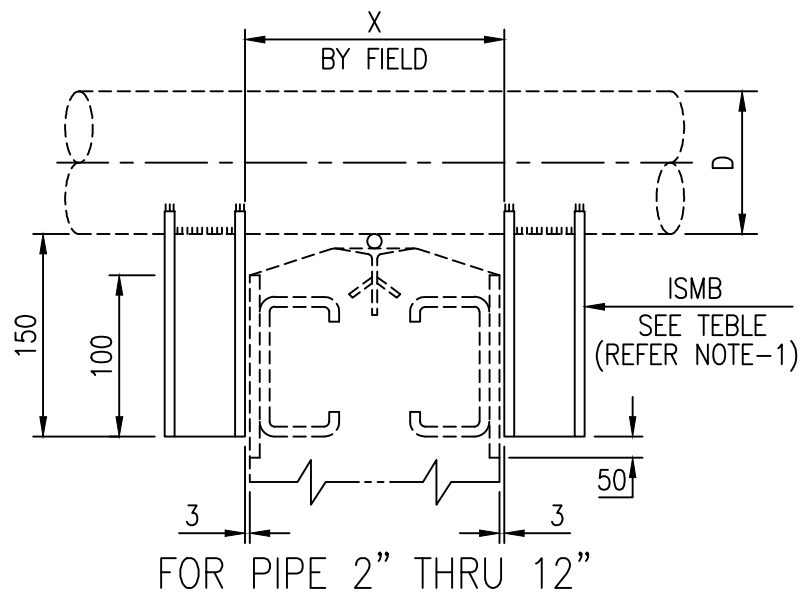
DRAWING NO.

SD-PI-002

SHEET NO.

1 OF 1

| D         | 8   | 10 | 12 | 14 | 16  | 18 | 20 | 24  |
|-----------|-----|----|----|----|-----|----|----|-----|
| I<br>BEAM | 150 |    |    |    | 200 |    |    | 250 |



G4 - D  
NOM. PIPE DIA. IN INCHES  
TYPE

SYMBOL

NOTE:-

- FOR SUPPORTING DETAILS FOR PIPE SIZE 2" THRU 6", REFER STD. 00004-PL-PI-STD-009

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |





M/s. VCS QUALITY SERVICES  
PVT. LTD.

CROSS GUIDE FOR BARE  
PIPE SIZE 2" THRU 24"  
TYPE-G4 ( OFFSITE)

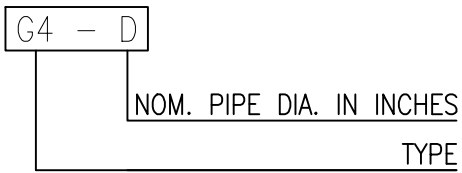
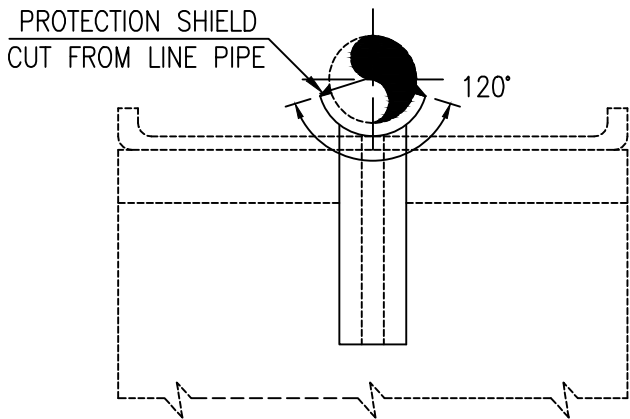
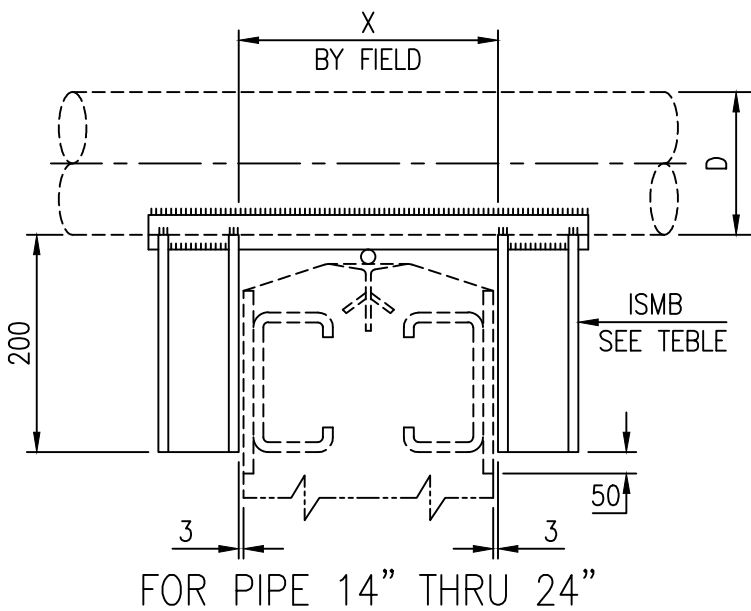
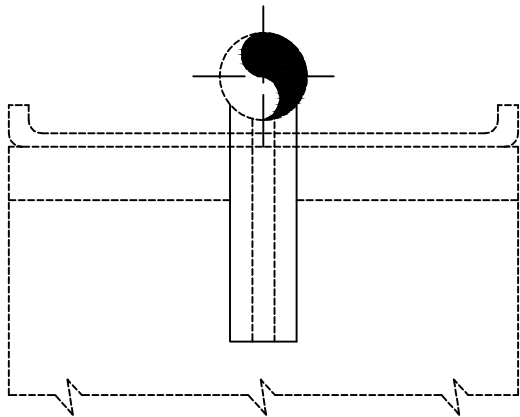
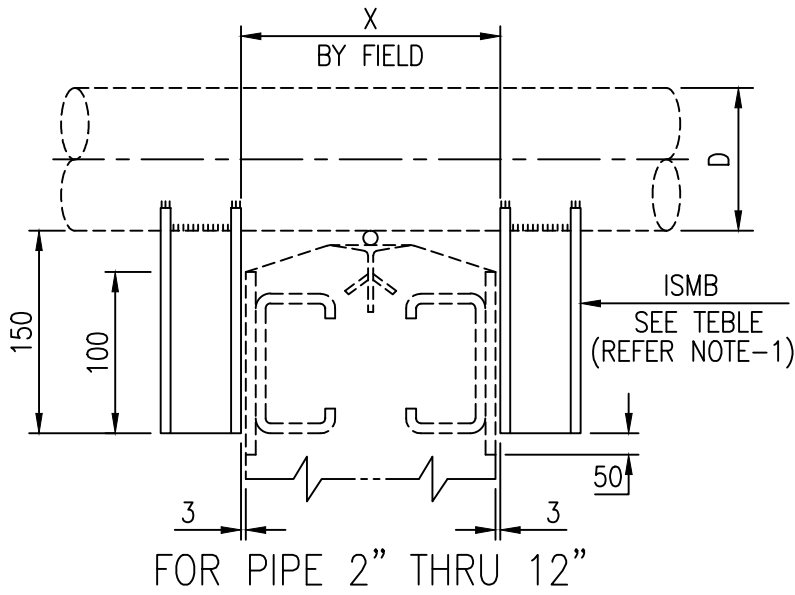
DRAWING NO.

SD-PI-003

SHEET NO.

1 OF 1

| D         | 8   | 10 | 12 | 14 | 16  | 18 | 20 | 24  |
|-----------|-----|----|----|----|-----|----|----|-----|
| I<br>BEAM | 150 |    |    |    | 200 |    |    | 250 |



SYMBOL

NOTE:-

- FOR SUPPORTING DETAILS FOR PIPE SIZE  
2" THRU 6", REFER STD.  
STD.00004-PL-PI-STD-009

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



M/s. VCS QUALITY SERVICES  
PVT. LTD.

CROSS GUIDE FOR BARE  
PIPE SIZE 2" THRU 24"  
TYPE-G3

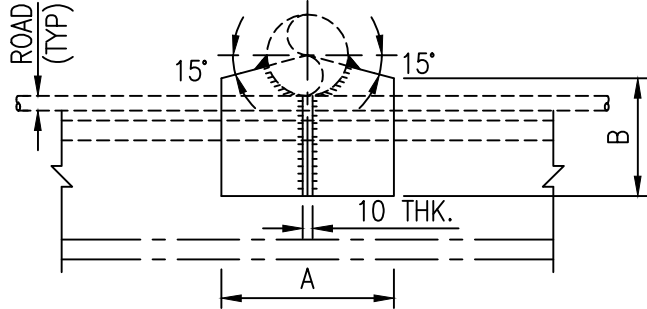
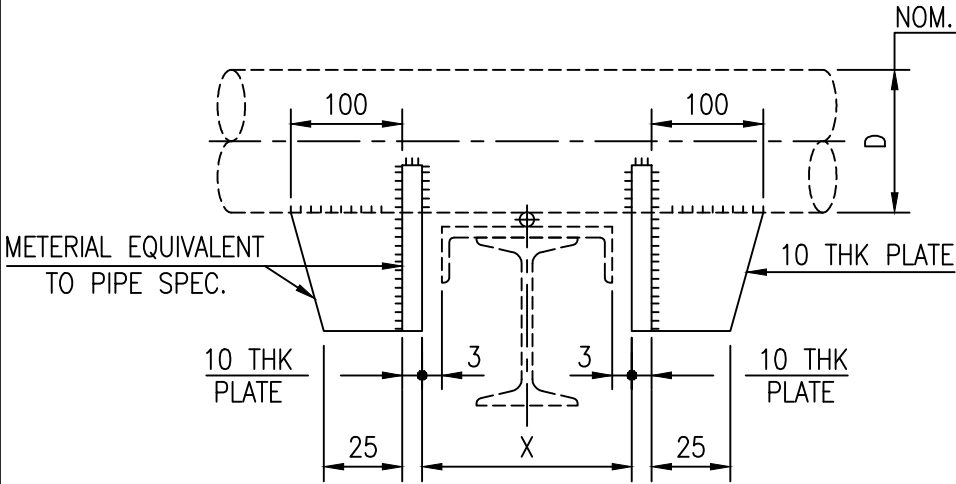
DRAWING NO.

SD-PI-004

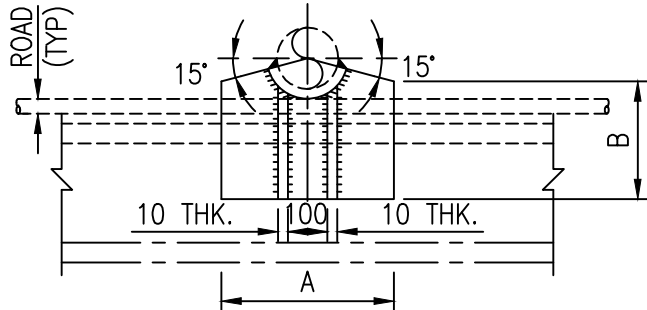
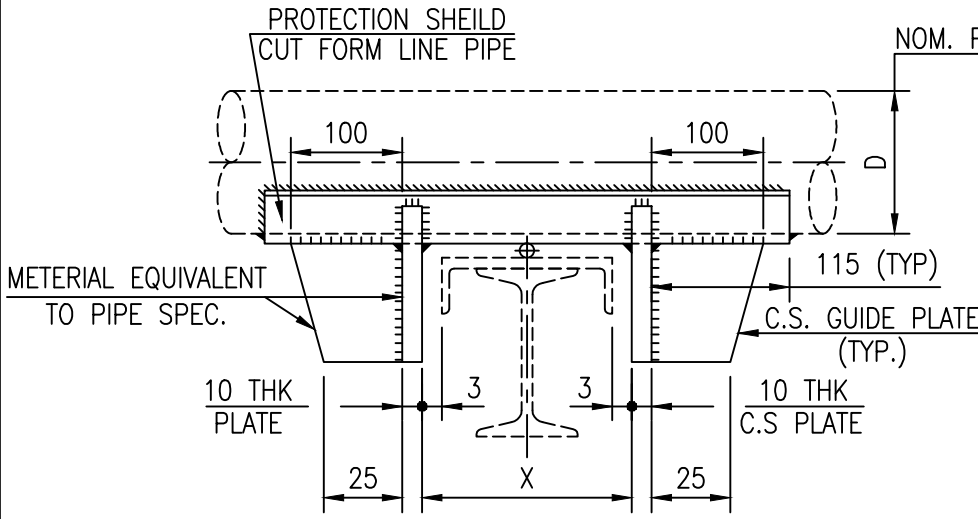
SHEET NO.

1 OF 1

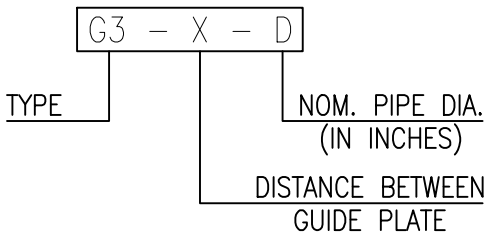
| CROSS GUIDE |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D           | 2"  | 3"  | 4"  | 6"  | 8"  | 10" | 12" | 14" | 16" | 18" | 20" | 22" | 24" |
| A           | 100 | 130 | 154 | 208 | 280 | 314 | 364 | 396 | 446 | 498 | 548 | 598 | 650 |
| B           | 67  | 78  | 86  | 106 | 131 | 145 | 163 | 175 | 193 | 212 | 231 | 248 | 268 |



CROSS GUIDE 2" THRU 12"



CROSS GUIDE 14" THRU 24"



SYMBOL

NOTE:-  
1. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



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PVT. LTD.

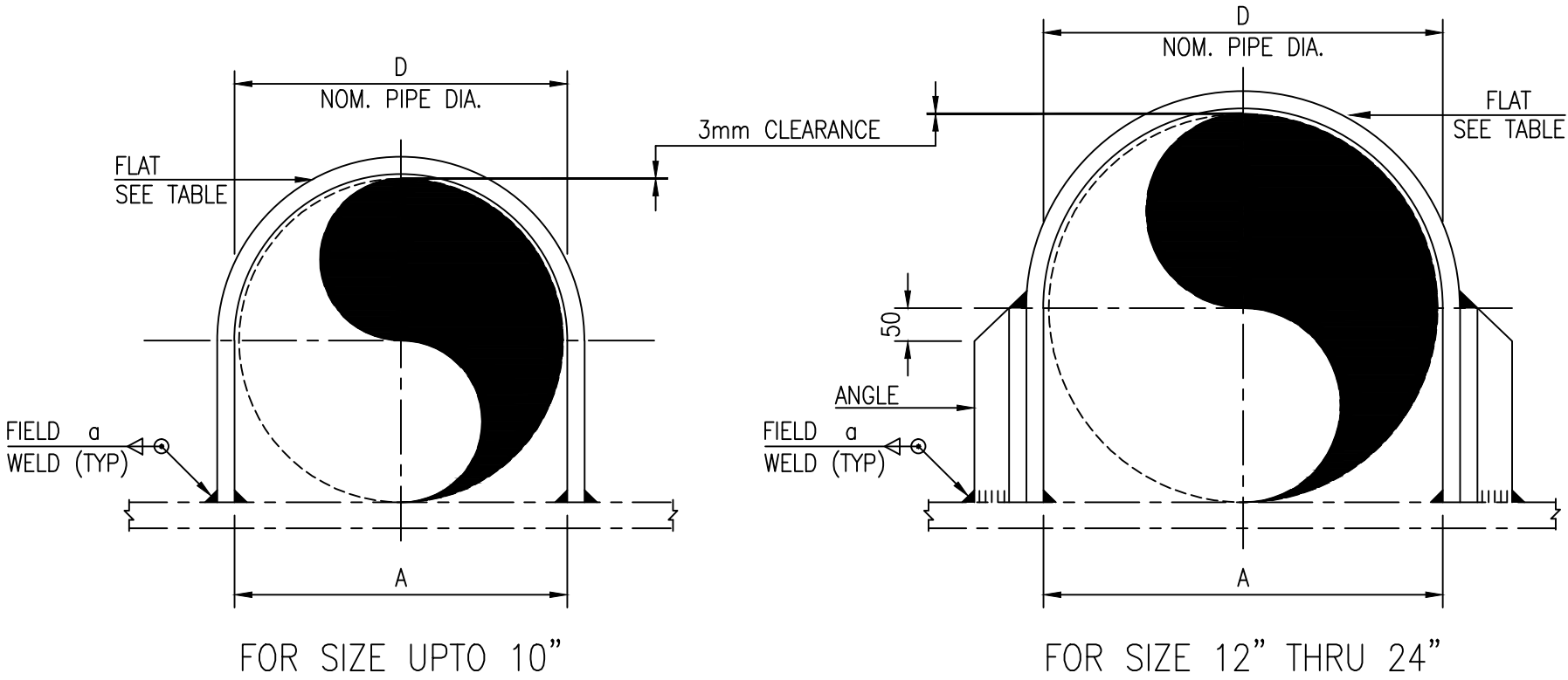
GUIDE SUPPORT FOR BARE PIPE  
SIZE 1/2" THRU 24" TYPE-G1

DRAWING NO.

SD-PI-005

SHEET NO.

1 OF 1



| D      | A   | a  | FLAT SIZE | ANGLE SIZE |
|--------|-----|----|-----------|------------|
| 1/2"   | 26  | 6  | 40 x 6    | -          |
| 3/4"   | 33  |    |           |            |
| 1"     | 40  |    |           |            |
| 1 1/4" | 48  |    |           |            |
| 1 1/2" | 55  |    |           |            |
| 2"     | 65  |    |           |            |
| 2 1/2" | 80  |    |           |            |
| 3"     | 95  | 10 | 50 x 10   | -          |
| 3 1/2" | 107 |    |           |            |
| 4"     | 120 |    |           |            |
| 5"     | 146 |    |           |            |
| 6"     | 174 |    |           |            |
| 8"     | 225 | 10 | 65 x 12   | 75x75x10   |
| 10"    | 278 |    |           |            |
| 12"    | 328 |    |           |            |
| 14"    | 362 | 10 | 75 x 12   | 90x90x10   |
| 16"    | 412 |    |           |            |
| 18"    | 463 |    |           |            |
| 20"    | 515 |    |           |            |
| 24"    | 616 |    |           |            |

G1 - D  
TYPE                      NOM. PIPE DIA. (INCH)  
SYMBOL

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |





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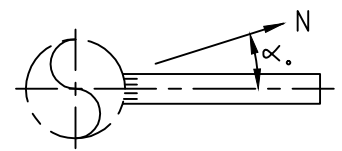
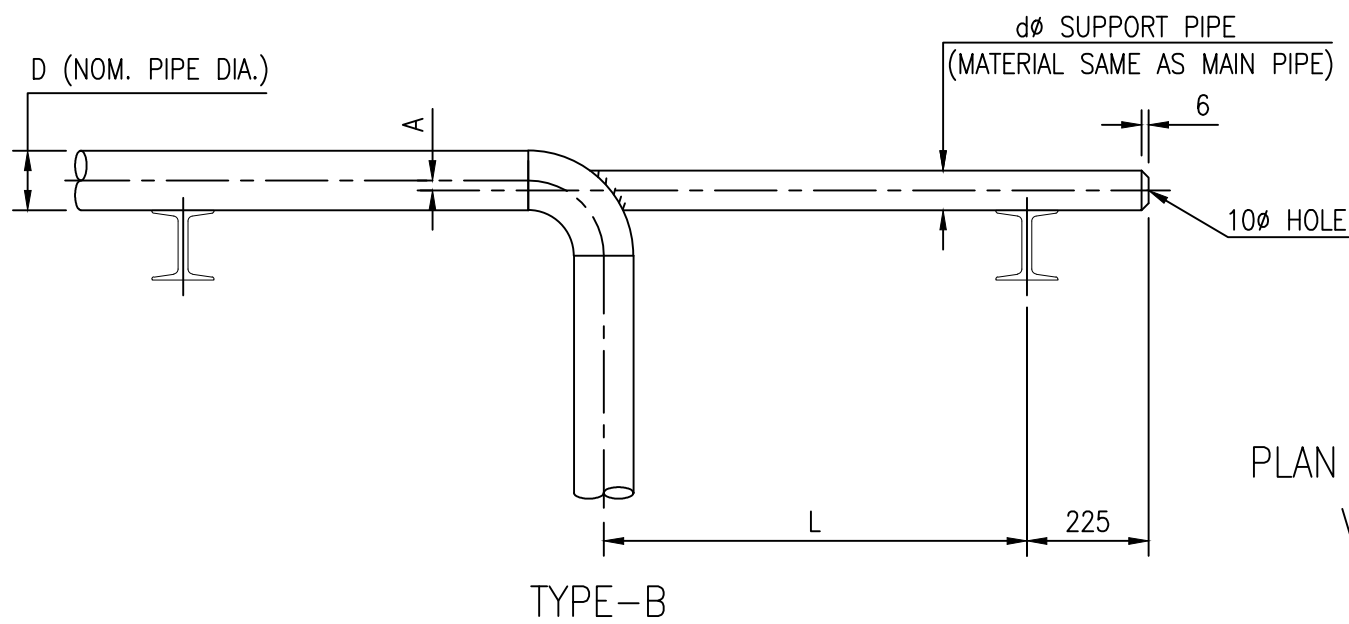
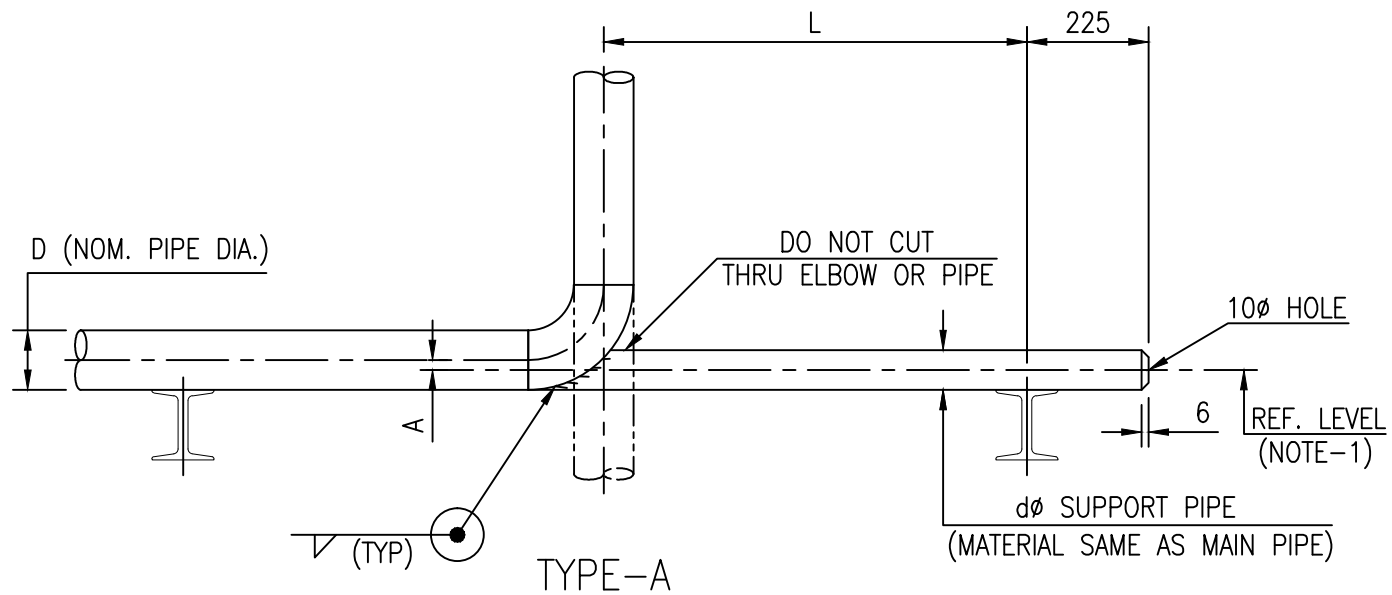
DUMMY PIPE SUPPORT FOR  
BARE PIPE SIZE 2" THRU 24"  
TYPE-B-39

DRAWING NO.

SD-PI-006

SHEET NO.

1 OF 1

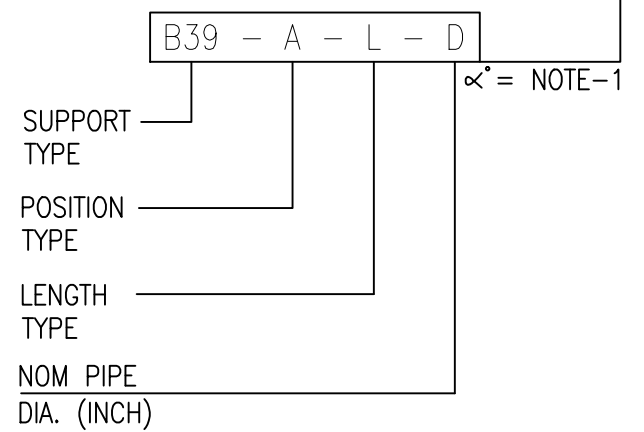


PLAN FOR SUPPORT ON  
VERTICAL PIPE

| FOR L, 1500 OR LESS |               |     |
|---------------------|---------------|-----|
| D                   | d<br>(NOTE 2) | A   |
| 2"                  | 2"-SCH.40     | -   |
| 3"                  | 2"-SCH.40     | 15  |
| 4"                  | 3"-SCH.40     | 13  |
| 6"                  | 3"-SCH.40     | 40  |
| 8"                  | 4"-SCH.40     | 52  |
| 10"                 | 6"-SCH.40     | 52  |
| 12"                 | 6"-SCH.40     | 78  |
| 14"                 | 8"-SCH.40     | 68  |
| 16"                 | 8"-SCH.40     | 94  |
| 18"                 | 8"-SCH.40     | 119 |
| 20"                 | 10"-SCH.40    | 118 |
| 24"                 | 10"-SCH.40    | 168 |

| FOR L, OVER 1500 |               |     |
|------------------|---------------|-----|
| D                | d<br>(NOTE 2) | A   |
| 2"               | 2"-SCH.40     | -   |
| 3"               | 2"-SCH.40     | 15  |
| 4"               | 3"-SCH.40     | 13  |
| 6"               | 4"-SCH.40     | 27  |
| 8"               | 6"-SCH.40     | 25  |
| 10"              | 8"-SCH.40     | 27  |
| 12"              | 8"-SCH.40     | 52  |
| 14"              | 10"-SCH.40    | 41  |
| 16"              | 10"-SCH.40    | 67  |
| 18"              | 10"-SCH.40    | 92  |
| 20"              | 12"-SCH.40    | 92  |
| 24"              | 12"-SCH.40    | 143 |

REFER LEVEL  
(NOTE-1)



SYMBOL

NOTES:-

1. REF. LEVEL &  $\alpha^\circ$  TO BE GIVEN IN CASE SUPPORT IS WELDED TO VERTICAL PIPE.
2. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



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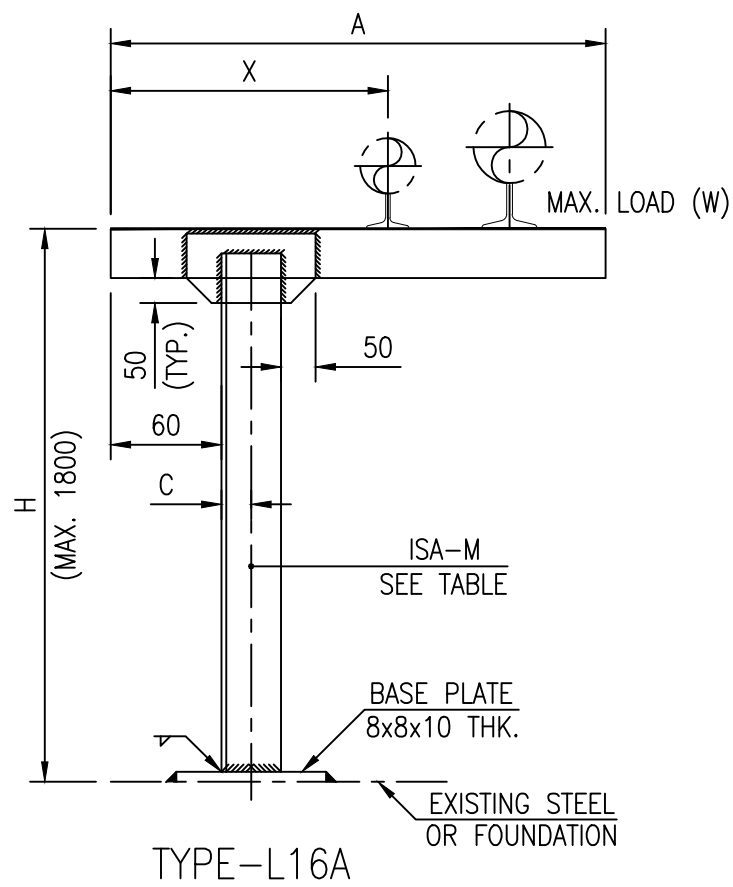
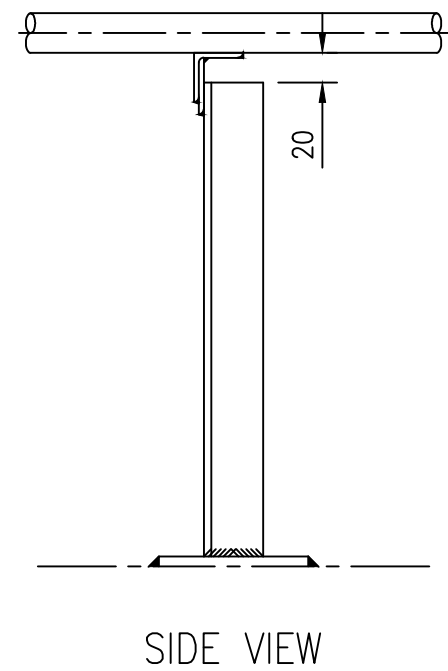
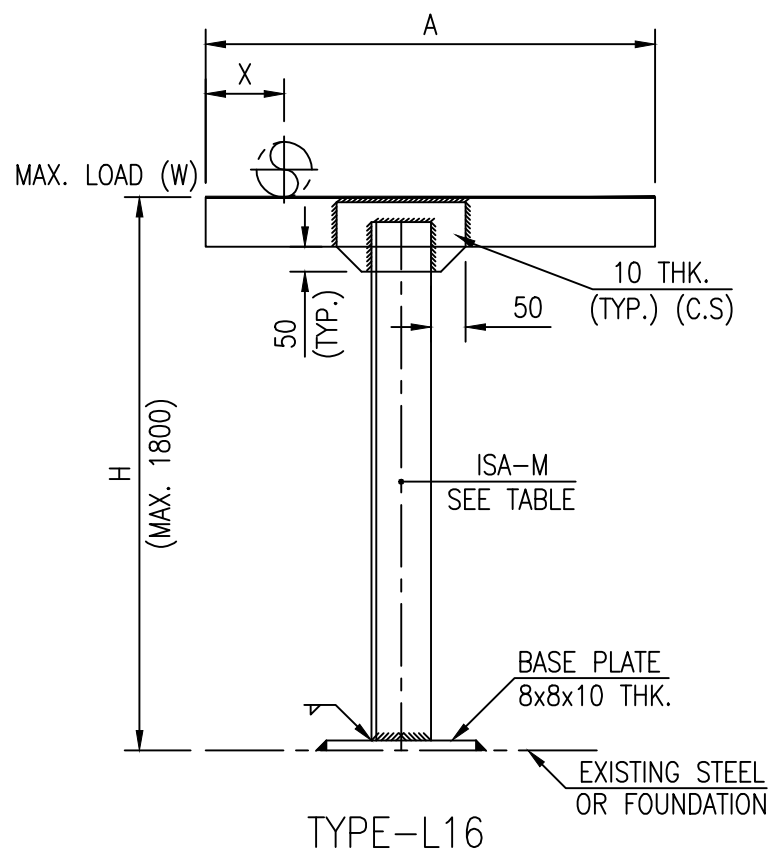
LOW SUPPORT STANCHION  
TYPE-L16 AND L-16A

DRAWING NO.

SD-PI-007

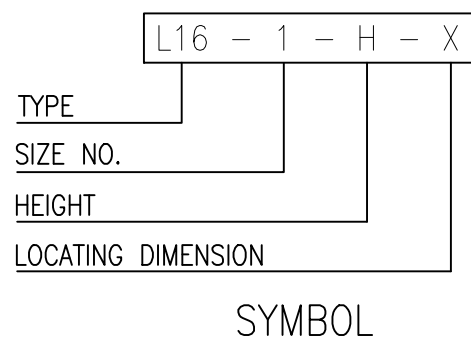
SHEET NO.

1 OF 1



NOTE:-

1. DO NOT USE FOR ANCHORING THE PIPE.



| SIZE NO. | MAX. LOAD (W) Kg. | M              | A   | B   | C  |
|----------|-------------------|----------------|-----|-----|----|
| 1        | 500               | ISA 80x80x8    | 600 | 150 | 45 |
| 2        | 800               | ISA 100x100x10 | 700 | 150 | 60 |
| 3        | 1500              | ISA 130x130x12 | 800 | 150 | 80 |

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



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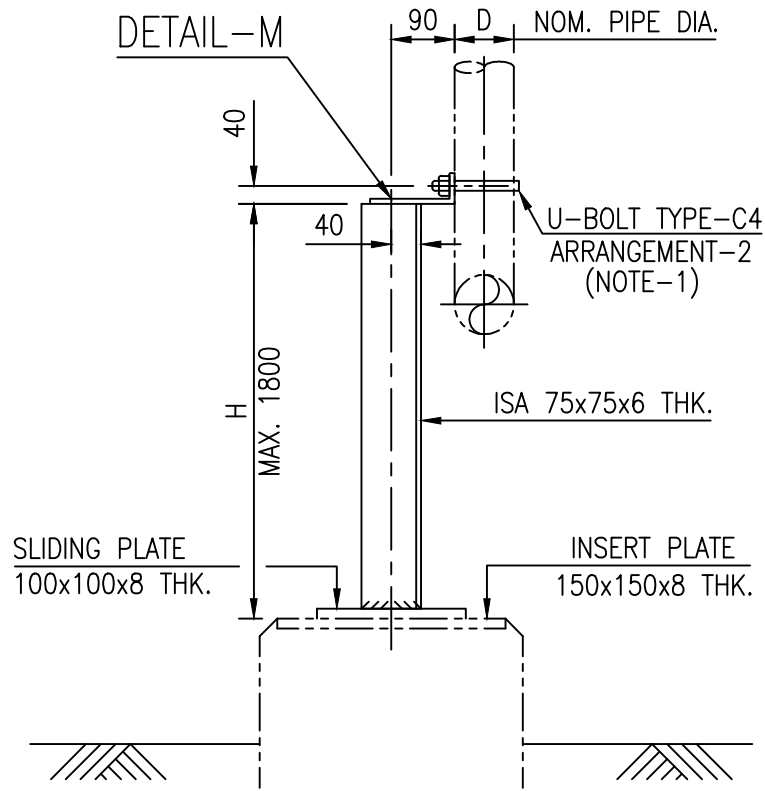
LOW SUPPORT SLIDING AND  
FIXED FOR PIPE SIZE 3/4"  
THRU 1 1/2" TYPE L-15

DRAWING NO.

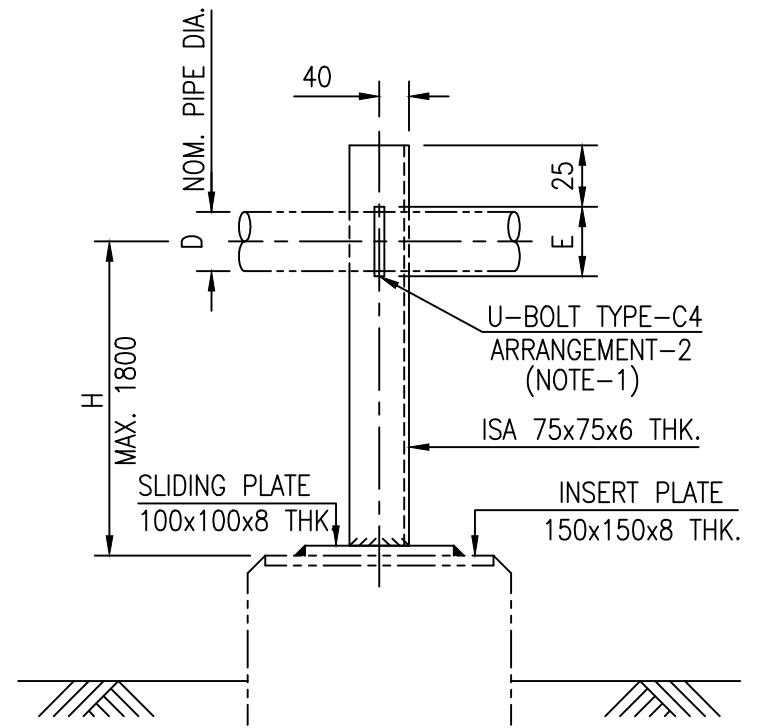
SD-PI-008

SHEET NO.

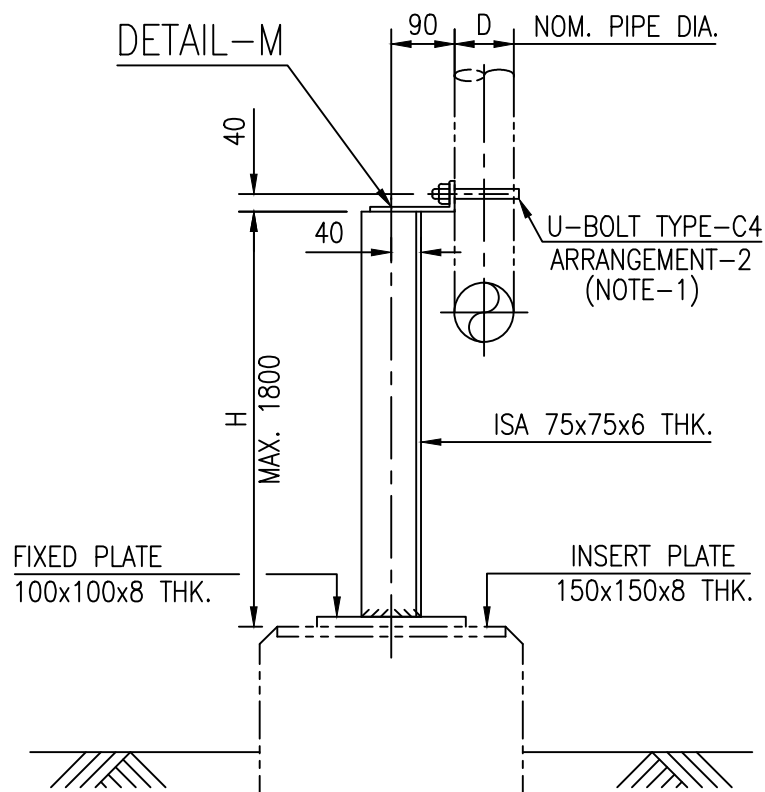
1 OF 1



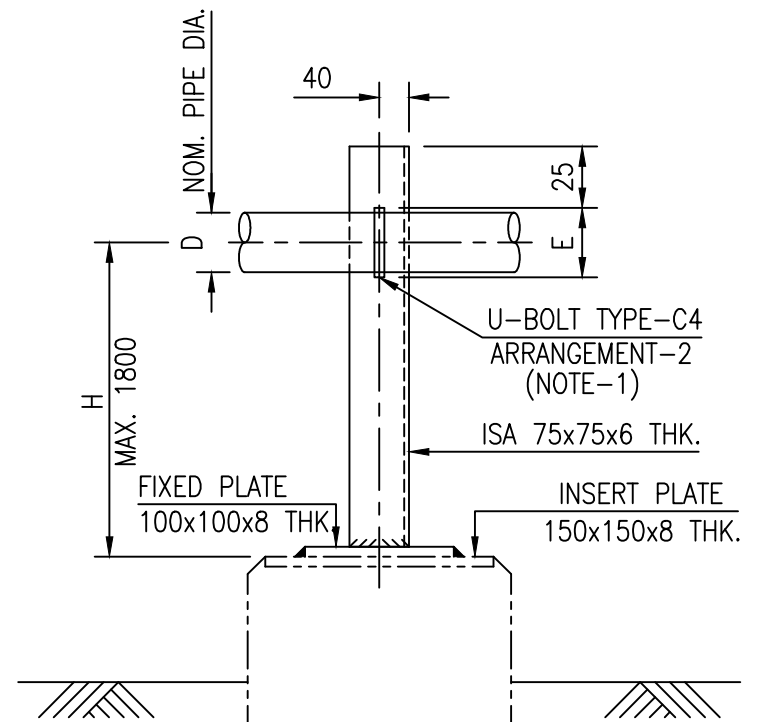
ARRANGEMENT TYPE-1  
(SLIDING)



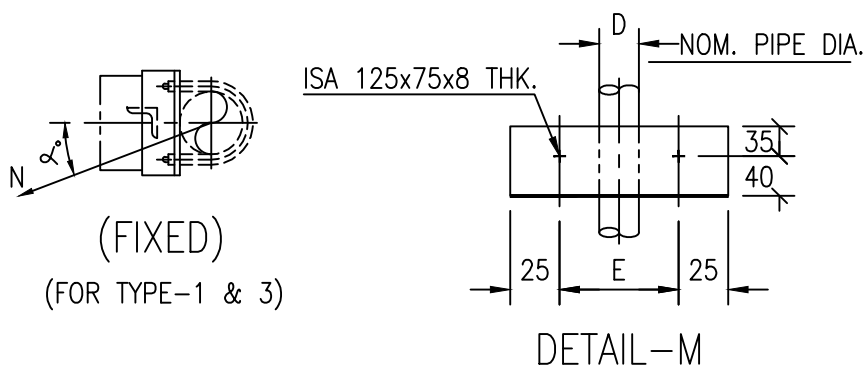
ARRANGEMENT TYPE-2  
(SLIDING)



ARRANGEMENT TYPE-3  
(FIXED)



ARRANGEMENT TYPE-4  
(FIXED)



(FIXED)

(FOR TYPE-1 & 3)

DETAIL-M

| D      | E  |
|--------|----|
| 3/4"   | 36 |
| 1"     | 45 |
| 1 1/2" | 60 |

$\alpha^\circ =$  (FOR TYPE 1 & 3)

TYPE  
ARRANGEMENT TYPE  
HEIGHT  
NOM. PIPE DIA. (INCH)

L15 - 1 - H - D

SYMBOL

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



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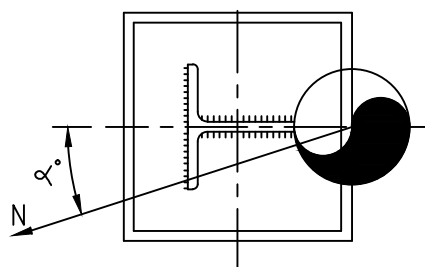
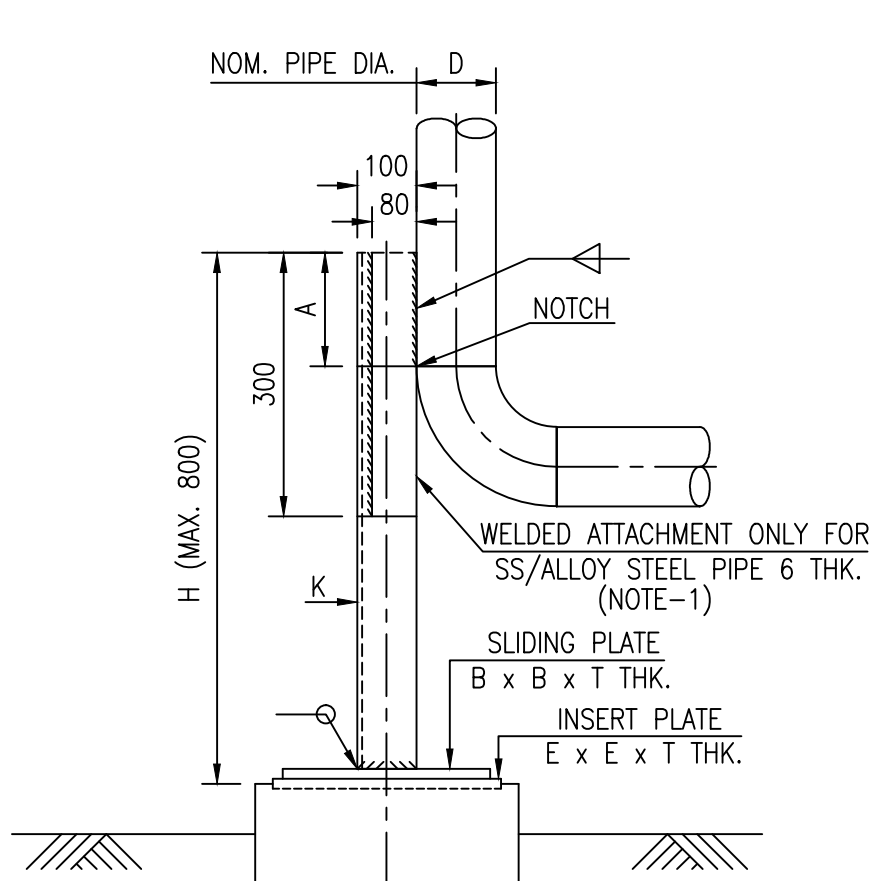
LOW SUPPORT SLIDING FOR  
BARE & INSULATED PIPE  
SIZE 2" THRU 24" TYPE-L6

DRAWING NO.

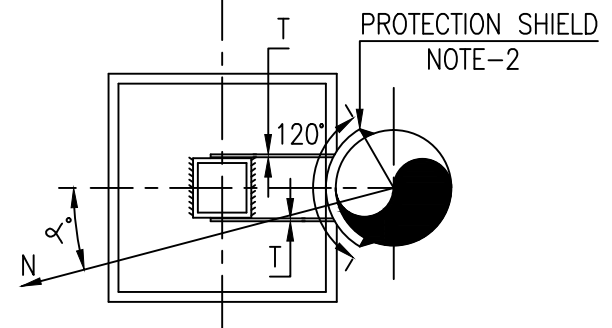
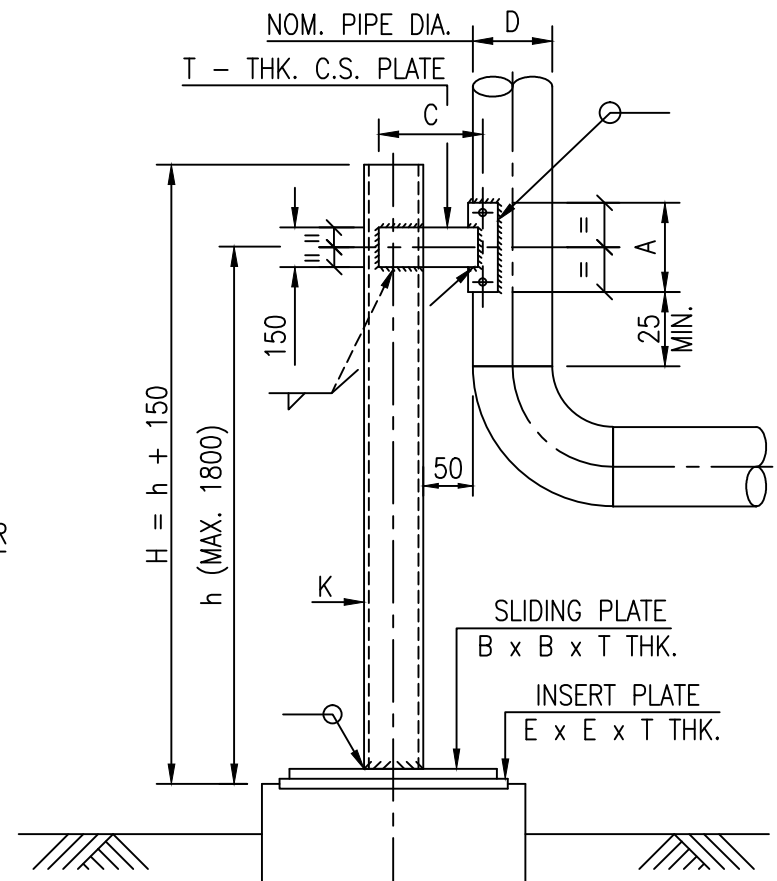
SD-PI-009

SHEET NO.

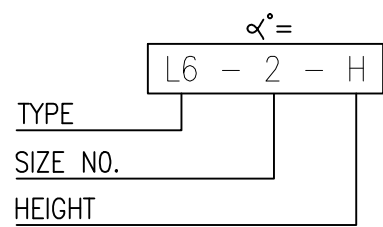
1 OF 1



FOR PIPE SIZES 2" THRU 4"



FOR PIPE SIZES 6" THRU 24"



SYMBOL

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD IS TO BE CUT FROM LINE PIPE.

| SIZE NO. | D          | K                 | A   | T  | C   | E   | B   |
|----------|------------|-------------------|-----|----|-----|-----|-----|
| 1        | 2" TO 4"   | CUT FROM ISMB 200 | 200 | 10 | -   | 250 | 150 |
| 2        | 6" TO 10"  | ISMC-125 2 NOS.   | 200 | 12 | 150 | 300 | 200 |
| 3        | 12" TO 24" | ISMC-225 2 NOS.   | 300 | 12 | 230 | 400 | 300 |

FOR TEMP. UP TO 400 °C ONLY

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



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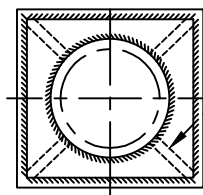
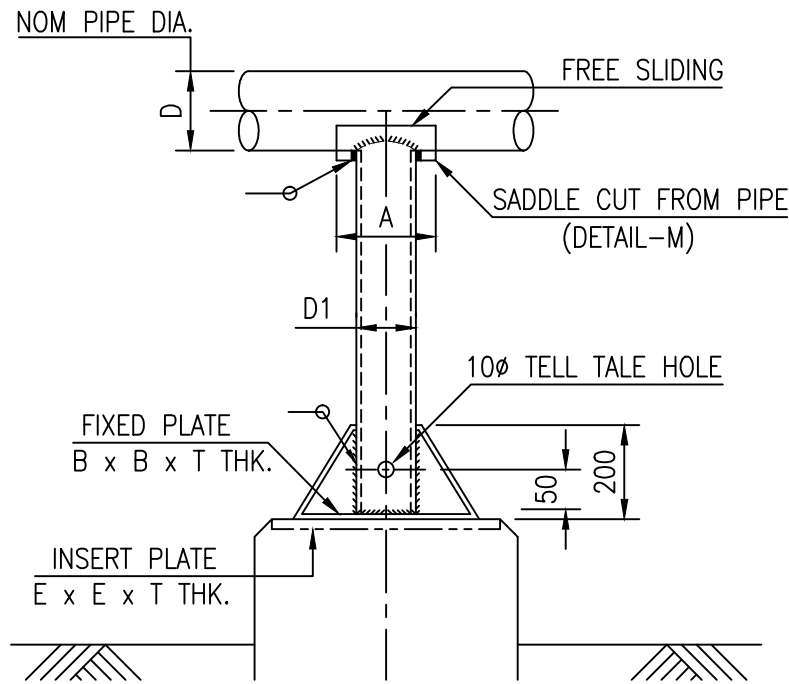
LOW SUPPORT SLIDING FOR BARE  
PIPE SIZE 3/4" THRU 36"  
TYPE-L5 & L5A

DRAWING NO.

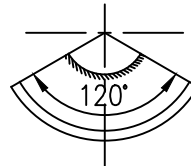
SD-PI-010

SHEET NO.

1 OF 1



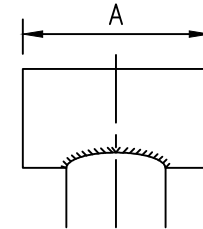
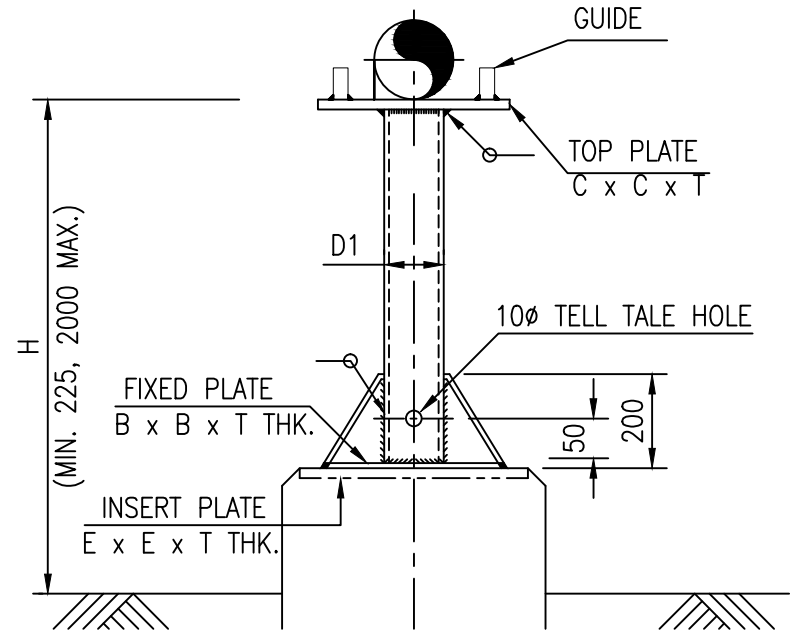
10 THK. PLATE TO BE  
WELDED WHEN H EXCEEDS 1000



DETAIL-M

TYPE  
SIZE NO.  
HEIGHT

SYMBOL



TYPE  
SIZE NO.  
HEIGHT

SYMBOL

| SIZE NO. | D      | A                | D1 (NOTE-1)          | C   | B   | E   | T  |
|----------|--------|------------------|----------------------|-----|-----|-----|----|
| 1        | 3/4"   | 2" NB x 100 Lg.  | 2" HEAVY<br>IS :1239 | 150 | 150 | 200 | 12 |
|          | 1"     |                  |                      | 200 |     |     |    |
|          | 1.1/2" | 3" NB x 100 Lg.  |                      |     |     |     |    |
|          | 2"     |                  |                      |     |     |     |    |
| 2        | 3"     | 6" NB x 150 Lg.  | 2" HEAVY<br>IS :1239 | 200 | 150 | 200 | 12 |
|          | 4"     |                  |                      |     |     |     |    |
| 3        | 6"     | 10" NB x 250 Lg. | 3" HEAVY<br>IS :1239 | 300 | 200 | 250 | 16 |
|          | 8"     |                  |                      |     |     |     |    |
| 4        | 10"    | 14" NB x 350 Lg. | 4" HEAVY<br>IS :1239 | 350 | 200 | 250 | 16 |
|          | 12"    |                  |                      |     |     |     |    |
| 5        | 14"    | 18" NB x 350 Lg. | 6" HEAVY<br>IS :1239 | 400 | 250 | 300 | 20 |
|          | 16"    |                  |                      |     |     |     |    |
| 6        | 18"    | 20" NB x 350 Lg. | 8" SCH. 40           | 400 | 300 | 350 | 20 |
| 7        | 20"    | 24" NB x 350 Lg. | 10" SCH. 40          | 450 | 350 | 400 | 20 |
|          | 24"    |                  |                      |     |     |     |    |
| 8        | 26"    | 30" NB x 350 Lg. | 12" SCH. 40          | 550 | 400 | 500 | 20 |
|          | 30"    |                  |                      |     |     |     |    |
|          | 36"    | 36" NB x 400 Lg. |                      |     |     |     |    |

NOTES:-

1. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (D) LISTED IN THE TABLE IS NOT AVAILABLE, USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. MATERIAL FOR SUPPORT PIPE & PLATE SHALL BE CARBON STEEL.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



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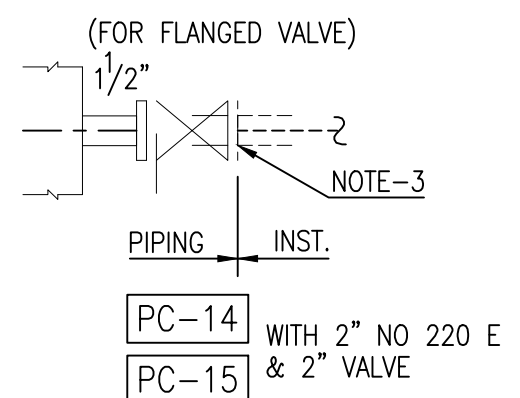
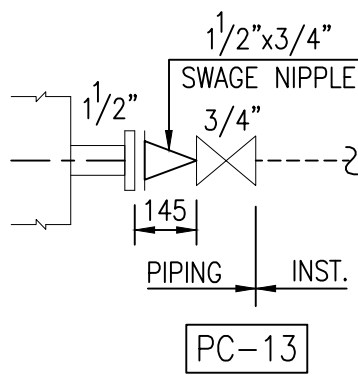
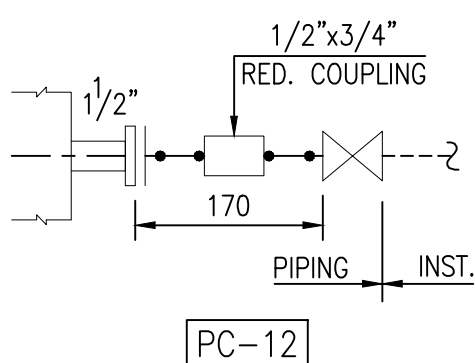
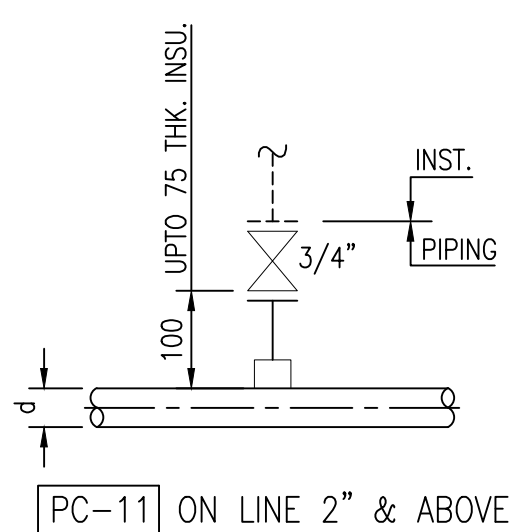
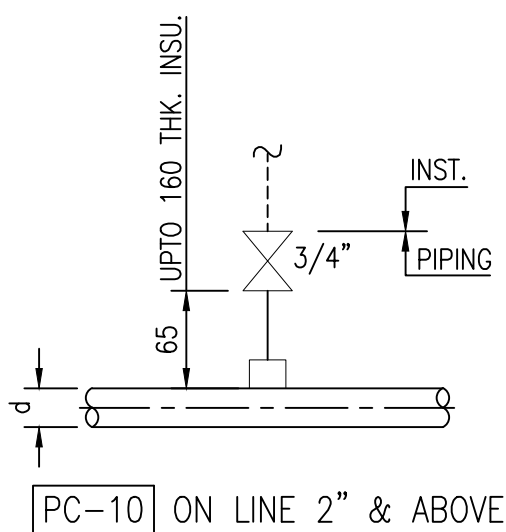
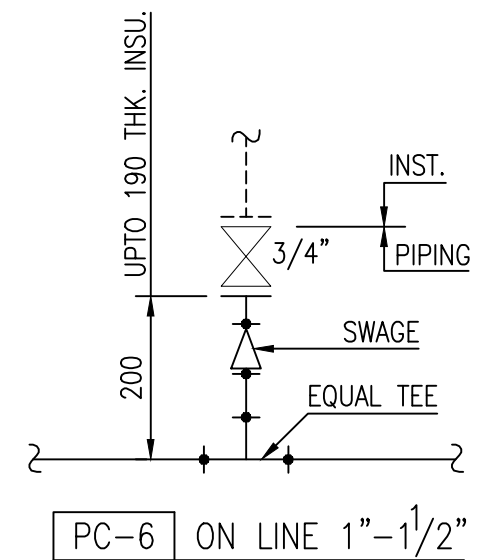
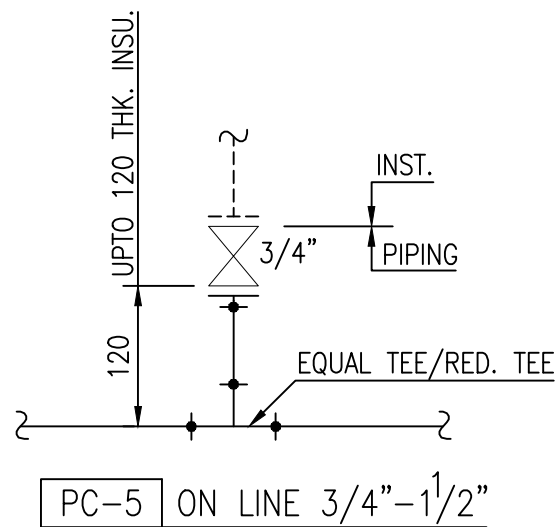
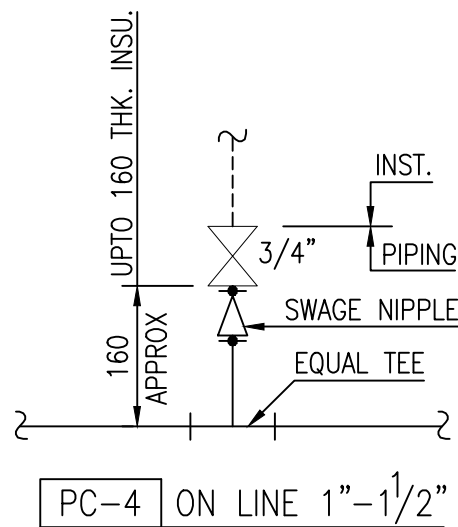
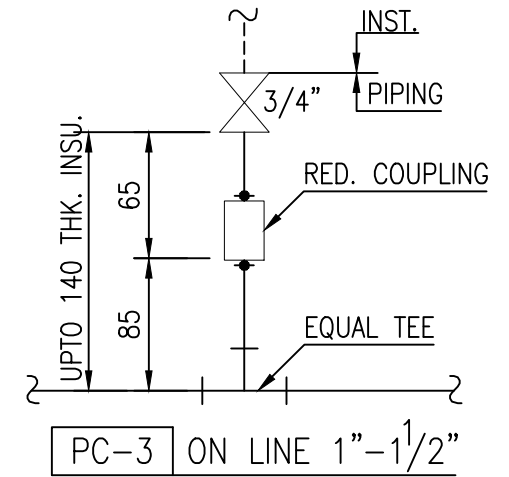
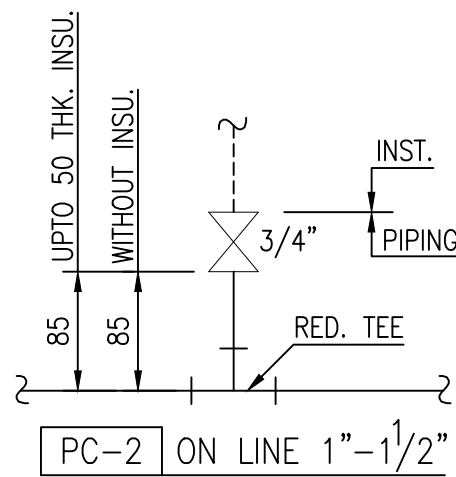
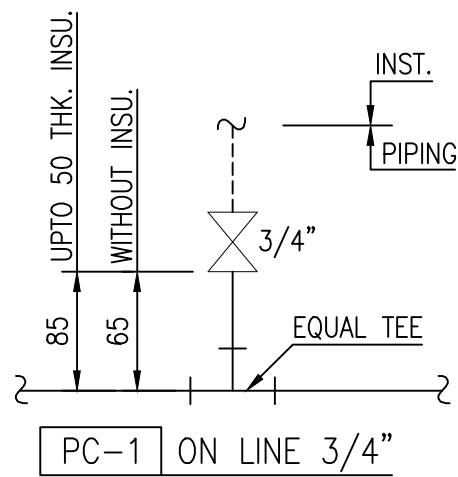
PRESSURE TAPPINGS  
(PA, PG, PC, PT, PIC ETC.)

DRAWING NO.

SD-PI-011

SHEET NO.

1 OF 1



NOTES:-

1. THE INDICATED DIMENSIONS ARE MINIMUM WHICH ALSO COVER INSULATION TO THE EXTENT SHOWN ABOVE IN HIGHER THICKNESS OF INSULATION THAN INDICATED, THE DIFFERENCE SHALL BE ADDED IN THE DIMENSIONS SHOWN ABOVE ACCORDINGLY.
2. PRESSURE TAPPING SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLGD. SW. OR SCR'D) WITH TEE (EQ. OR RED.) HALF COUPLING (.W. OR SCR'D) OR STUB-IN AS PER PIPING SPECIFICATION.
3. IN CASE OF FLGD. VALVES BOLTING & GASKET ON BOTH SIDES OF VALVE SHALL BE IN PIPING SCOPE.
4. IN CASE OF TAPPING PROVIDED OTHER THAN INDICATED IN THIS STD FOR LAYOUT REASONS DETAILED DIMENSIONS WILL BE CALLED FOR OR CARRIED OUT.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |





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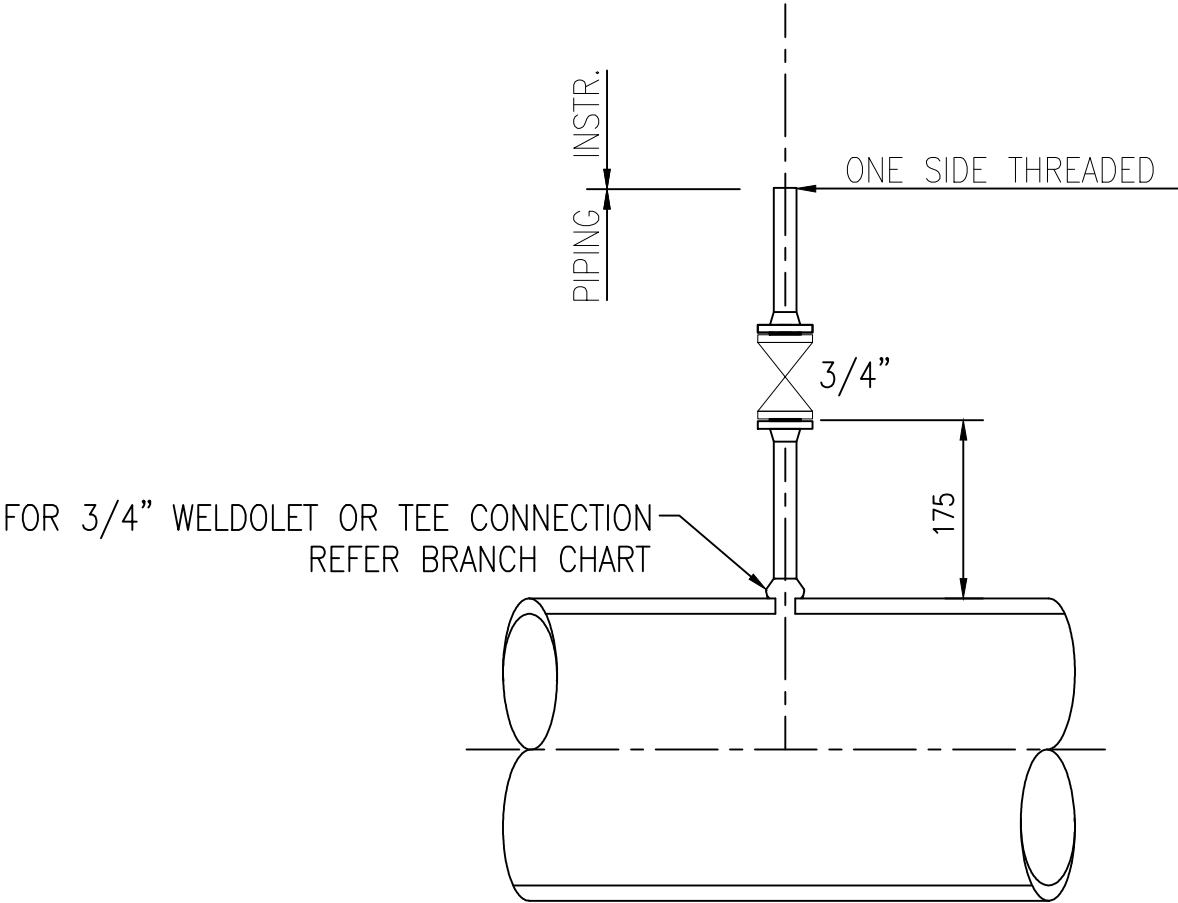
DETAIL OF PRESSURE  
CONNECTIONS ABOVE GROUND  
PIPE

DRAWING NO.

SD-PI-012

SHEET NO.

1 OF 1



|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



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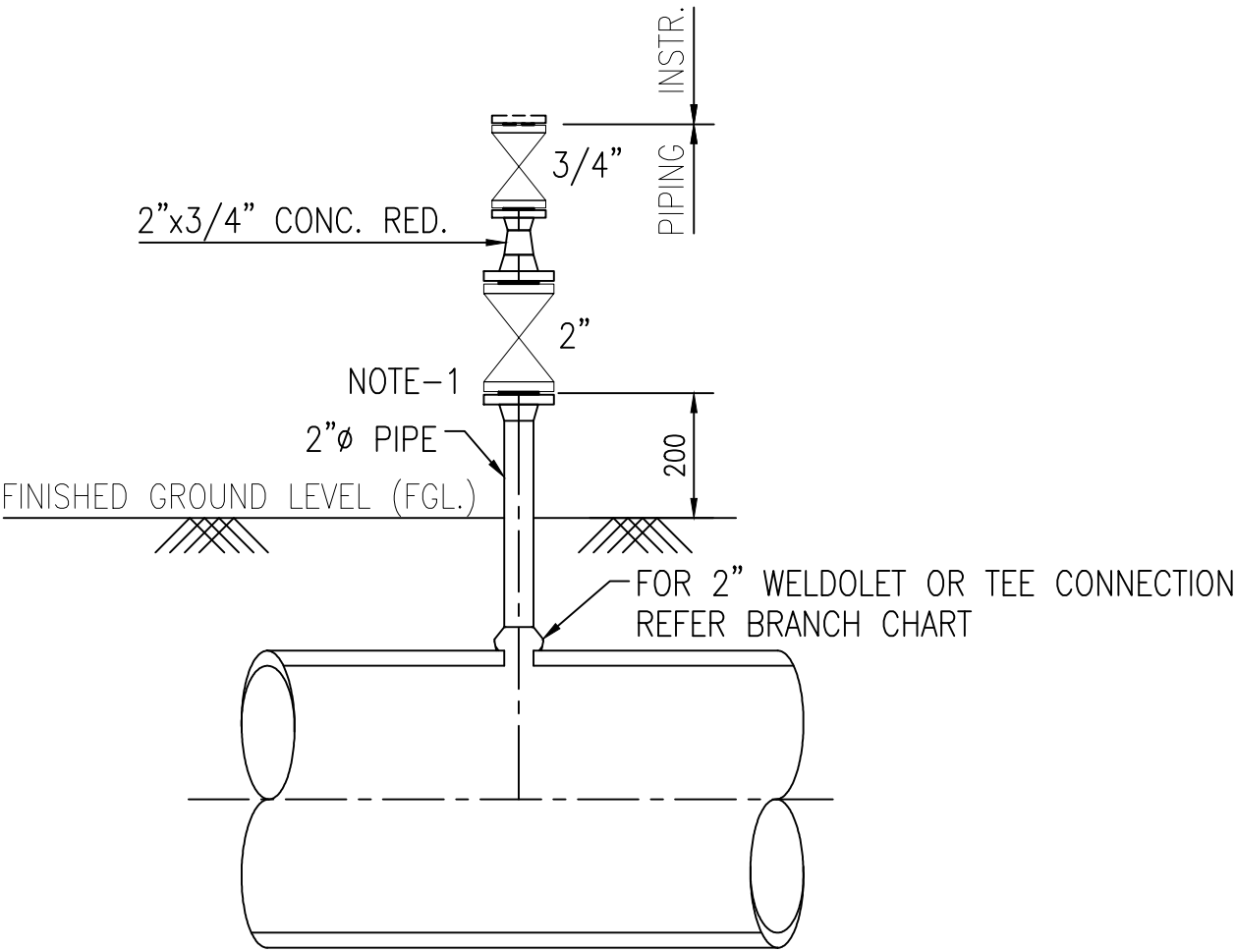
DETAIL OF PRESSURE CONNECTIONS  
UNDER GROUND PIPE

DRAWING NO.

SD-PI-013

SHEET NO.

1 OF 1



NOTE:  
1 INSULATION GASKET SHALL BE INSTALLED.

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |





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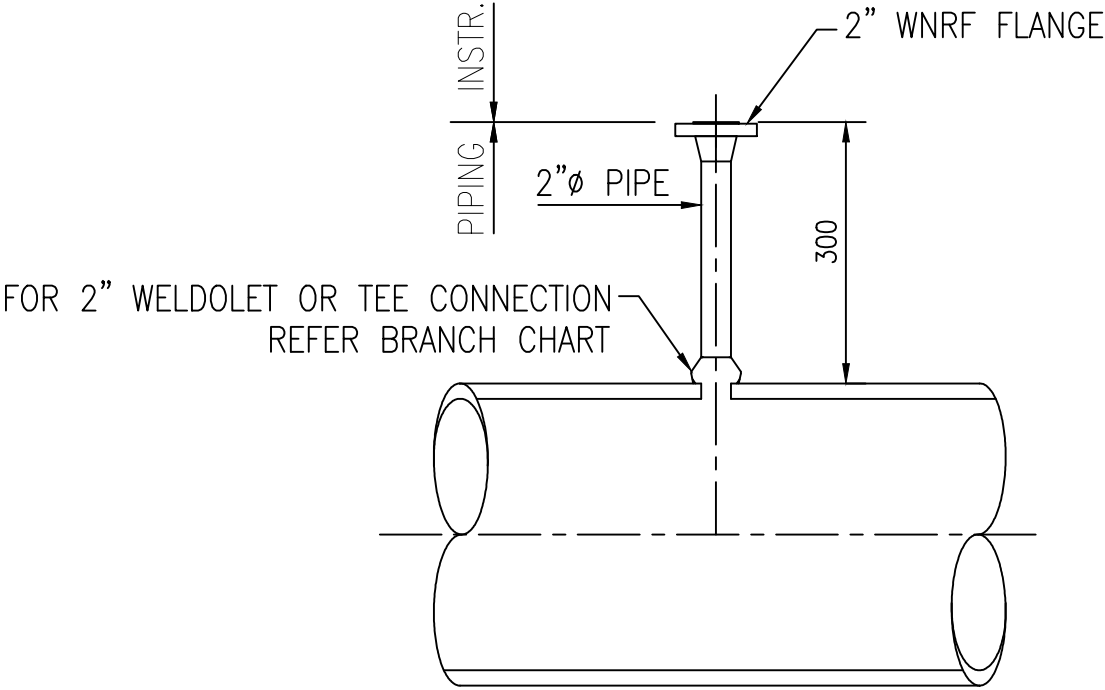
DETAIL OF TEMPERATURE CONNECTIONS  
ABOVE GROUND PIPE

DRAWING NO.

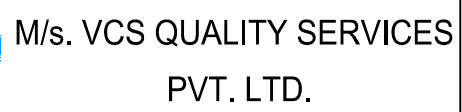
SD-PI-014

SHEET NO.

1 OF 1



|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



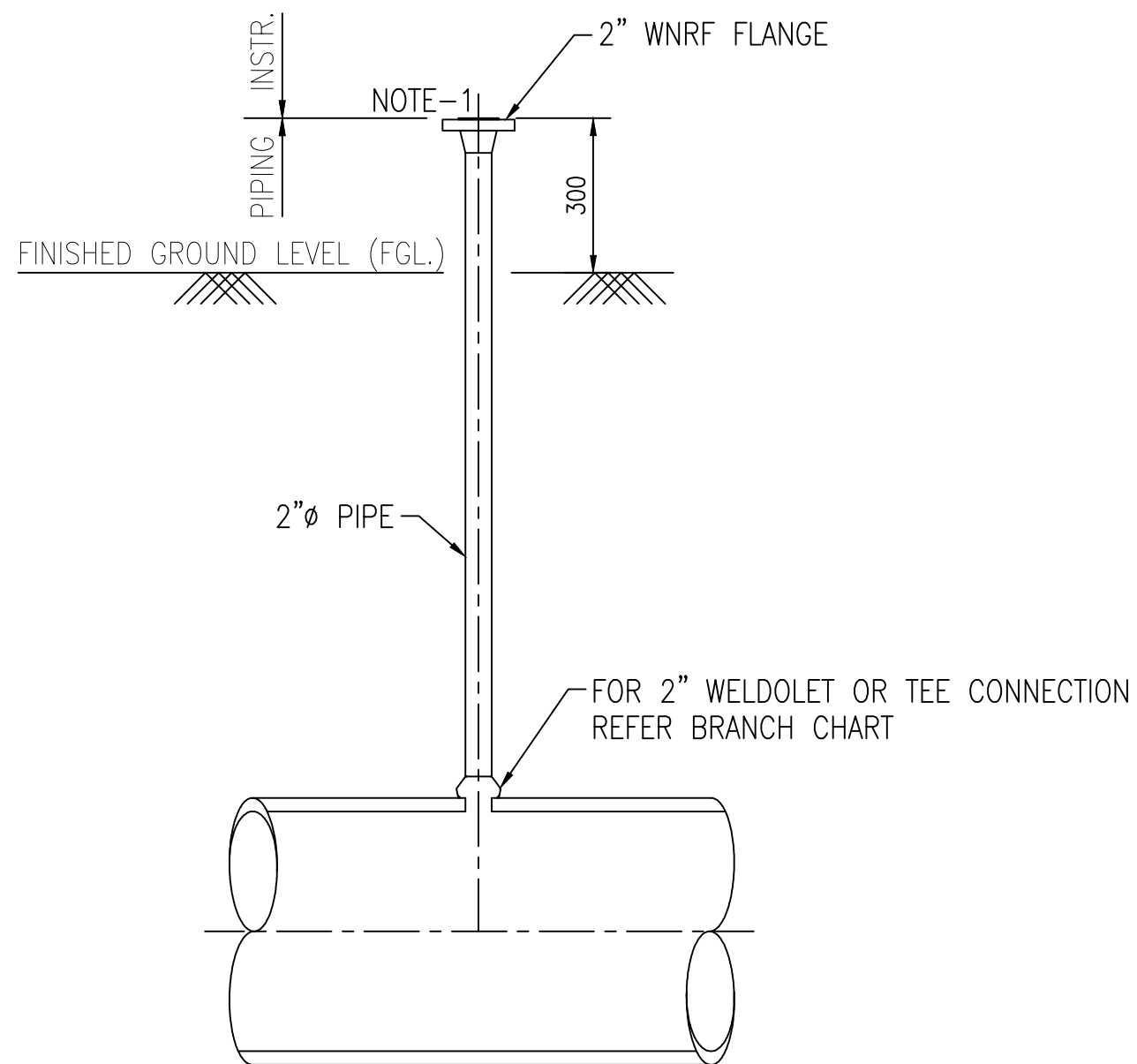
## DRAWING NO.

SD-PI-015

SHEET NO.

---

1 OF 1



NOTE:

- 1 INSULATION GASKET SHALL BE INSTALLED.

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



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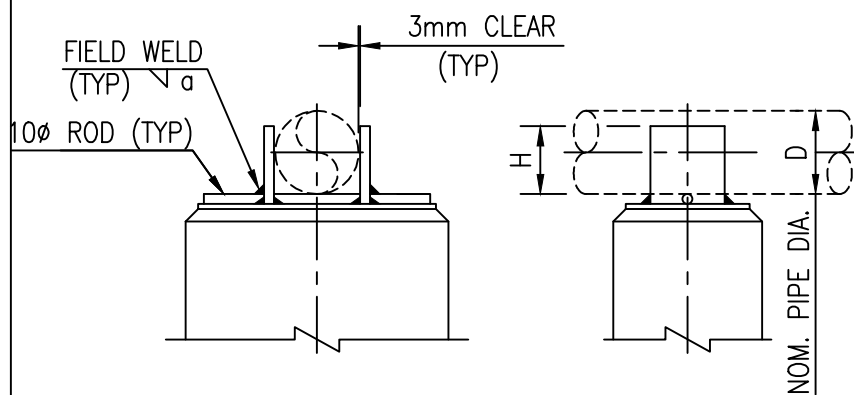
GUIDE SUPPORT FOR BARE PIPE  
(SIZE 1/2" TO 24") TYPE G2

DRAWING NO.

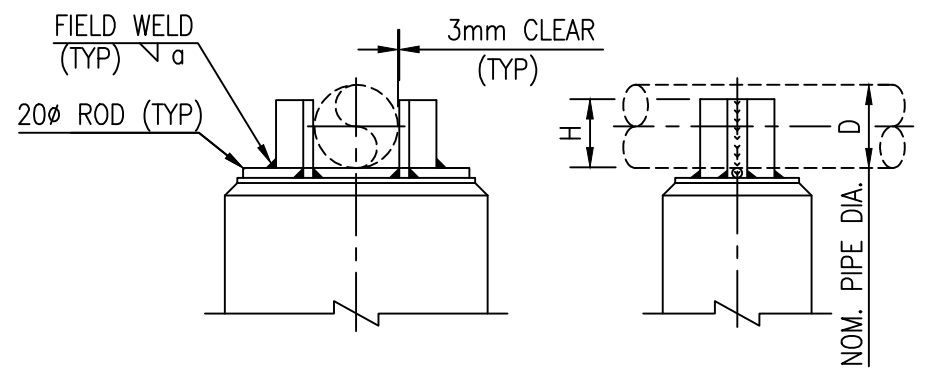
SD-PI-016

SHEET NO.

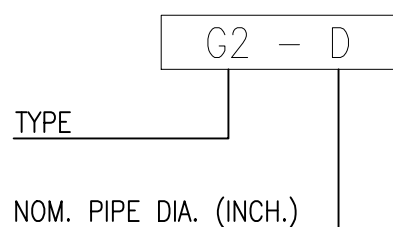
1 OF 1



FOR SIZES UPTO 4"



FOR SIZES 6" THRU 24"



SYMBOL

| D            | H   | a  | METERIAL                |
|--------------|-----|----|-------------------------|
| 2" & SMALLER | 40  | 6  | FLAT 60 x 10            |
| 3" TO 4"     | 70  | 6  | FLAT 75 x 10            |
| 6" TO 8"     | 130 | 6  | 2 NOS. ISA 50 x 50 x 6  |
| 10" TO 18"   | 230 | 10 | 2 NOS. ISA 75 x 75 x 10 |
| 20" TO 24"   | 350 | 10 | 2 NOS. ISA 90 x 90 x 10 |

NOTES:-

GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER THESE OBSTRUCT ADJOINING GUIDE ANGLES.

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   |  | DK   |  | AD   |  |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP |  | CHKD |  | APPD |  |



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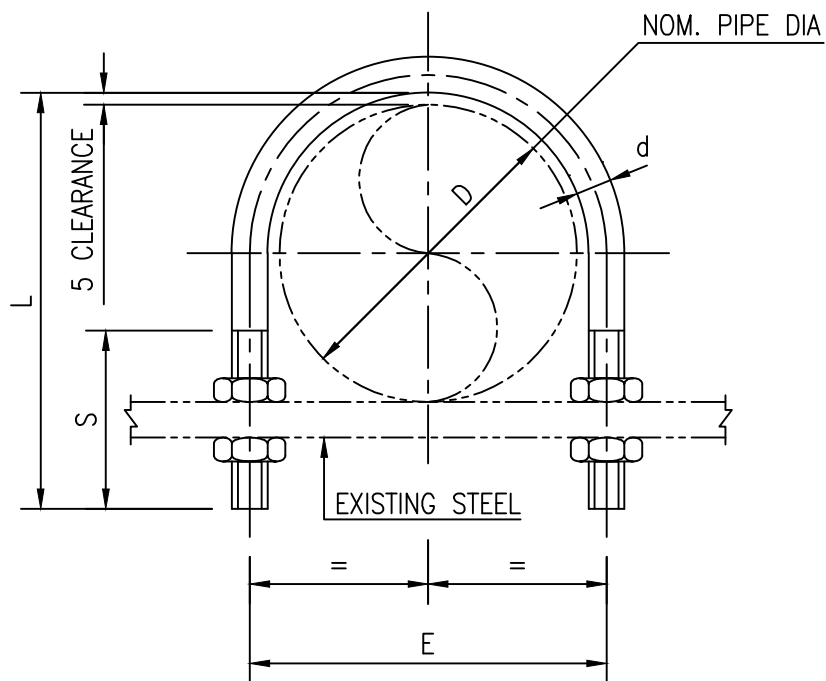
U-BOLT FOR BARE PIPE  
(SIZE 1/2" TO 24")

DRAWING NO.

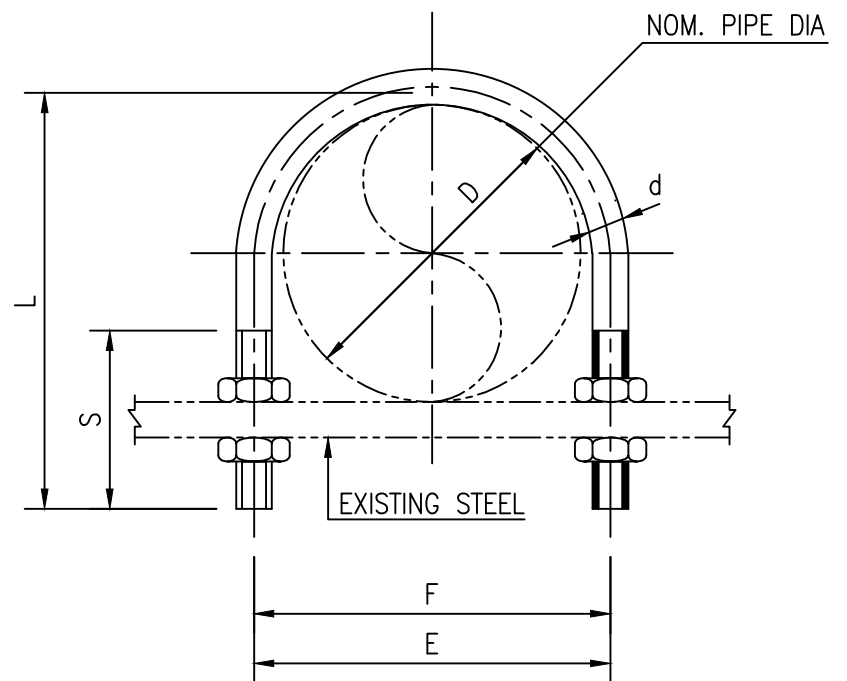
SD-PI-017

SHEET NO.

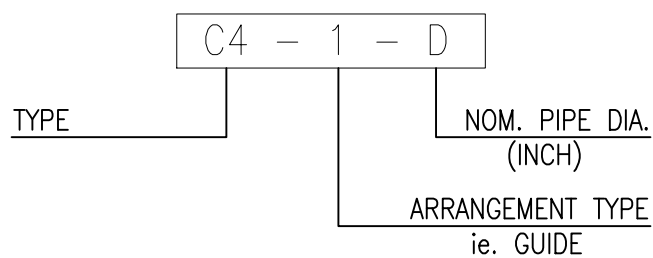
1 OF 1



GUIDE  
ARRANGEMENT TYPE-1  
(1/2" TO 24")



FIXED  
ARRANGEMENT TYPE-2  
(1/2" TO 1 1/2")



SYMBOL

| D      | O.D.<br>(mm) | 'U' CLAMP |     |     |    |     |
|--------|--------------|-----------|-----|-----|----|-----|
|        |              | L         | E   | S   | d  | F   |
| 1/2"   | 21           | 65        | 30  | 50  | 6  | 24  |
| 3/4"   | 27           | 70        | 36  | 50  | 6  | 30  |
| 1"     | 33           | 75        | 45  | 55  | 8  | 37  |
| 1 1/2" | 48           | 90        | 60  | 55  | 8  | 52  |
| 2"     | 60           | 105       | 72  | 60  | 8  | 64  |
| 3"     | 89           | 145       | 106 | 80  | 12 | 94  |
| 4"     | 114          | 170       | 130 | 80  | 12 | 119 |
| 6"     | 168          | 240       | 190 | 100 | 16 | 173 |
| 8"     | 219          | 290       | 242 | 100 | 16 | 226 |
| 10"    | 273          | 345       | 296 | 100 | 16 | 280 |
| 12"    | 324          | 420       | 351 | 130 | 20 | 331 |
| 14"    | 356          | 450       | 382 | 130 | 20 | 362 |
| 16"    | 408          | 500       | 435 | 130 | 20 | 414 |
| 18"    | 457          | 565       | 490 | 140 | 24 | 465 |
| 20"    | 508          | 620       | 540 | 140 | 24 | 515 |
| 24"    | 610          | 720       | 645 | 140 | 24 | 620 |

|          |          |                     |      |  |      |  |      |  |
|----------|----------|---------------------|------|--|------|--|------|--|
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M/s. VCS QUALITY SERVICES  
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VENTS AND DRAINS  
(ON LINES 2" AND ABOVE)

DRAWING NO.

SD-PI-018

SHEET NO.

1 OF 1

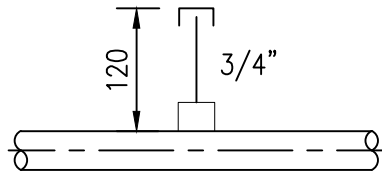
TYPE

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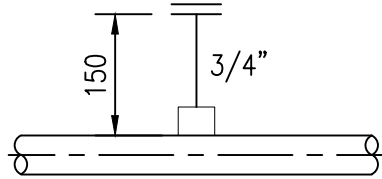
DRAIN

TYPE

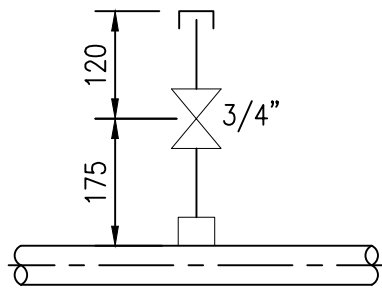
VP1  
V1C



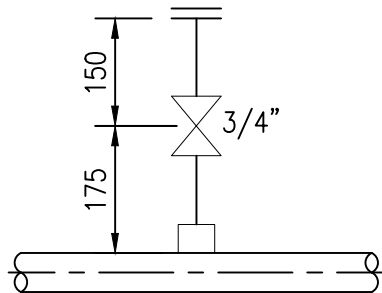
V2F



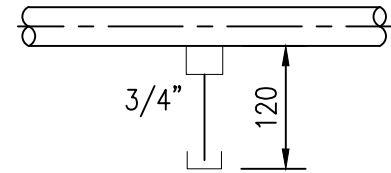
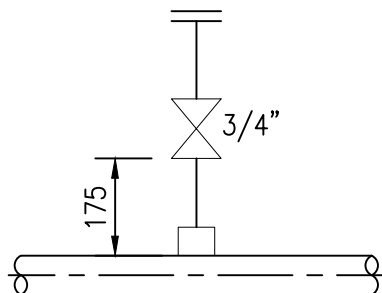
V3  
V3C



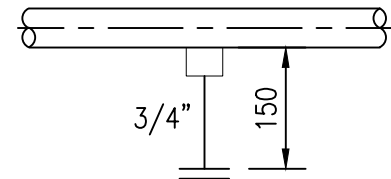
V4F



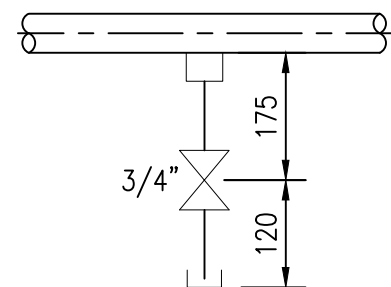
V5F



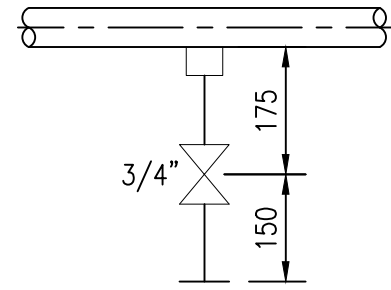
D1  
D1C



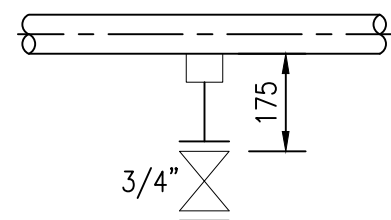
D2F



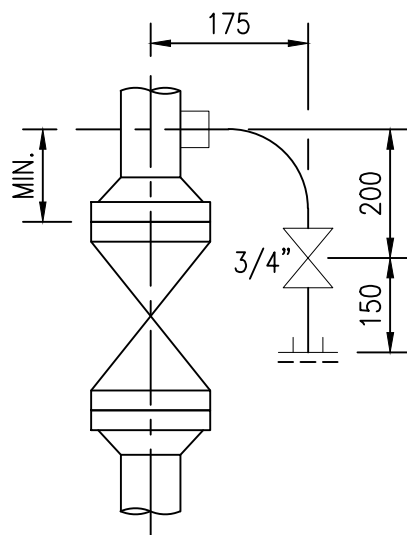
D3  
D3C



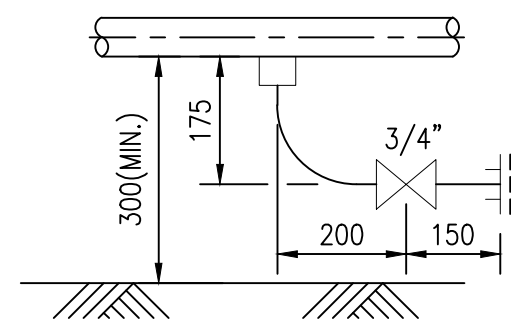
D4F



D5F



DC9  
DF9



DC10  
DF10

NOTES:—

1. DELETED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLG'D.) WITH HALF COUPLING. OR STUB IN, WITH CAP OR FLANGE & BLIND FLANGE AS PER PIPING SPECIFICATIONS.
3. DELETED.
4. LEGEND : V = VENT; D = DRAIN; C = CAP; F = FLANGE; P = PLUG.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
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M/s. VCS QUALITY SERVICES  
PVT. LTD.

VENTS AND DRAINS  
(ON LINES 1 1/2" AND BELOW)

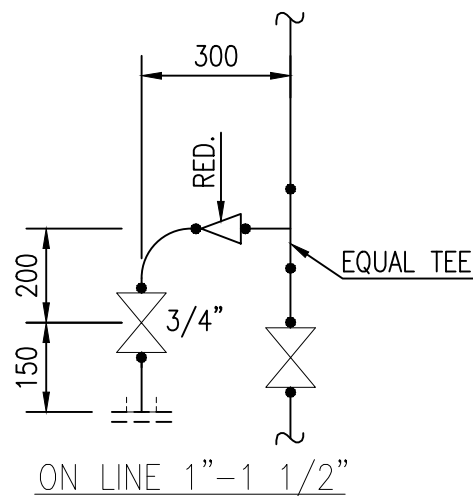
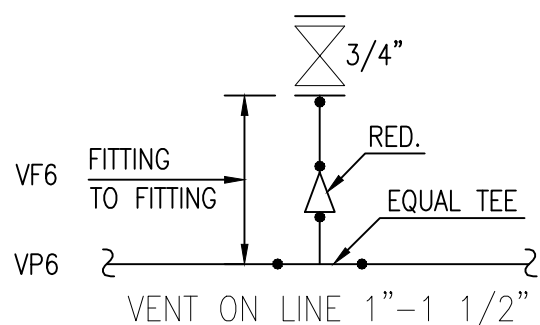
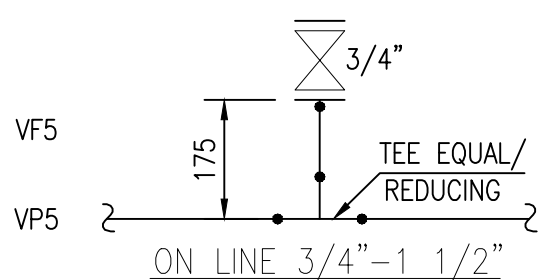
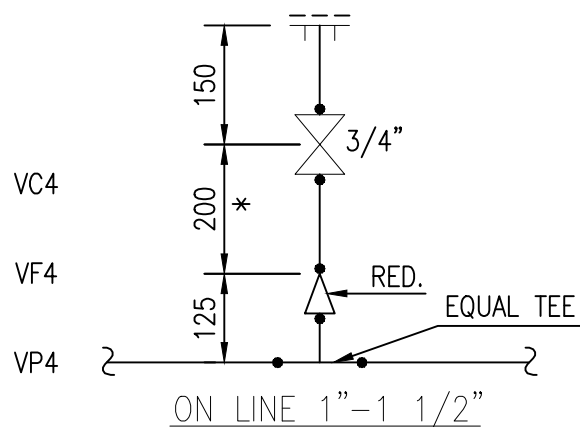
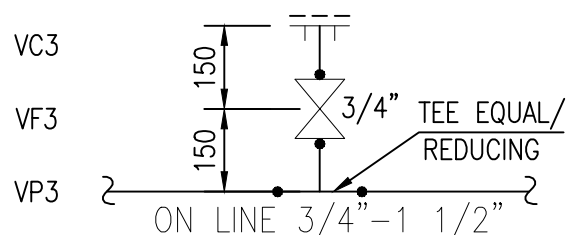
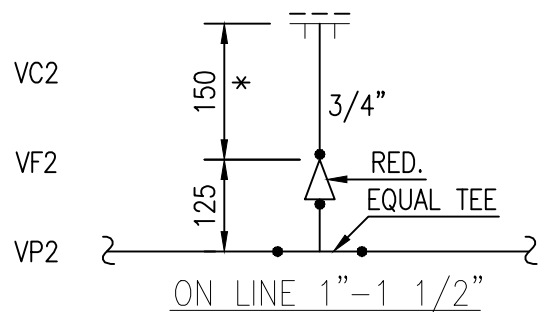
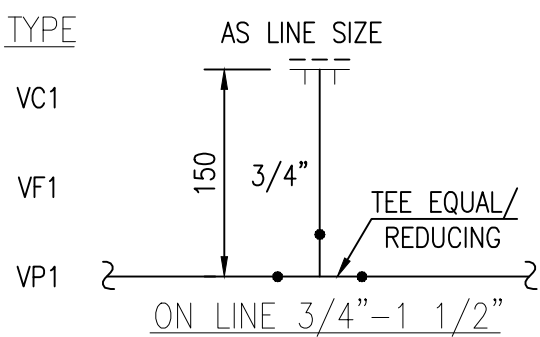
DRAWING NO.

SD-PI-019

SHEET NO.

1 OF 1

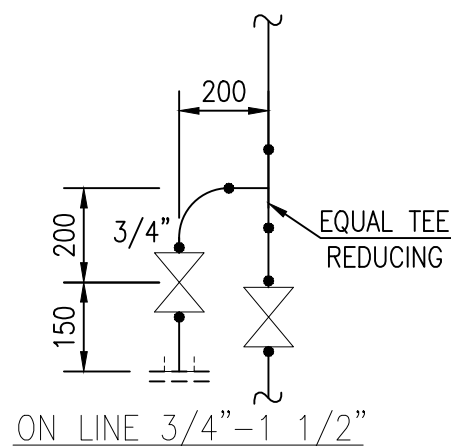
TYPE



DC7

DF7

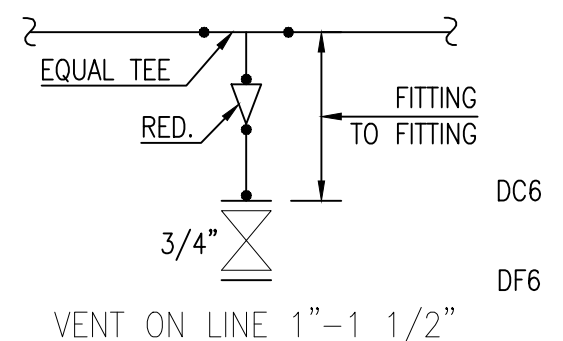
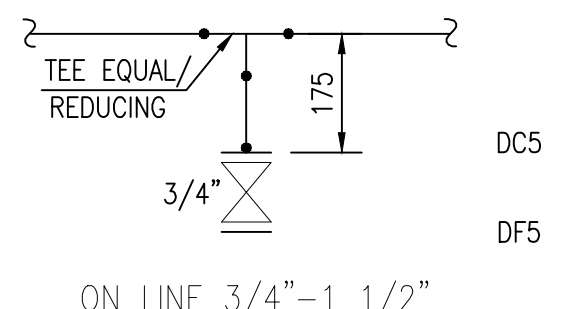
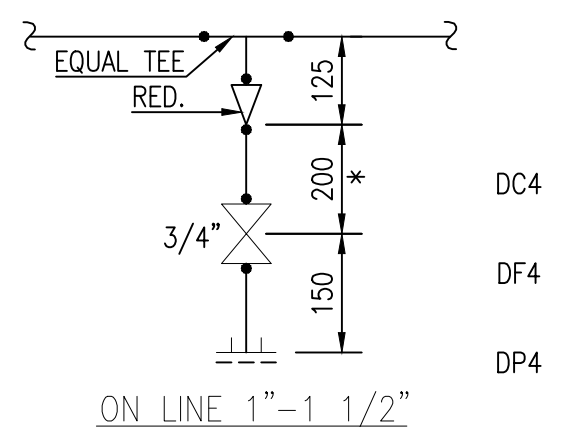
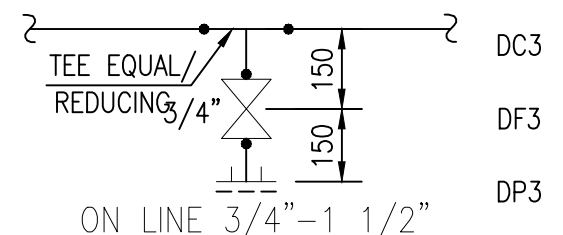
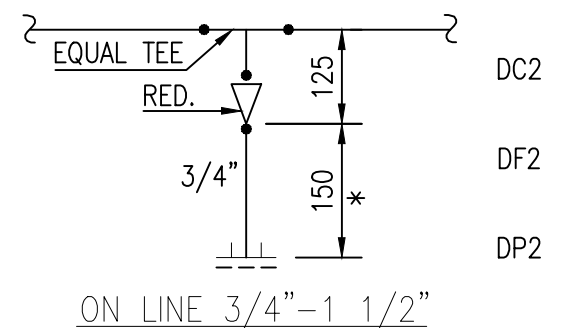
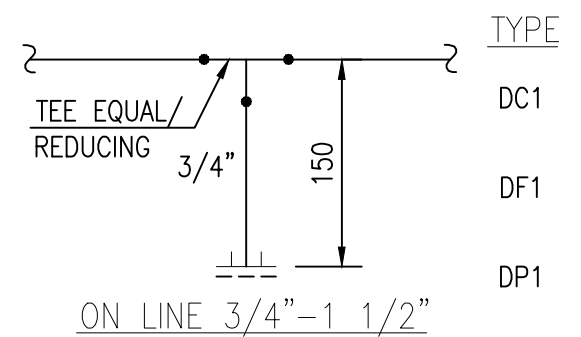
DP7



DC8

DF8

DP8



NOTES:-

- DIMENSIONS ARE VALID FOR 50mm(MAX) INSULATION THICKNESS, INCREASE DIMENSIONS AS REQUIRED, DIMENSIONS MARKED '\*' ARE MAXIMUM AND MAY BE REDUCED TO SUIT.
- VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLGD.) WITH TEE (EQUAL OR REDUCING), HALF COUPLING OR STUB IN, CAP OR PLUG FLANGE AND BLIND FLANGE AS PER PIPING SPECIFICATION.  
LEGEND : V = VENT; D = DRAIN; C = CAP; F = FLANGE; RED. = REDUCER, COUPLING OR SOCKET; P = PLUG.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
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M/s. VCS QUALITY SERVICES  
PVT. LTD.

SYMBOLS OF PIPING  
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

SHEET NO.

1 OF 4

| DESCRIPTION                | FLANGED | SCREWED | WELDED<br>(NOTE-1) | SOCKET WELD |
|----------------------------|---------|---------|--------------------|-------------|
| 90° ELBOW                  |         |         |                    |             |
| ELBOW<br>(TURNED UP)       |         |         |                    |             |
| ELBOW<br>(TURNED DOWN)     |         |         |                    |             |
| MITERED BEND 90°           |         |         |                    |             |
| MITERED BEND 45°           |         |         |                    |             |
| 45° ELBOW                  |         |         |                    |             |
| 45° ELBOW<br>(TURNED UP)   |         |         |                    |             |
| 45° ELBOW<br>(TURNED DOWN) |         |         |                    |             |
| TEE<br>EQUAL/UNEQUAL       |         |         |                    |             |
| TEE<br>(OUTLET UP)         |         |         |                    |             |
| TEE<br>(OUTLET DOWN)       |         |         |                    |             |
| CROSS                      |         |         |                    |             |
| CONCENTRIC REDUCER         |         |         |                    |             |
| ECCENTRIC REDUCER          |         |         |                    |             |
| DEAD END                   |         |         |                    |             |
| LATERAL                    |         |         |                    |             |
| SIGHT GLASS                |         |         |                    |             |
| UNION                      |         |         |                    |             |
| HALF COUPLING              |         |         |                    |             |
| FULL COUPLING              |         |         |                    |             |
| HOSE COUPLING              |         |         |                    |             |

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
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M/s. VCS QUALITY SERVICES  
PVT. LTD.

SYMBOLS OF PIPING  
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

SHEET NO.

3 OF 4

| DESCRIPTION                             | FLANGED | SCREWED | WELDED<br>(NOTE-1) | SOCKET WELD |
|-----------------------------------------|---------|---------|--------------------|-------------|
| BUTTERFLY VALVE<br>(PLAN OR ELEVATION)  |         |         |                    |             |
| DIAPHRAGM VALVE<br>(PLAN OR ELEVATION)  |         |         |                    |             |
| 3-WAY PLUG VALVE<br>(PLAN OR ELEVATION) |         |         |                    |             |
| 4-WAY PLUG VALVE<br>(PLAN OR ELEVATION) |         |         |                    |             |
| EXPANSION JOINT                         |         |         |                    |             |
| ANGLE CONTROL VALVE                     |         |         |                    |             |
| CHAIN OPERATING VALVE                   |         |         |                    |             |
| GEAR OPERATED VALVE<br>(BEVEL GEAR)PLAN |         |         |                    |             |
| GEAR OPERATED VALVE<br>(SPUR GEAR)PLAN  |         |         |                    |             |
| MOTOR OPERATING VALVE                   |         |         |                    |             |
| STEAM TRAP                              |         |         |                    |             |
| Y-STRAINER                              |         |         |                    |             |

| DESCRIPTION                | SYMBOL | DESCRIPTION                          | SYMBOL |
|----------------------------|--------|--------------------------------------|--------|
| SLIP ON FLANGE             |        | STUB - IN<br>(WITH OR WITHOUT RENIF) |        |
| WELDNECK FLANGE            |        |                                      |        |
| SCREWED FLANGE             |        | STUB - IN<br>(SADDLE RENIF)          |        |
| SOCKET WELD FLANGE         |        |                                      |        |
| SPACER                     |        | STUB - IN WITH RENIF<br>(IN PLAN)    |        |
| SPACER BLIND               |        |                                      |        |
| SPECTALE FIG. 8<br>(BLIND) |        | INSULATED<br>(LINES 12" AND BELOW)   |        |
| SPECTALE FIG. 8<br>(OPEN)  |        |                                      |        |

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
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SYMBOLS OF PIPING  
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

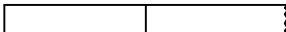
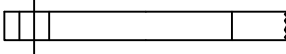
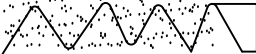
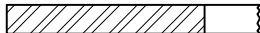
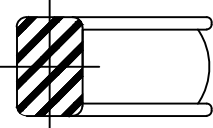
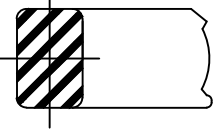
SHEET NO.

3 OF 4

| DESCRIPTION                             | FLANGED | SCREWED | WELDED<br>(NOTE-1) | SOCKET WELD |
|-----------------------------------------|---------|---------|--------------------|-------------|
| BUTTERFLY VALVE<br>(PLAN OR ELEVATION)  |         |         |                    |             |
| DIAPHRAGM VALVE<br>(PLAN OR ELEVATION)  |         |         |                    |             |
| 3-WAY PLUG VALVE<br>(PLAN OR ELEVATION) |         |         |                    |             |
| 4-WAY PLUG VALVE<br>(PLAN OR ELEVATION) |         |         |                    |             |
| EXPANSION JOINT                         |         |         |                    |             |
| ANGLE CONTROL VALVE                     |         |         |                    |             |
| CHAIN OPERATING VALVE                   |         |         |                    |             |
| GEAR OPERATED VALVE<br>(BEVEL GEAR)PLAN |         |         |                    |             |
| GEAR OPERATED VALVE<br>(SPUR GEAR)PLAN  |         |         |                    |             |
| MOTOR OPERATING VALVE                   |         |         |                    |             |
| STEAM TRAP                              |         |         |                    |             |
| Y-STRAINER                              |         |         |                    |             |

| DESCRIPTION                | SYMBOL | DESCRIPTION                          | SYMBOL |
|----------------------------|--------|--------------------------------------|--------|
| SLIP ON FLANGE             |        | STUB - IN<br>(WITH OR WITHOUT RENIF) |        |
| WELDNECK FLANGE            |        |                                      |        |
| SCREWED FLANGE             |        | STUB - IN<br>(SADDLE RENIF)          |        |
| SOCKET WELD FLANGE         |        |                                      |        |
| SPACER                     |        | STUB - IN WITH RENIF<br>(IN PLAN)    |        |
| SPACER BLIND               |        |                                      |        |
| SPECTALE FIG. 8<br>(BLIND) |        | INSULATED<br>(LINES 12" AND BELOW)   |        |
| SPECTALE FIG. 8<br>(OPEN)  |        |                                      |        |

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
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|                                                                                                                                                 |                                                                                                                                                                      |                                             |                                                    |                        |                                       |        |  |      |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------|------------------------|---------------------------------------|--------|--|------|--|
| <div></div> <div>M/s. VCS QUALITY SERVICES<br/>PVT. LTD.</div> |                                                                                                                                                                      | GASKET THICKNESS                            |                                                    | DRAWING NO.            |                                       |        |  |      |  |
|                                                                                                                                                 |                                                                                                                                                                      |                                             |                                                    | SD-PI-024              |                                       |        |  |      |  |
|                                                                                                                                                 |                                                                                                                                                                      |                                             |                                                    | SHEET NO.              |                                       | 1 OF 1 |  |      |  |
| TYPICAL<br>CROSS SECTION                                                                                                                        |                                                                                                                                                                      | DESCRIPTION                                 |                                                    | THICKNESS<br>OF GASKET | COMPRESSED<br>THICKNESS<br>( NOTE -1) |        |  |      |  |
|                                                                | FLAT RING FOR<br>RAISED FACE FLANGE                                                                                                                                  | COMPRESSED ASBESTOS<br>FOR SYNTHETIC RUBBER | 2.0                                                | 2.0                    |                                       |        |  |      |  |
|                                                                | FULL FACE FOR<br>FLAT FACE FLANGES                                                                                                                                   |                                             |                                                    |                        |                                       |        |  |      |  |
|                                                               | SPIRAL WOUND METAL FLAT RING GASKET, NON<br>METALLIC FILTER, AND A STEEL SOLID RING TYPE<br>CENTERING DEVICE- FOR RAISED FACE FLANGES.                               |                                             | 4.4                                                | 3.0                    |                                       |        |  |      |  |
|                                                              | FLAT METAL JACKETED GASKET, NON METALLIC<br>FILTER COMPLETELY ENCLOSED WITHIN A FULLY<br>ANNEALED DOUBLE METAL JACKET-FORRAISED<br>FACE FLANGES                      |                                             | 3.0                                                | 2.0                    |                                       |        |  |      |  |
|                                                              | CORRUGATED METAL JACKETED GASKET, NON<br>METALLIC FILTER, COMPLETELY ENCLOSED WITHIN<br>A FULLY ANNEALED DOUBLE METAL CORRUGATED<br>JACKET- FOR RAISED FACE FLANGES. |                                             | 3.2                                                | 1.0                    |                                       |        |  |      |  |
|                                                              | CORRUGATED METAL GASKET-FULLY ANNEALED<br>CORRUGATED METAL WITH FILTER MATERIAL<br>CEMENTED TO THE CORRUGATIONS ON BOTH FACES<br>-FOR RAISED FACE FLANGES            |                                             | 3.2                                                | 1.0                    |                                       |        |  |      |  |
|                                                              | SOLID METAL FLAT RING FOR SMALL TONGUE<br>AND GROOVE FLANGES.                                                                                                        |                                             | AS SPECIFIED                                       |                        |                                       |        |  |      |  |
|                                                              | SOLID METAL FLAT RING FOR LARGE TONGUE<br>AND GROOVE FLANGES.                                                                                                        |                                             | AS SPECIFIED                                       |                        |                                       |        |  |      |  |
|                                                              | SOLID METAL OCTAGONAL RING FOR R.T.J FLANGES                                                                                                                         |                                             | DIMENSIONS SHALL BE AS PER<br>ASME B 16.20(NOTE-2) |                        |                                       |        |  |      |  |
|                                                              | SOLID METAL OVAL RING FOR R.T.J FLANGES                                                                                                                              |                                             | DIMENSIONS SHALL BE AS PER<br>ASME B 16.20(NOTE-2) |                        |                                       |        |  |      |  |
|                                                              | FULLY ANEALED CORRUGATED METAL FOR RAISED<br>FACE FLANGES.                                                                                                           |                                             | 3.2                                                | 1.0                    |                                       |        |  |      |  |
| 0                                                                                                                                               | 10.05.17                                                                                                                                                             | ISSUED WITH TENDER                          |                                                    | US                     |                                       | DK     |  | AD   |  |
| REV. NO.                                                                                                                                        | DATE                                                                                                                                                                 | SUBJECT OF REVISION                         |                                                    | PREP                   |                                       | CHKD   |  | APPD |  |



M/s. VCS QUALITY SERVICES  
PVT. LTD.

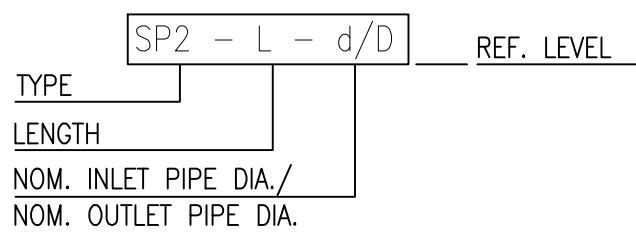
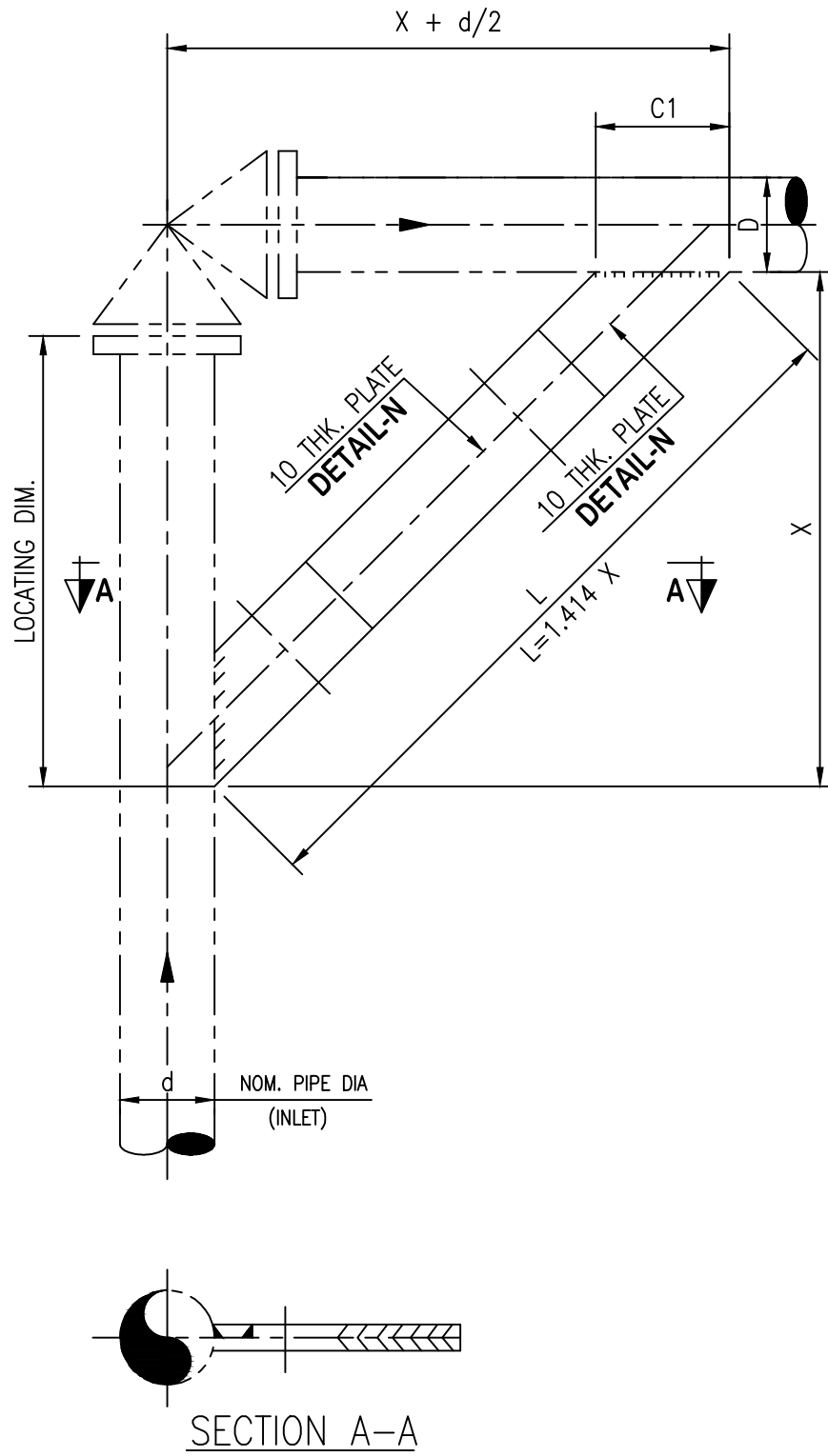
SUPPORTING ARRANGEMENT  
FOR ANGLE AND RELIEF VALVES  
TYPE-SP2

DRAWING NO.

SD-PI-025

SHEET NO.

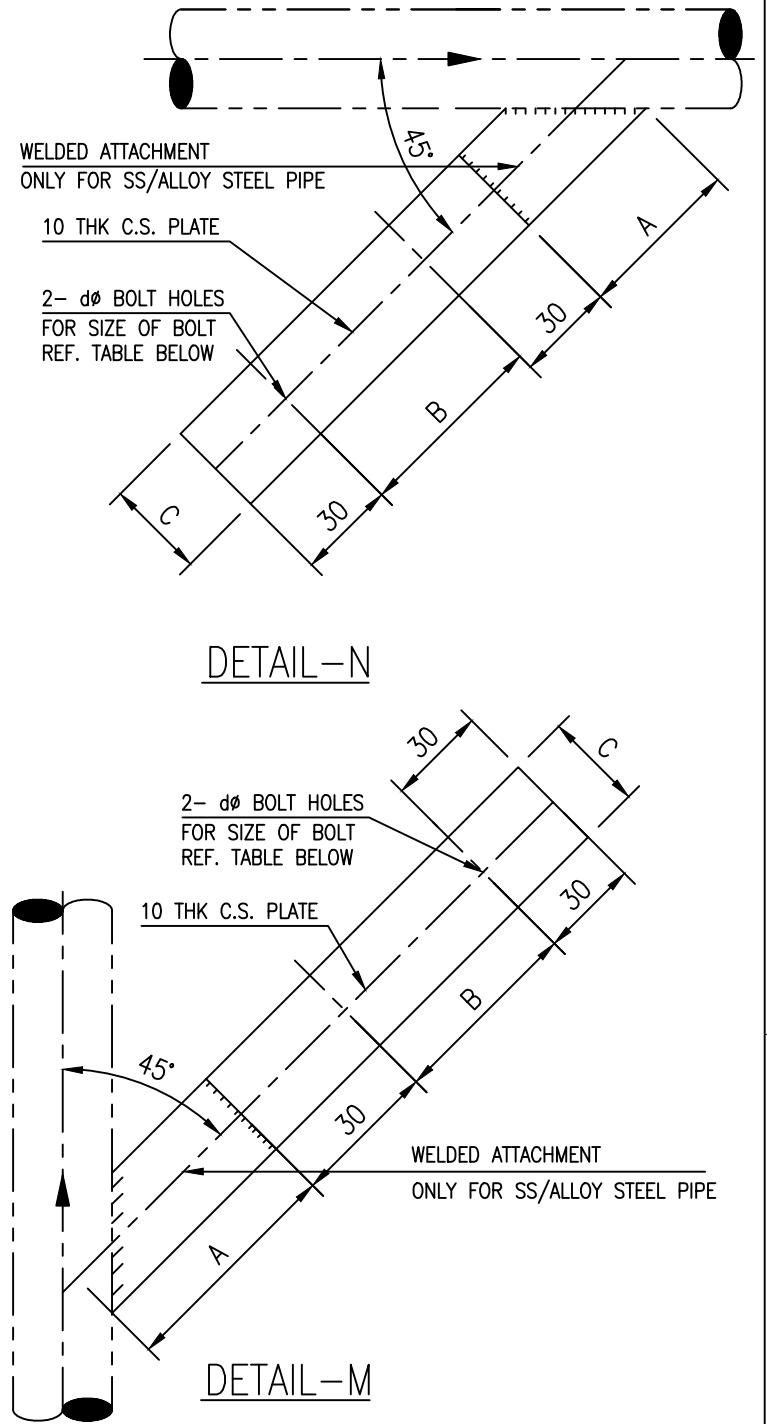
1 OF 1



SYMBOL

| D         | BOLT SIZE<br>d $\phi$ | A   | C  | B<br>MIN. | C1  | D1 |
|-----------|-----------------------|-----|----|-----------|-----|----|
| 1" TO 4"  | M12 X 50              | 75  | 50 | 150       | 71  | 14 |
| 6" TO 12" | M16 X 50              | 100 | 75 | 200       | 106 | 18 |

FOR TEMP. UP TO 400 °C ONLY



NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



M/s. VCS QUALITY SERVICES  
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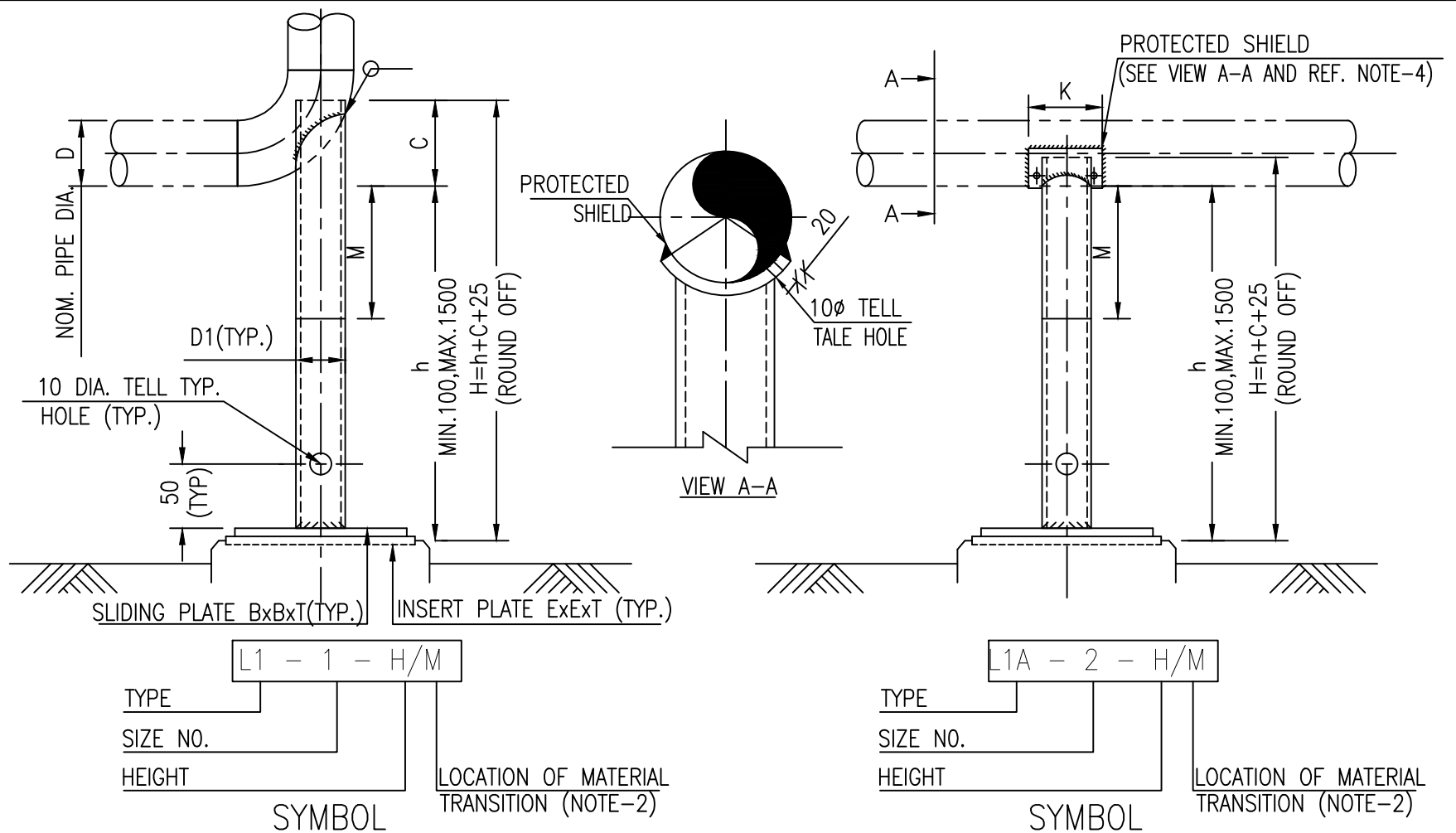
LOW SUPPORT SLIDING FOR BARE  
& INSULATED PIPE SIZE 2"  
THRU 36" TYPE-L1 AND L1A

DRAWING NO.

SD-PI-026

SHEET NO.

1 OF 1



| SIZE NO. | D   | D1<br>(NOTE-3) | B   | T  | C<br>(NOTE-5) | E   | K<br>(NOTE-4) |
|----------|-----|----------------|-----|----|---------------|-----|---------------|
| 1        | 2"  | 2" S40/10S     | 150 | 10 | 70            | 250 | 160           |
|          | 3"  |                |     |    | 115           |     |               |
| 2        | 4"  | 3" S40/10S     | 200 | 10 | 137           | 300 | 190           |
|          | 6"  |                |     |    | 174           |     |               |
| 3        | 8"  | 4" S40/10S     | 200 | 12 | 205           | 300 | 215           |
|          | 10" |                |     |    | 262           |     |               |
|          | 12" |                |     |    | 287           |     |               |
| 4        | 14" | 6" S40/10S     | 250 | 12 | 388           | 350 | 270           |
|          | 16" |                |     |    | 418           |     |               |
| 5        | 18" | 8" S40/10S     | 300 | 12 | 454           | 400 | 320           |
| 6        | 20" | 10" S40/10S    | 350 | 12 | 554           | 450 | 375           |
|          | 24" |                |     |    | 615           |     |               |
| 7        | 26" | 12" S40/10S    | 400 | 16 | 675           | 500 | 425           |
|          | 30" |                |     |    | 800           |     |               |
|          | 36" |                |     |    | 950           |     |               |

NOTES:-

- INSERT AND SLIDING PLATE MATERIAL SHALL BE CARBON STEEL WHERE DESIGN TEMP. IS  $>345^{\circ}\text{C}$  WITH  $h < 200\text{MM}$ , SLIDING PLATE MATERIAL SHALL BE EUVALENT TO PIPE MATERIAL.
- DIMENSION "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE AND THE LOWER SUPPORT PIPE SHALL BE CARBON STEEL. MINIMUM VALUE OF M SHALL BE "INSULATION THICKNESS+25MM".  
A. FOR CARBON STEEL(CS) LINE PIPE, THE ENTIRE SUPPORT PIPE SHALL BE CS, THAT IS  $M=0$ .  
B. FOR ALLOY STEEL(AS) OR STAINLESS STEEL(SS) LINE -PIPE, SUPPORT PIPE SHALL CONSIST OF THE FOLLOWING-  
-FOR  $h$  LESS THAN OR EQUAL TO 500MM, ENTIRE SUPPORT PIPE MATERIAL SHALL BE EQUIVALENT TIO THAT OF LINE PIPE, THAT IS  $M=h$ .  
-FOR  $h$  GREATER THAN 500MM,SUPPORT PIPE SHALL BE COMPOSITE WITH  $M=\text{INSULATION THK.}+25\text{MM}$  OR 100MM, WHICHEVER IS GREATER.
- IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABE USE NEXT HIGHER SIZE AND/OR NEAREST HIGHER THICKNESS AVAILABLE.
- PROTECTION SHIELD (LENGTH=KMM) CUT FROM LINE-PIPE OR EQUIVALANT PLATE SHALL BE PROVIDED ON HORIZONTAL LINE AS FOLLOWS-  
A. FOR 150# AND 300# CLASS PIPEING  
CS AND AS LINES - 10" AND ABOVE  
SS LINES - 2" AND ABOVE  
B. FOR 600# AND HIGHER CLASS PIPING  
CS, AS AND SS LINES - 10" AND ABOVE
- DIMENSION "C" IS TO BE MODIFIED IF OTHER THAN 1.5 D RADIUS ELBOWS ARE USED.
- IN CASE CALCULATED  $h$  EXCEEDS THE MAX. VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |



M/s. VCS QUALITY SERVICES  
PVT. LTD.

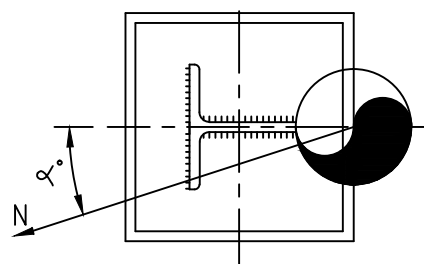
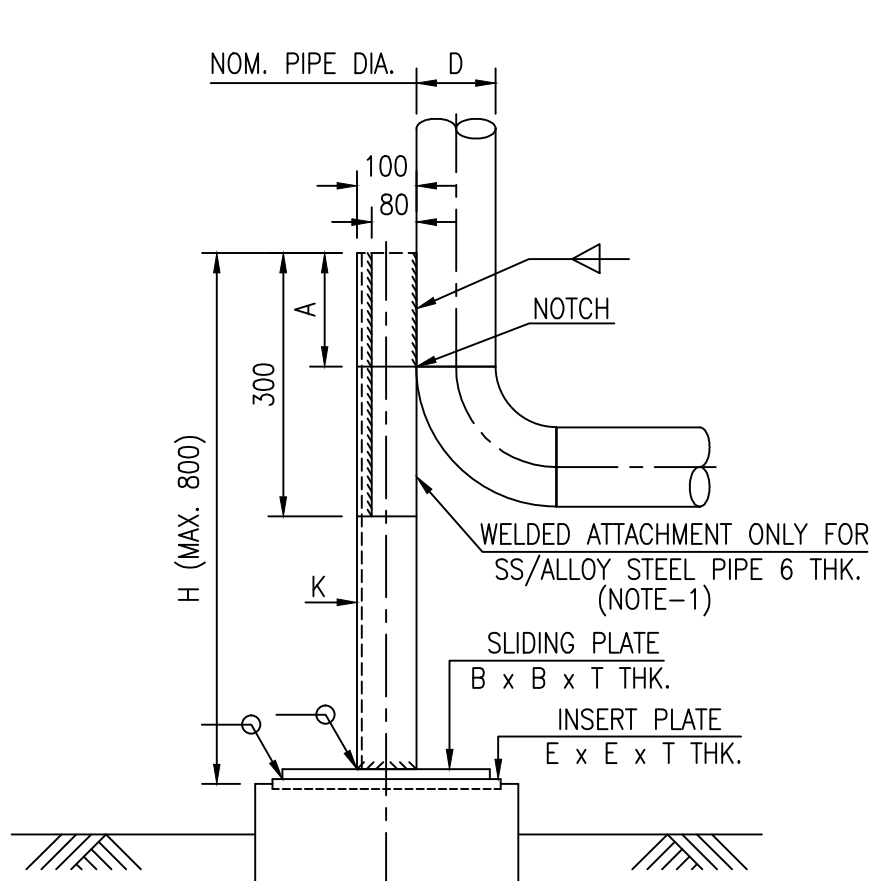
LOW SUPPORT FIXED FOR BARE  
& INSULATED PIPE SIZE 2"  
THRU 24"TYPE-L6

DRAWING NO.

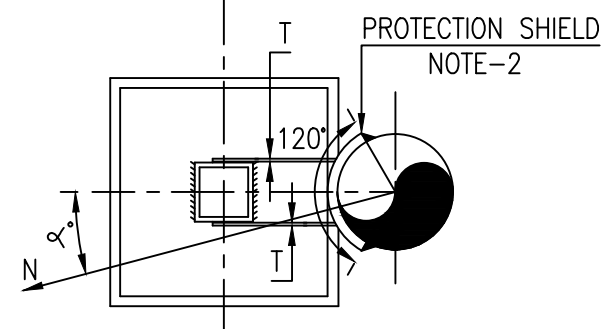
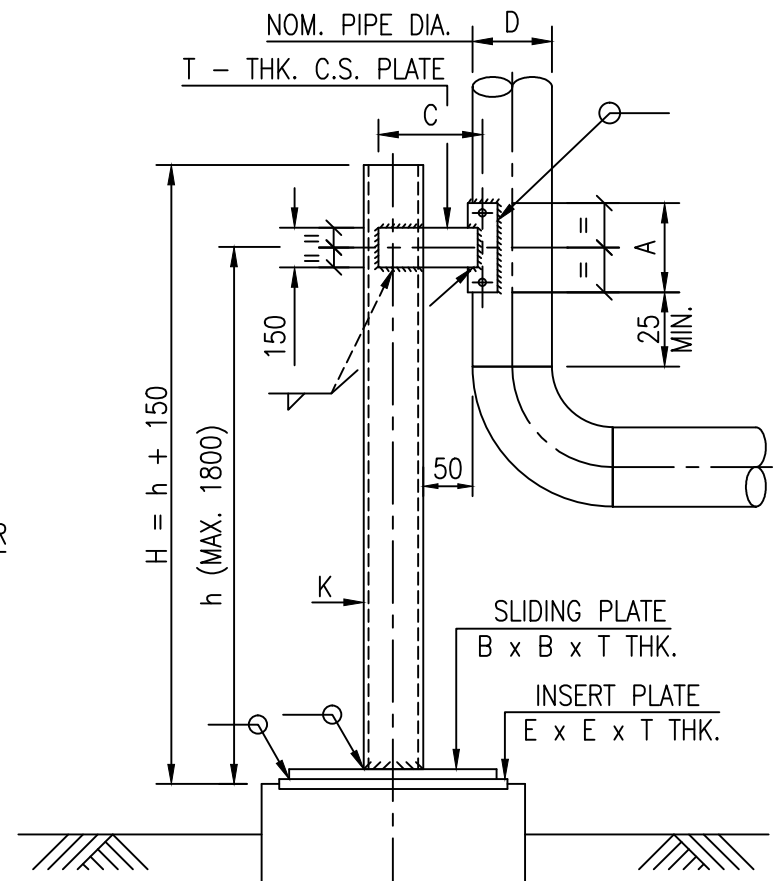
SD-PI-027

SHEET NO.

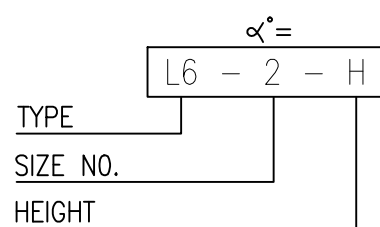
1 OF 1



FOR PIPE SIZES 2" THRU 4"



FOR PIPE SIZES 6" THRU 24"



SYMBOL

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD IS TO BE CUT FROM LINE PIPE.

| SIZE NO. | D          | K                 | A   | T  | C   | E   | B   |
|----------|------------|-------------------|-----|----|-----|-----|-----|
| 1        | 2" TO 4"   | CUT FROM ISMB 200 | 200 | 10 | -   | 250 | 150 |
| 2        | 6" TO 10"  | ISMC-125 2 NOS.   | 200 | 12 | 150 | 300 | 200 |
| 3        | 12" TO 24" | ISMC-225 2 NOS.   | 300 | 12 | 230 | 400 | 300 |

FOR TEMP. UP TO 400 °C ONLY

|          |          |                     |      |      |      |
|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED WITH TENDER  | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |





M/s. VCS QUALITY SERVICES  
PVT. LTD.

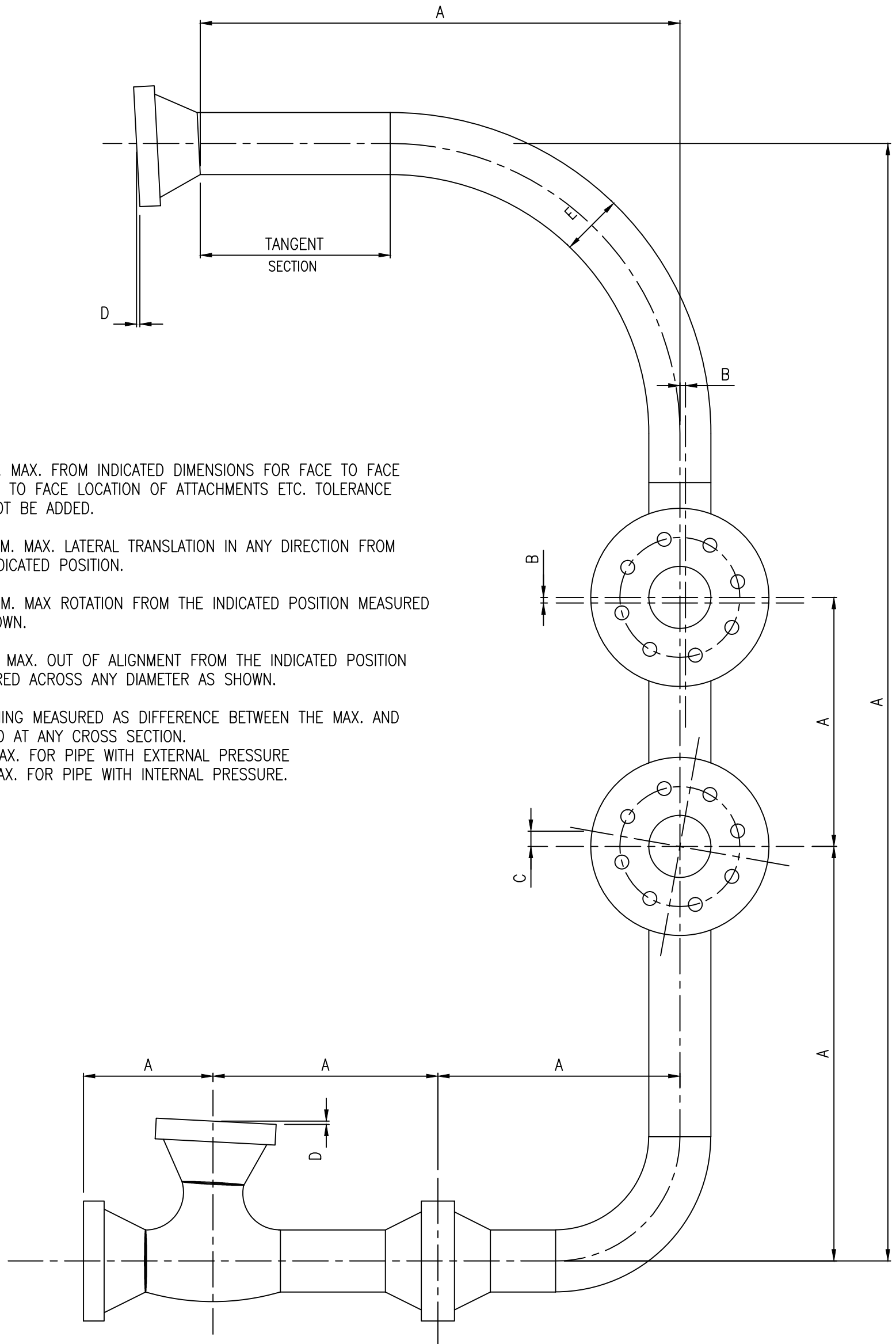
## TOLERANCES FOR FABRICATION

DRAWING NO.

SD-PI-028

SHEET NO.

1 OF 1

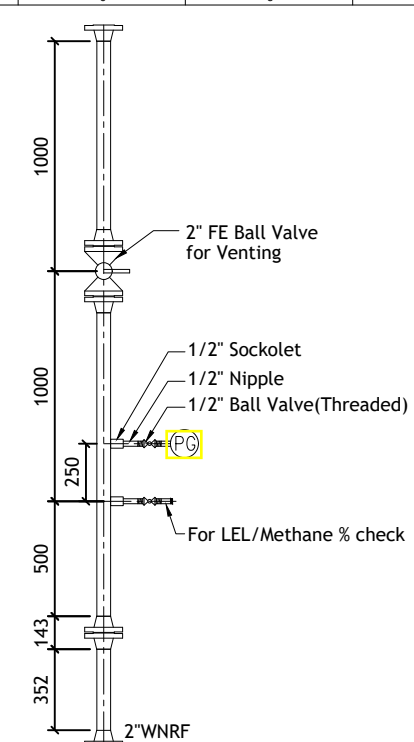
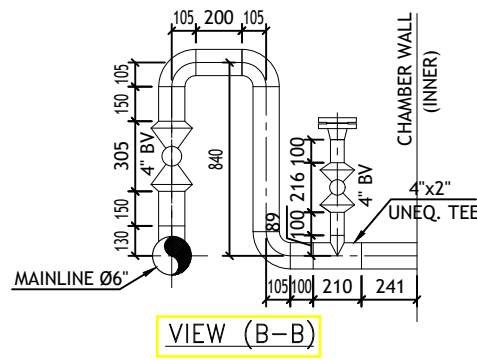
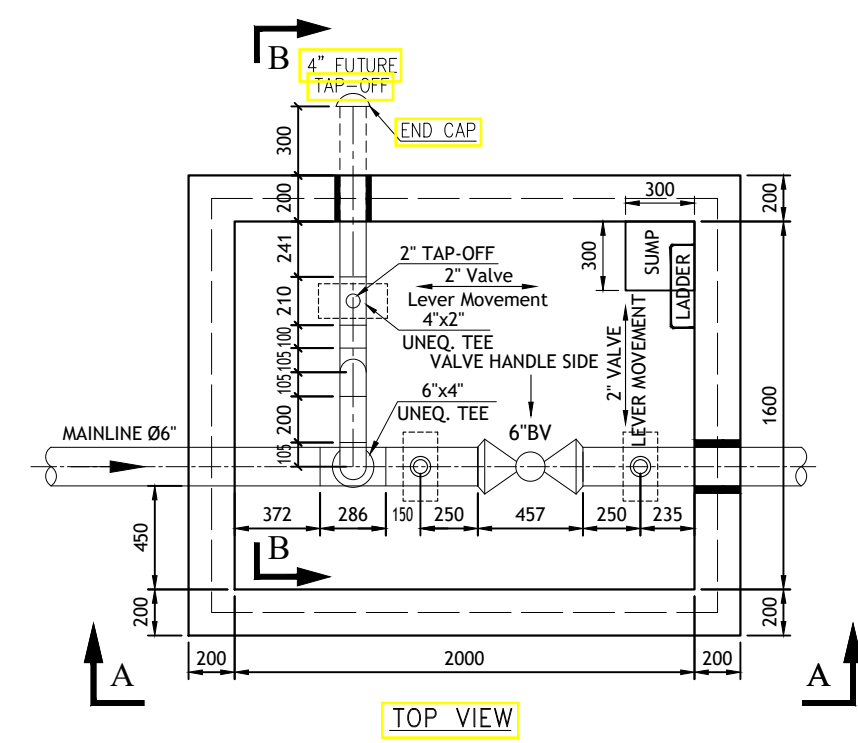


- A  $\pm 3$  MM. MAX. FROM INDICATED DIMENSIONS FOR FACE TO FACE CENTRE TO FACE LOCATION OF ATTACHMENTS ETC. TOLERANCE CAN NOT BE ADDED.
- B  $\pm 1.5$  MM. MAX. LATERAL TRANSLATION IN ANY DIRECTION FROM THE INDICATED POSITION.
- C  $\pm 1.5$  MM. MAX ROTATION FROM THE INDICATED POSITION MEASURED AS SHOWN.
- D  $\pm 1$  MM MAX. OUT OF ALIGNMENT FROM THE INDICATED POSITION MEASURED ACROSS ANY DIAMETER AS SHOWN.
- E FLATTENING MEASURED AS DIFFERENCE BETWEEN THE MAX. AND MIN. OD AT ANY CROSS SECTION.  
-3% MAX. FOR PIPE WITH EXTERNAL PRESSURE  
8% MAX. FOR PIPE WITH INTERNAL PRESSURE.

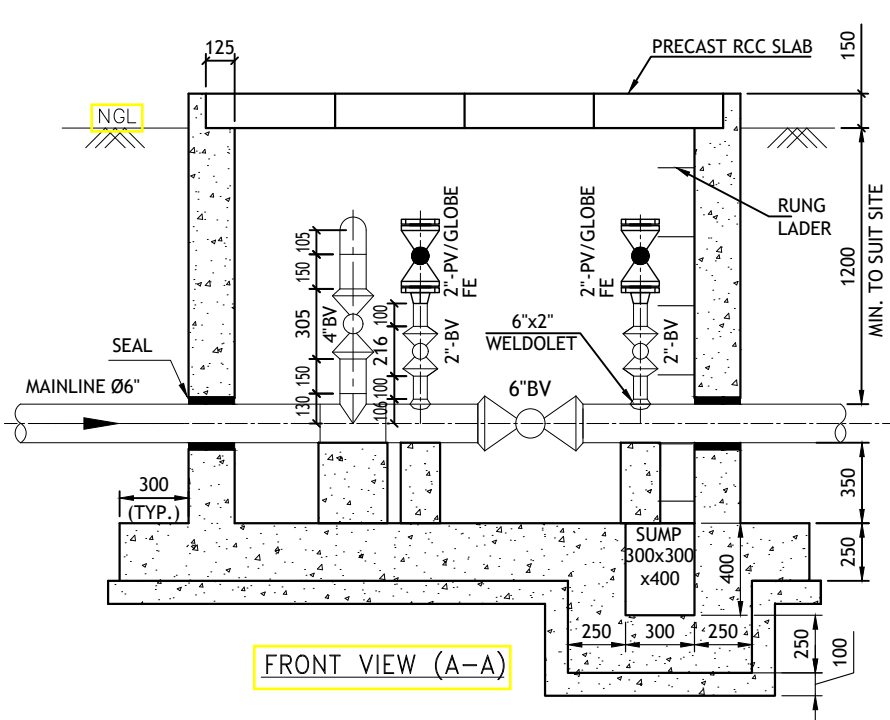
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|----------|----------|---------------------|------|------|------|
| 0        | 10.05.17 | ISSUED FOR STANDARD | US   | DK   | AD   |
| REV. NO. | DATE     | SUBJECT OF REVISION | PREP | CHKD | APPD |

|                                                                                                                                                 |                                 |                                                                                       |                                 |             |  |        |  |      |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------|---------------------------------|-------------|--|--------|--|------|--|
| <div></div> <div>M/s. VCS QUALITY SERVICES<br/>PVT. LTD.</div> |                                 | ABBREVIATIONS                                                                         |                                 | DRAWING NO. |  |        |  |      |  |
|                                                                                                                                                 |                                 |                                                                                       |                                 | SD-PI-029   |  |        |  |      |  |
|                                                                                                                                                 |                                 |                                                                                       |                                 | SHEET NO.   |  | 1 OF 1 |  |      |  |
|                                                                                                                                                 |                                 |                                                                                       |                                 |             |  |        |  |      |  |
| M&F                                                                                                                                             | MALE & FEMALE                   | SO                                                                                    | SLIP ON                         |             |  |        |  |      |  |
| MI                                                                                                                                              | MALLEABLE IRON                  | SOL                                                                                   | SOCKOLET                        |             |  |        |  |      |  |
| MOLY OR MO                                                                                                                                      | MOLYBDENUM                      | SP. GR                                                                                | SPECIFIC GRAVITY                |             |  |        |  |      |  |
| MR                                                                                                                                              | MATERIAL REQUISITION            | SR                                                                                    | SHORT RADIUS                    |             |  |        |  |      |  |
| MTO                                                                                                                                             | MATERIAL TAKE OFF               | SS                                                                                    | STAINLESS STEEL                 |             |  |        |  |      |  |
| MS                                                                                                                                              | MILD STEEL                      | ST                                                                                    | STEAM TRAP                      |             |  |        |  |      |  |
| MSS                                                                                                                                             | MANUFACTURER’S STANDARD SOCIETY | STN                                                                                   | STATION                         |             |  |        |  |      |  |
| MH                                                                                                                                              | MAN HLOE                        | STM                                                                                   | STEAM                           |             |  |        |  |      |  |
| NPT                                                                                                                                             | NATIONAL PIPE THREAD            | STD                                                                                   | STANDARD                        |             |  |        |  |      |  |
| NPSH                                                                                                                                            | NET POSITIVE SUCTION HEAD       | SW                                                                                    | SOCKET WELD                     |             |  |        |  |      |  |
| NIP                                                                                                                                             | NIPPLE                          | SWG                                                                                   | SWAGE NIPPLE / STD WIRE GAGE    |             |  |        |  |      |  |
| OD                                                                                                                                              | OUTSIDE DIAMETER                | STA                                                                                   | STEAM TRAP ASSEMBLY             |             |  |        |  |      |  |
| PC.MK                                                                                                                                           | PIECE MARK                      | TOG                                                                                   | TOP OF GRATING                  |             |  |        |  |      |  |
| PE                                                                                                                                              | PLAIN END                       | TEMP.                                                                                 | TEMPERATURE                     |             |  |        |  |      |  |
| PL                                                                                                                                              | PLATE                           | TOL                                                                                   | THREDOLET                       |             |  |        |  |      |  |
| PLTF                                                                                                                                            | PLATFORM                        | T&C                                                                                   | THREADED & COUPLED              |             |  |        |  |      |  |
| P.S                                                                                                                                             | PIPE SUPPORT                    | THRD                                                                                  | THREADED                        |             |  |        |  |      |  |
| PSE                                                                                                                                             | PLAIN SMALL END                 | T&G                                                                                   | TONGUE & GROOVE                 |             |  |        |  |      |  |
| PRESS.                                                                                                                                          | PRESSURE                        | TBE                                                                                   | THREADED BOTH ENDS              |             |  |        |  |      |  |
| PSI                                                                                                                                             | POUNDS PER SQUARE INCH          | TLE                                                                                   | THREADED LARGE END              |             |  |        |  |      |  |
| POE                                                                                                                                             | PLAIN ONE END                   | TSE                                                                                   | THREADED SMALL END              |             |  |        |  |      |  |
| PSIG                                                                                                                                            | POUNDS PER SQUARE INCH GAUGE    | TOS                                                                                   | TOP OF STEEL                    |             |  |        |  |      |  |
| RAD OR R                                                                                                                                        | RADIUS                          | TOE                                                                                   | THREADED ONE END                |             |  |        |  |      |  |
| RED.                                                                                                                                            | REDUCER                         | TYP                                                                                   | TYPICAL                         |             |  |        |  |      |  |
| RF                                                                                                                                              | RAISED FACE                     | VC                                                                                    | VENT CONNECTION                 |             |  |        |  |      |  |
| R/L                                                                                                                                             | RANDOM LENGTH                   | VERT.                                                                                 | VERTICAL                        |             |  |        |  |      |  |
| REF.                                                                                                                                            | REFERENCE                       | WP                                                                                    | WORKING PRESSURE, WORKING POINT |             |  |        |  |      |  |
| RPM                                                                                                                                             | REVOLUTIONS PER MINUTE          |  | INVERT LEVEL OF PIPE            |             |  |        |  |      |  |
| RTJ                                                                                                                                             | RING TYPE JOINT                 |  | BOTTOM LEVEL OF THE PIPE        |             |  |        |  |      |  |
| SH                                                                                                                                              | SPRING HANGER                   |  | CENTRELINE ELEVATION OF PIPE    |             |  |        |  |      |  |
| SHT                                                                                                                                             | SHEET                           | WN                                                                                    | WELD NECK                       |             |  |        |  |      |  |
| SCH                                                                                                                                             | SCHEDULE                        | WT                                                                                    | WEIGHT                          |             |  |        |  |      |  |
| SCRD                                                                                                                                            | SCREWED                         | WOL                                                                                   | WELDOLET                        |             |  |        |  |      |  |
| S                                                                                                                                               | SAMPLE CONNECTION               | WLD                                                                                   | WELD                            |             |  |        |  |      |  |
| SG                                                                                                                                              | SIGHT GLASS                     | XS                                                                                    | EXTRA STRONG                    |             |  |        |  |      |  |
| SC                                                                                                                                              | SAMPLE COOLER                   | XXS                                                                                   | DOUBLE EXTRA STRONG             |             |  |        |  |      |  |
| SMLS                                                                                                                                            | SEAMLESS                        |                                                                                       |                                 |             |  |        |  |      |  |
| <b>NOTE:</b>                                                                                                                                    |                                 |                                                                                       |                                 |             |  |        |  |      |  |
| 1. FOR ABBREVIATIONS RELATED TO CIVIL ENGINEERING/UNDERGROUND PIPING WORK, REFER CIVIL ENGINEERING STANDARD.                                    |                                 |                                                                                       |                                 |             |  |        |  |      |  |
| 0                                                                                                                                               | 10.05.17                        | ISSUED WITH TENDER                                                                    |                                 | US          |  | DK     |  | AD   |  |
| REV. NO.                                                                                                                                        | DATE                            | SUBJECT OF REVISION                                                                   |                                 | PREP        |  | CHKD   |  | APPD |  |

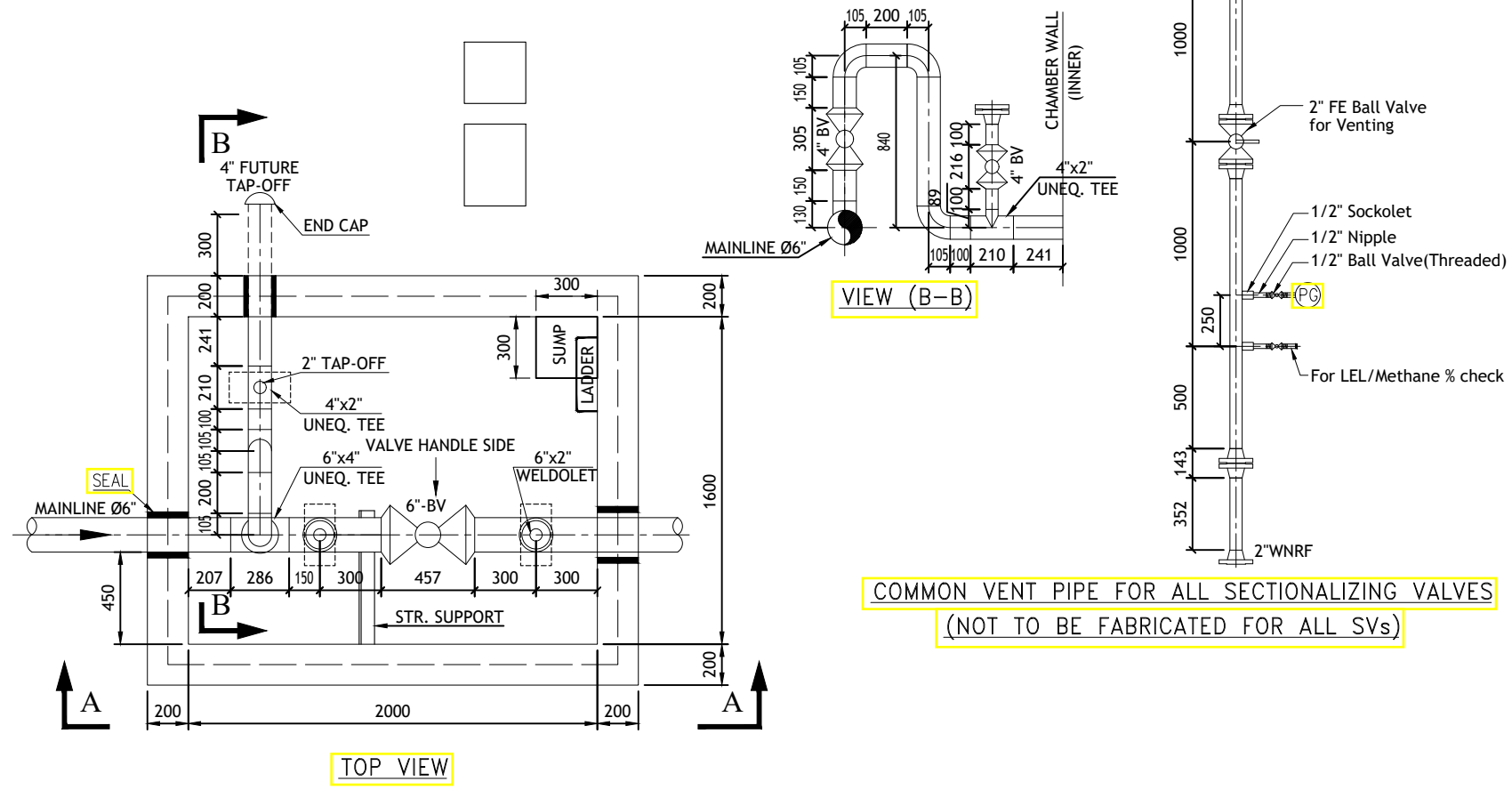




COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES  
(NOT TO BE FABRICATED FOR ALL SVs)



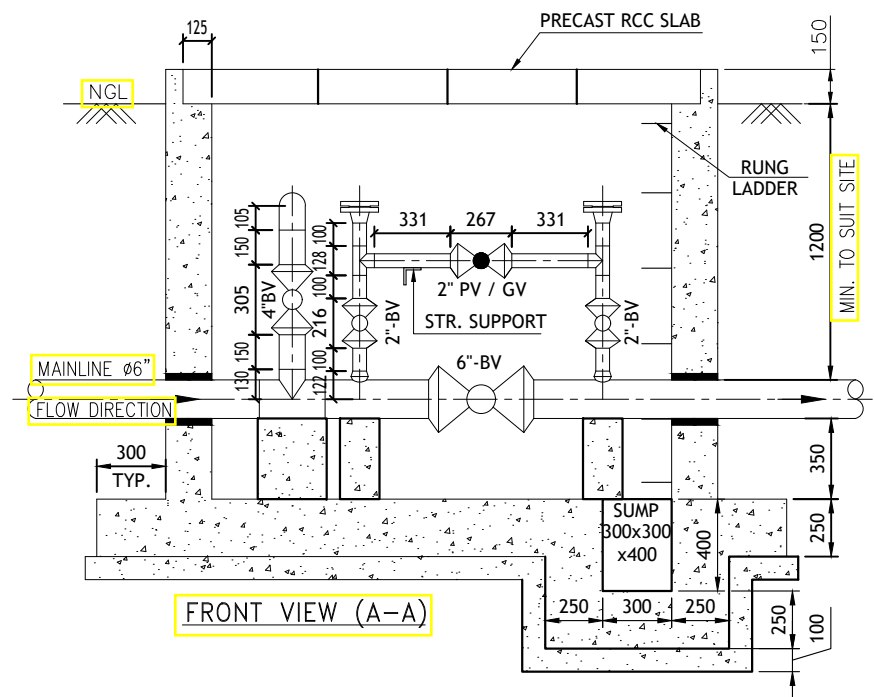
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------|--|-----------------|-------|--------|-------|
| 4                                                                                                                                                                                             |            | 3                            |  | 2               |       | 1      |       |
| REFERENCE DRAWINGS / DOCUMENTS                                                                                                                                                                |            |                              |  |                 |       |        |       |
| S.NO.                                                                                                                                                                                         |            | TITLE                        |  |                 |       | NO.    |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
| NOTES:-                                                                                                                                                                                       |            |                              |  |                 |       |        |       |
| 1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS OTHERWISE MENTIONED.                                                                                                                   |            |                              |  |                 |       |        |       |
| 2. APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY & EXIT OF PIPELINE TO RESTRICT WATER INTO PIT.                                                                                          |            |                              |  |                 |       |        |       |
| 3. COMMON VENT NOT TO BE FABRICATED FOR EACH SV. MINIMUM TWO SUCH VENTS TO BE FABRICATED FOR GAS COMMISSIONING AND THEN TO BE KEPT IN ERV FOR O&M PURPOSE.                                    |            |                              |  |                 |       |        |       |
| 4. FIRST SECTIONALIZING VALVE OF MAINLINE TO BE PROVIDED WITH PERMANENT BY-PASS & VENT. THEREAFTER SVs MAY BE PROVIDED WITH PERMANENT BY-PASS & WITHOUT PERMANENT BY-PASS LINE ALTERNATIVELY. |            |                              |  |                 |       |        |       |
| 5. FOR VALVE CHAMBER CONSTRUCTION, REFER RESPECTIVE DRAWING FOR CIVIL WORK. CHAMBER SLEEPERS MAY BE FABRICATED AS SHOWN IN THIS DRAWING FOR EASY LIFTING DURING O&M.                          |            |                              |  |                 |       |        |       |
| 6. ORIENTATION OF 2" VALVES INSTALLED IN BY-PASS/TAP-OFF TO BE SUCH THAT VALVE LEVER/HANDLE MOVEMENT IS NOT RESTRICTED BY ADJACENT WALL OF A CHAMBER.                                         |            |                              |  |                 |       |        |       |
| 7. VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.                                                                                                     |            |                              |  |                 |       |        |       |
| LEGEND:-                                                                                                                                                                                      |            |                              |  |                 |       |        |       |
|                                                                                                            |            | BUTT WELD BALL VALVE (B.V.)  |  |                 |       |        |       |
|                                                                                                            |            | FLANGED BALL VALVE           |  |                 |       |        |       |
|                                                                                                            |            | BUTT WELD GLOBE VALVE (G.V.) |  |                 |       |        |       |
|                                                                                                            |            | FLANGED GLOBE VALVE          |  |                 |       |        |       |
|                                                                                                           |            | THREAD END BALL VALVE        |  |                 |       |        |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
| 0                                                                                                                                                                                             | 02.05.2023 | ISSUED AS STANDARD           |  |                 | AK    | MN     | HK    |
| REV.                                                                                                                                                                                          | DATE       | DESCRIPTION                  |  |                 | PREP. | CHKD.  | APPD. |
| PMC                                                                                                                                                                                           |            |                              |  |                 |       |        |       |
|  VCS QUALITY SERVICES PVT. LTD.                                                                          |            |                              |  |                 |       |        |       |
| TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 6" SIZE WITH 4" FUTURE TAP-OFF & WITH FLEXIBLE BY-PASS PROVISION AND VENT (TYPE-6MV-1)                                          |            |                              |  |                 |       |        |       |
| SIZE                                                                                                                                                                                          |            | JOB NO.                      |  | DRAWING NUMBER  |       | SHEET  |       |
| A3                                                                                                                                                                                            |            | XXXX                         |  | VPC-STD-PP-2026 |       | 1 OF 5 |       |
|                                                                                                                                                                                               |            |                              |  |                 |       |        |       |
| 4                                                                                                                                                                                             |            | 3                            |  | 2               |       | 1      |       |



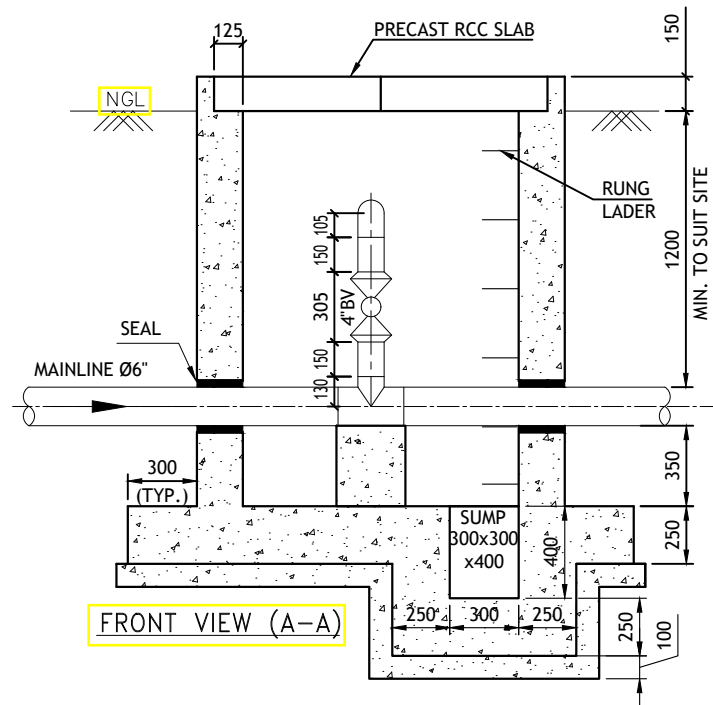
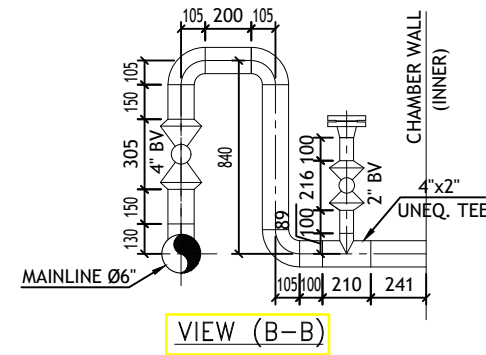
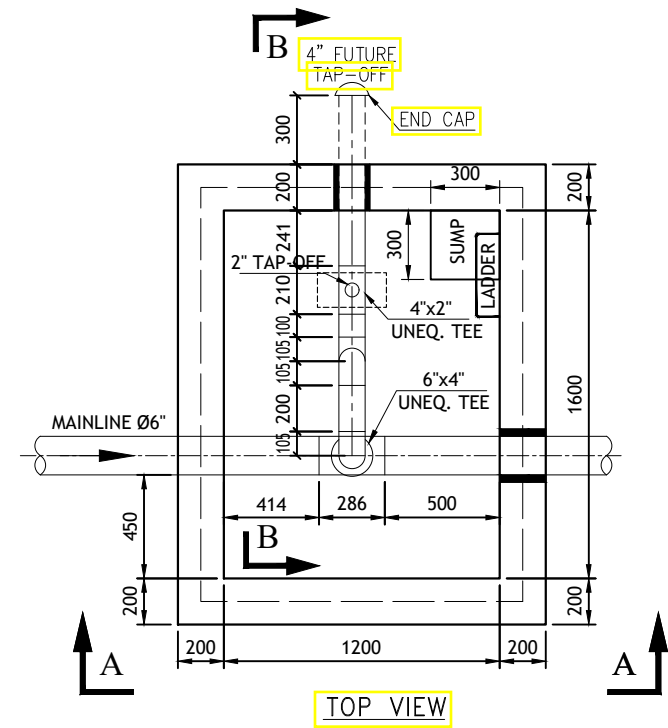
| REFERENCE DRAWINGS / DOCUMENTS |       |     |
|--------------------------------|-------|-----|
| S.NO.                          | TITLE | NO. |
|                                |       |     |
|                                |       |     |

- NOTES:-**
- ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS OTHERWISE MENTIONED.
  - APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY & EXIT OF PIPELINE TO RESTRICT WATER INTO PIT.
  - COMMON VENT NOT TO BE FABRICATED FOR EACH SV. MINIMUM TWO SUCH VENTS TO BE FABRICATED FOR GAS COMMISSIONING AND THEN TO BE KEPT IN ERV FOR O&M PURPOSE.
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  - VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.

| LEGEND:- |                              |
|----------|------------------------------|
|          | BUTT WELD BALL VALVE (B.V.)  |
|          | FLANGED BALL VALVE           |
|          | BUTT WELD GLOBE VALVE (G.V.) |
|          | FLANGED GLOBE VALVE          |
|          | THREAD END BALL VALVE        |



| 0                                                                                                                                                | 02.05.2023 | ISSUED AS STANDARD | AK     | MN    | HK    |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|--------|-------|-------|
| REV.                                                                                                                                             | DATE       | DESCRIPTION        | PREP.  | CHKD. | APPD. |
| PMC                                                                                                                                              |            |                    |        |       |       |
| VCS QUALITY SERVICES PVT. LTD.                                                                                                                   |            |                    |        |       |       |
| TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 6" SIZE WITH 4" FUTURE TAP-OFF & WITH PERMANENT BY-PASS LINE AND VENT (TYPE-6MV-3) |            |                    |        |       |       |
| SIZE                                                                                                                                             | JOB NO.    | DRAWING NUMBER     | SHEET  | REV.  |       |
| A3                                                                                                                                               | XXXX       | VPC-STD-PP-2026    | 3 OF 5 | 0     |       |



# REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
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|       |       |     |
|       |       |     |

## NOTES:-

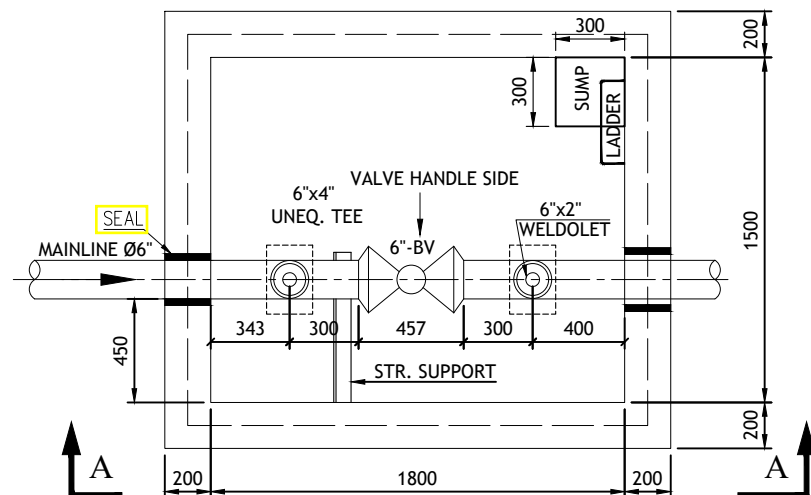
- ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS OTHERWISE MENTIONED.
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## LEGEND:-

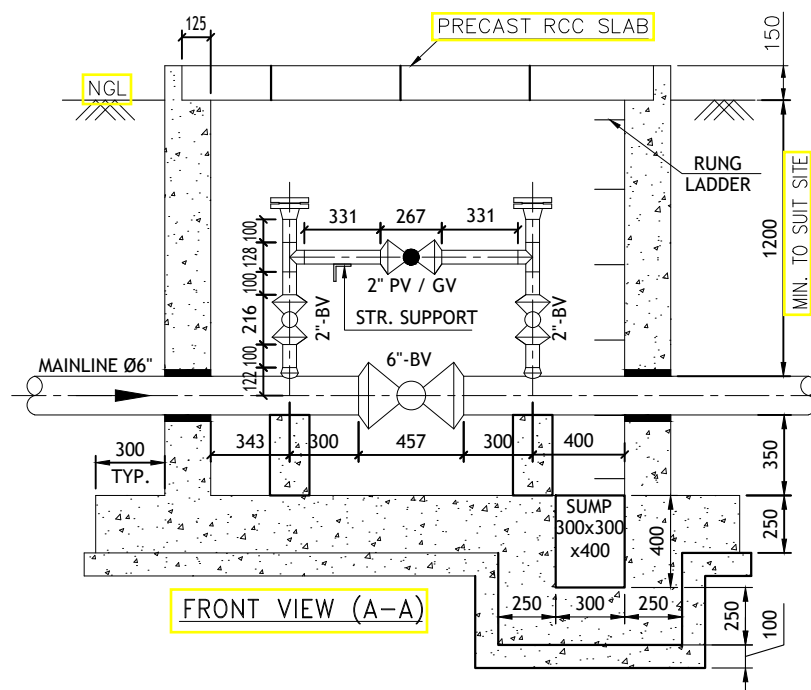
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|--|------------------------------|
|  | BUTT WELD BALL VALVE (B.V.)  |
|  | FLANGED BALL VALVE           |
|  | BUTT WELD GLOBE VALVE (G.V.) |
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|  | THREAD END BALL VALVE        |

| 0                                                                                                       | 02.05.2023 | ISSUED AS STANDARD | AK     | MN    | HK    |
|---------------------------------------------------------------------------------------------------------|------------|--------------------|--------|-------|-------|
| REV.                                                                                                    | DATE       | DESCRIPTION        | PREP.  | CHKD. | APPD. |
| <div> <div> </div> <div> VCS QUALITY SERVICES PVT. LTD. </div> </div>                                   |            |                    |        |       |       |
| <div> <div>TITLE</div> <div>GENERAL ARRANGEMENT DRAWING FOR 6" SIZE WITH 4" FUTURE TAP-OFF</div> </div> |            |                    |        |       |       |
| SIZE                                                                                                    | JOB NO.    | DRAWING NUMBER     | SHEET  | REV.  |       |
| A3                                                                                                      | XXXX       | VPC-STD-PP-2026    | 5 OF 5 | 0     |       |



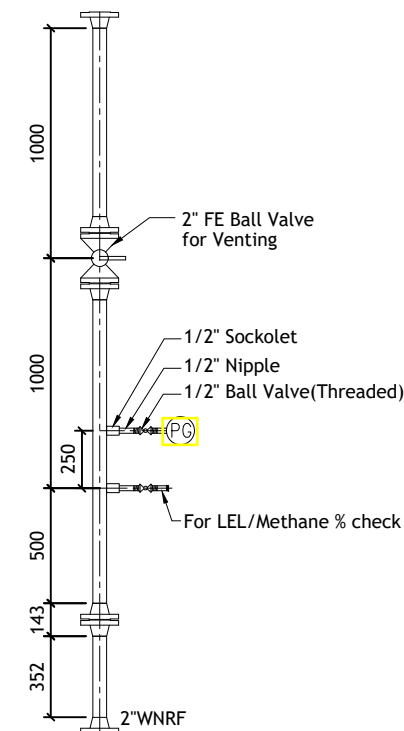


TOP VIEW



FRONT VIEW (A-A)

COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES  
(NOT TO BE FABRICATED FOR ALL SVs)



# REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
|       |       |     |

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|  |                              |
|--|------------------------------|
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|  | BUTT WELD GLOBE VALVE (G.V.) |
|  | FLANGED GLOBE VALVE          |
|  | THREAD END BALL VALVE        |

| REV. | DATE | DESCRIPTION | PREP. | CHKD. | APPD. |
|------|------|-------------|-------|-------|-------|
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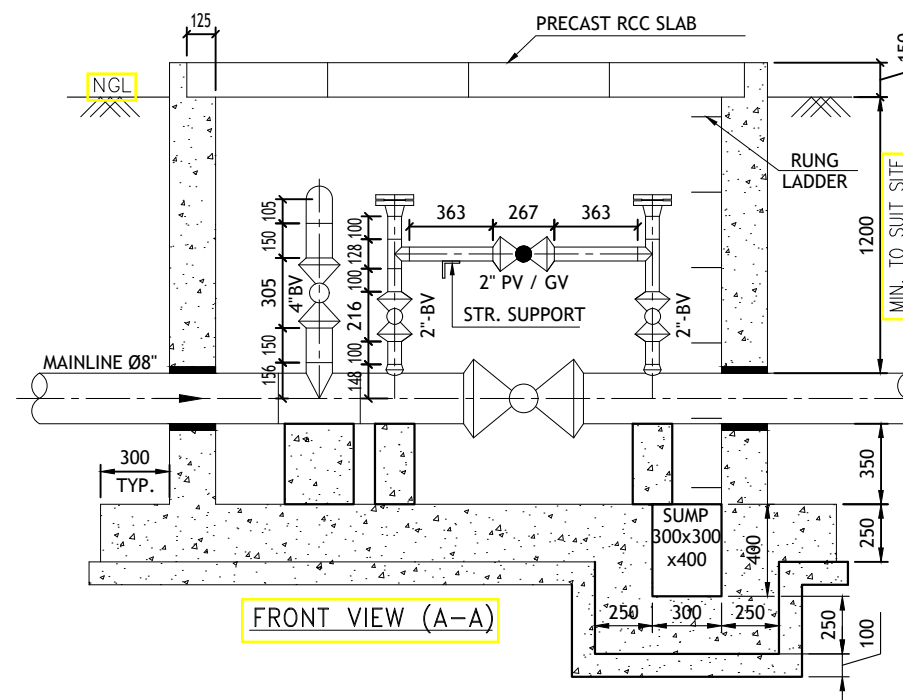
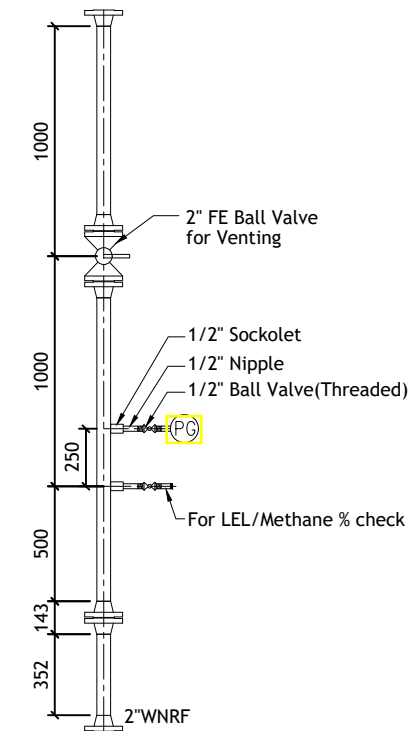
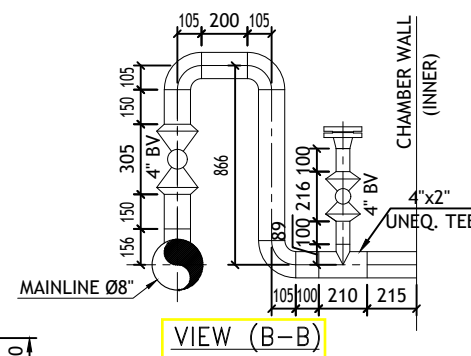
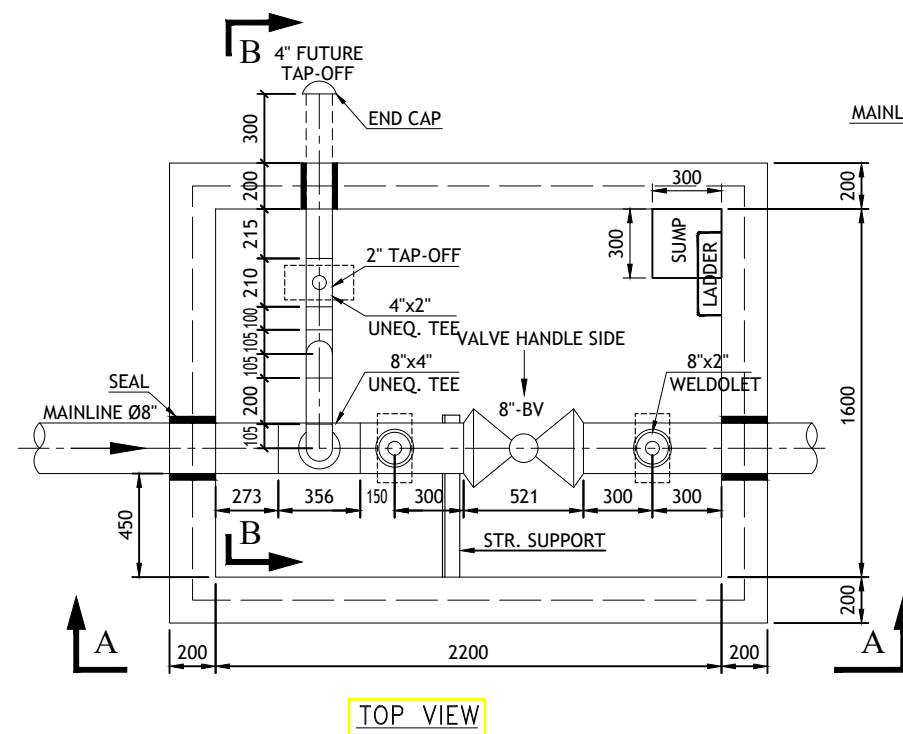
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| 0 | 02.05.2023 | ISSUED AS STANDARD | AK | MN | HK |
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| PMC | VCS QUALITY SERVICES PVT. LTD. |
|-----|--------------------------------|

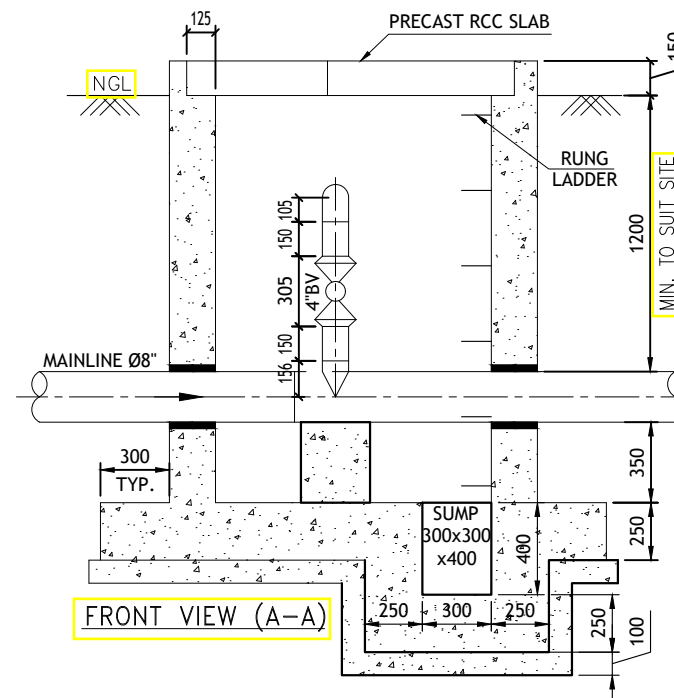
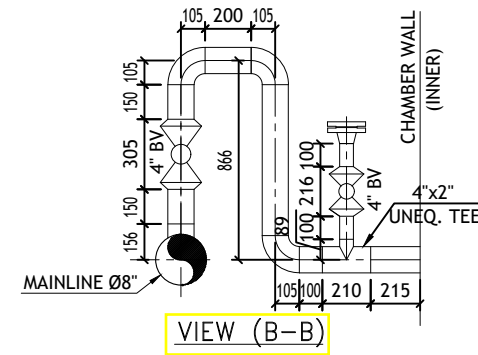
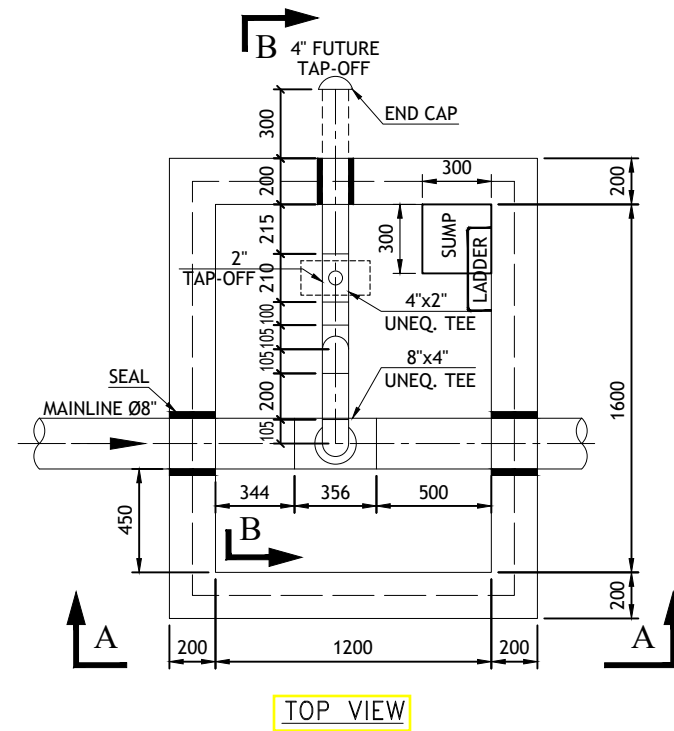
| SIZE | JOB NO. | DRAWING NUMBER  | SHEET  | REV. |
|------|---------|-----------------|--------|------|
| A3   | XXXX    | VPC-STD-PP-2026 | 4 OF 5 | 0    |







| <b>REFERENCE DRAWINGS / DOCUMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                    |        |       |       |
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| S.NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TITLE      |                    |        | NO.   |       |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                    |        |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                    |        |       |       |
| <b>NOTES:-</b> <ol style="list-style-type: none"> <li>1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS OTHERWISE MENTIONED.</li> <li>2. APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY &amp; EXIT OF PIPELINE TO RESTRICT WATER INTO PIT.</li> <li>3. COMMON VENT NOT TO BE FABRICATED FOR EACH SV. MINIMUM TWO SUCH VENTS TO BE FABRICATED FOR GAS COMMISSIONING AND THEN TO BE KEPT IN ERV FOR O&amp;M PURPOSE.</li> <li>4. FIRST SECTIONALIZING VALVE OF MAINLINE TO BE PROVIDED WITH PERMANENT BY-PASS &amp; VENT. THEREAFTER SVs MAY BE PROVIDED WITH PERMANENT BY-PASS &amp; WITHOUT PERMANENT BY-PASS LINE ALTERNATIVELY.</li> <li>5. FOR VALVE CHAMBER CONSTRUCTION, REFER RESPECTIVE DRAWING FOR CIVIL WORK. CHAMBER SLEEPERS MAY BE FABRICATED AS SHOWN IN THIS DRAWING FOR EASY LIFTING DURING O&amp;M.</li> <li>6. ORIENTATION OF 2" VALVES INSTALLED IN BY-PASS/TAP-OFF TO BE SUCH THAT VALVE LEVER/HANDLE MOVEMENT IS NOT RESTRICTED BY ADJACENT WALL OF A CHAMBER.</li> <li>7. VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.</li> </ol> |            |                    |        |       |       |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                    |        |       |       |
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| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 02.05.2023 | ISSUED AS STANDARD | AK     | MN    | HK    |
| REV.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DATE       | DESCRIPTION        | PREP.  | CHKD. | APPD. |
| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: left;"> <br/> <small>PROMOTING QUALITY</small> </div> <div style="text-align: right; font-weight: bold; font-size: 1.2em;">VCS QUALITY SERVICES PVT. LTD.</div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                    |        |       |       |
| <b>TITLE</b> GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 8" SIZE WITH 4" FUTURE TAP-OFF & WITH PERMANENT BY-PASS LINE AND VENT (TYPE-8MV-3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                    |        |       |       |
| SIZE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | JOB NO.    | DRAWING NUMBER     | SHEET  | REV.  |       |
| A3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | XXXX       | VPC-STD-PP-2027    | 3 OF 5 | 0     |       |



# REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
|-------|-------|-----|
|       |       |     |
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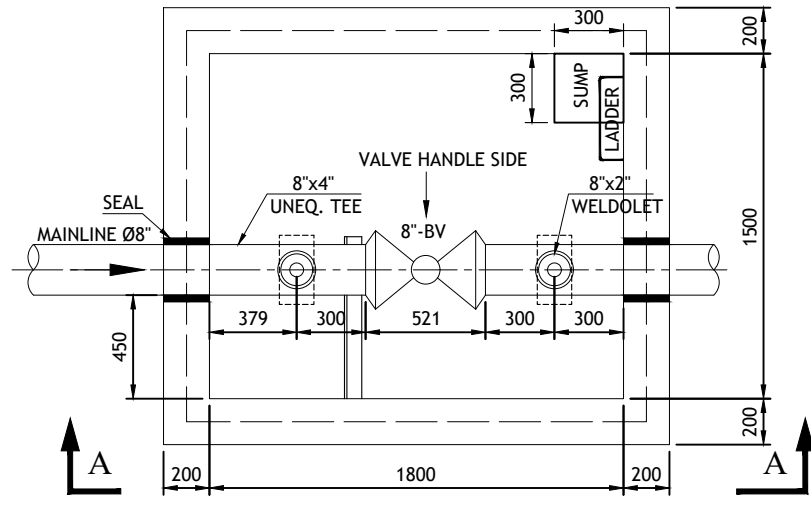
## LEGEND:-

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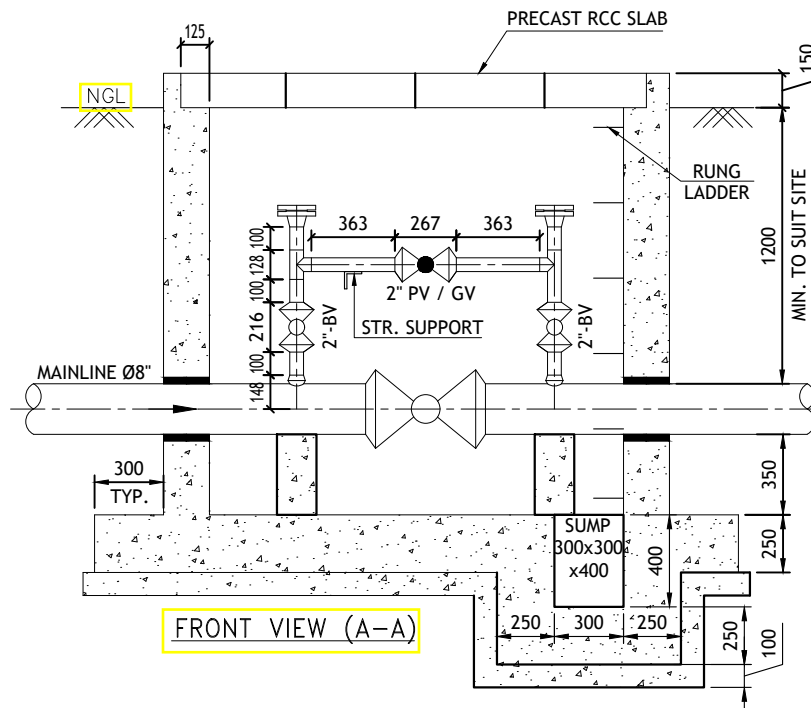
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| REV.                                                                                         | DATE       | DESCRIPTION        | PREP.  | CHKD. | APPD. |
|                                                                                              |            |                    |        |       |       |
| <div>  VCS QUALITY SERVICES PVT. LTD. </div>                                                 |            |                    |        |       |       |
| <div> <b>TITLE</b> GENERAL ARRANGEMENT DRAWING FOR<br/>8" SIZE WITH 4" FUTURE TAP-OFF </div> |            |                    |        |       |       |
| SIZE                                                                                         | JOB NO.    | DRAWING NUMBER     | SHEET  | REV.  |       |
| A3                                                                                           | XXXX       | VPC-STD-PP-2027    | 4 OF 5 | 0     |       |



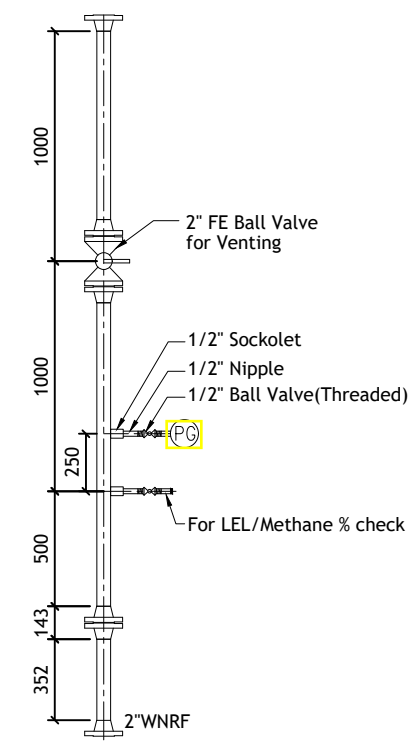




TOP VIEW



FRONT VIEW (A-A)



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES  
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS

| S.NO. | TITLE | NO. |
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|      |            |                    |       |       |       |
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| 0    | 02.05.2023 | ISSUED AS STANDARD | AK    | MN    | HK    |
| REV. | DATE       | DESCRIPTION        | PREP. | CHKD. | APPD. |

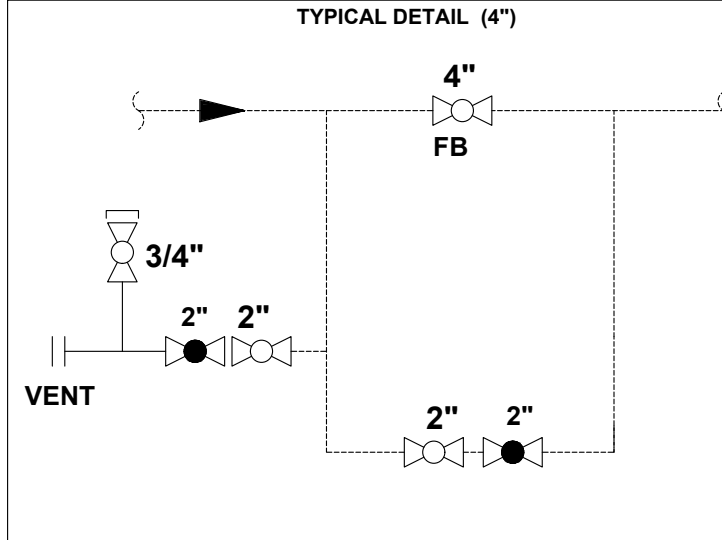
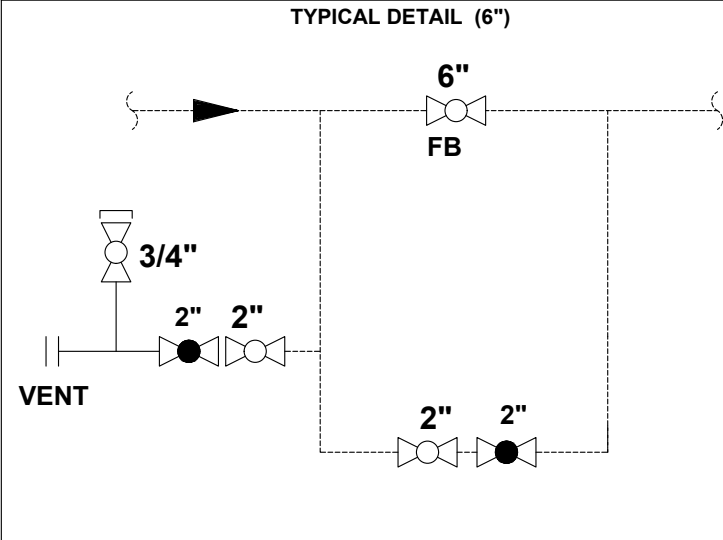
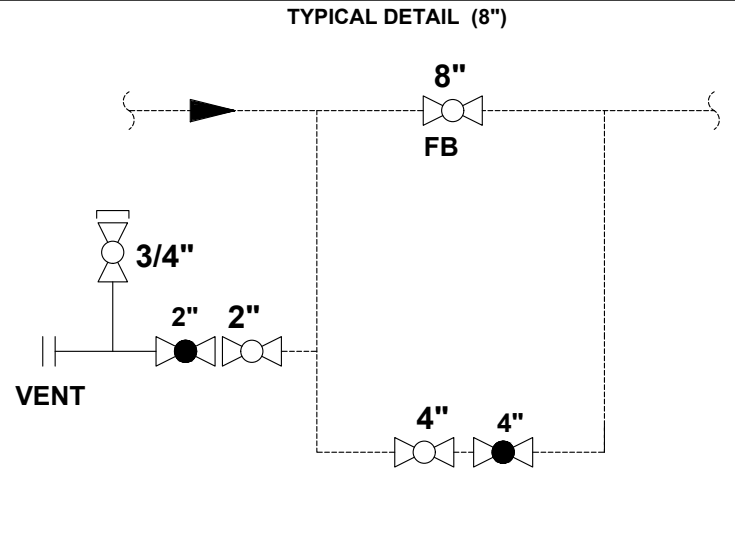
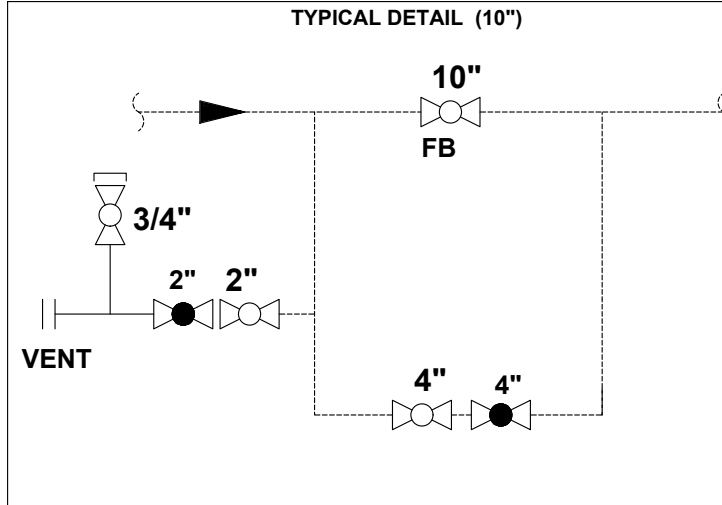
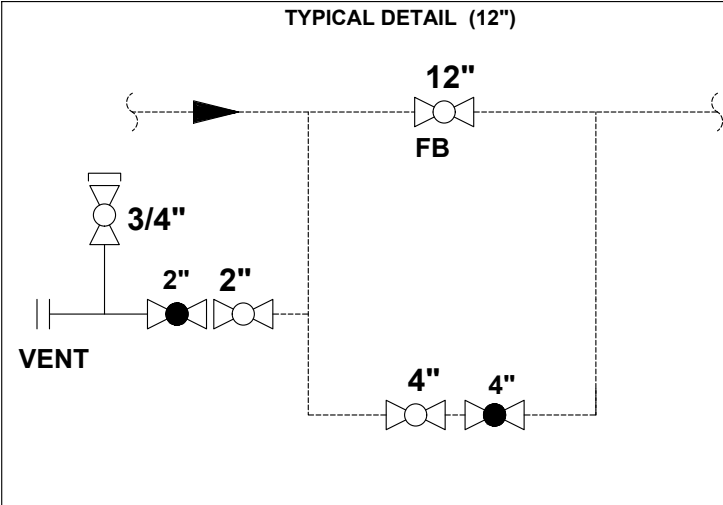
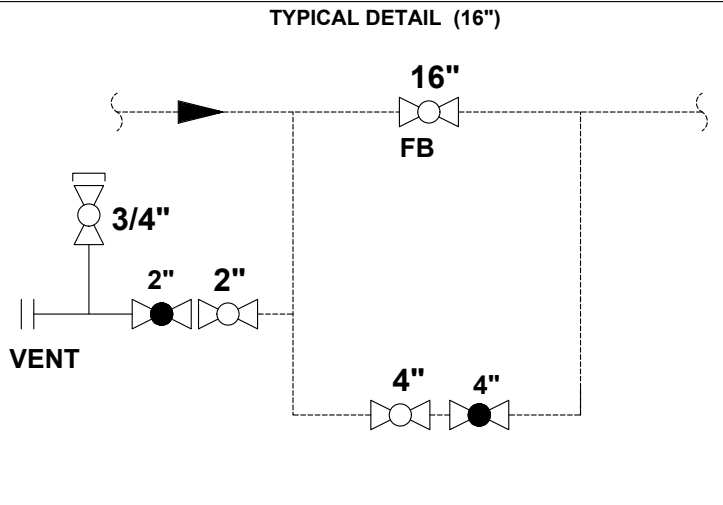
VCS QUALITY SERVICES PVT. LTD.

TITLE

GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 8" SIZE WITH PERMANENT BY-PASS LINE AND VENT (TYPE-8MV-4)

| SIZE | JOB NO. | DRAWING NUMBER  | SHEET  | REV. |
|------|---------|-----------------|--------|------|
| A3   | XXXX    | VPC-STD-PP-2027 | 4 OF 5 | 0    |

## ISOLATION VALVES TYPICAL DETAIL



### REFERENCE DRAWINGS

[illegible]

**GENERAL NOTES:-**

1. ALL LINE NUMBERING AND EQUIPMENT TAG NUMBERING SHALL BE PRE-FIXED WITH PROJECT & AREA CODE AS "C221085-DUM".
2. ALL INSTRUMENT TAG NUMBER SHALL BE PRE-FIXED WITH PROJECT AREA CODE AS "C221085-DUM" AND P & ID NUMBER.

**LEGENDS:**

|                                                                                     |                         |
|-------------------------------------------------------------------------------------|-------------------------|
|  | <b>ABOVE GROUND</b>     |
|  | <b>UNDERGROUND LINE</b> |
|  | <b>BALL VALVE</b>       |
|  | <b>GLOBE VALVE</b>      |

[illegible]

|      |          |                          |       |       |       |
|------|----------|--------------------------|-------|-------|-------|
| C1   | 06.01.26 | ISSUED FOR CLIENT REVIEW | HS    | VKG   | BND   |
| REV. | DATE     | DESCRIPTION              | PREP. | CHKD. | APPD. |

**CLIENT:**



**HINDUSTAN PETROLEUM CORPORATION LIMITED**

**PMC:**



Emerging Quality

**VCS PROJECT CONSULTANTS PVT. LTD.**  
**(ENGINEERING)**

PROJECT:

**CITY GAS DISTRIBUTION PROJECT AT GEOGRAPHICAL  
AREAS OF BIHAR - JHARKHAND DUMKA GA**

|       |                                                                                                |                         |        |      |
|-------|------------------------------------------------------------------------------------------------|-------------------------|--------|------|
| SCALE | TITLE:                                                                                         |                         |        |      |
| N.T.S | P&ID FOR ISOLATION VALVES TYPICAL DETAIL ,PIPE SIZE<br>16", 12", 10", 8", 6" AND 4" (DUMKA GA) |                         |        |      |
| SIZE  | JOB NO.                                                                                        | DRAWING NUMBER          | SHEET  | REV. |
| A1    | C221085                                                                                        | C221085-DUM-PC-PID-2001 | 1 OF 1 | C1   |

# **SURVEY REPORT**

**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES  
OF PIPELINE ROUTE AND STATIONS AT DIMAPUR,  
KOHIMA, CHUMUKEDIMA, NIULAND & OTHER  
DISTRICTS IN NAGALAND GA**

**CLIENT :**



**HP OIL GAS PRIVATE LIMITED**



**JAN - 2026**

**INVESTIGATED & PREPARED BY:**

**M/s. SWAYIN & ASSOCIATES**

**77, SATYANAGAR, BHUBANESWAR - 751 007**

**Ph. 9114468643, 9114057789**

**Email: kbs@swayinassociates.com / sns@swayinassociates.com**

**Website: www.swayiengineering.com**



|                                                             |                                                                                                                                                                              |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of Project</b>                                      | <b>Route Survey &amp; Associated<br/>Facilities Of Pipeline Route And<br/>Stations At Dimapur, Kohima,<br/>Chumukedima, Niuland &amp; Other<br/>Districts In Nagaland Ga</b> |
| <b>REF No. &amp; Date</b>                                   | <b>W.O No. NGLS025T0002<br/>Date:19.11.2025</b>                                                                                                                              |
| <b>Job No.</b>                                              | <b>SA-1146</b>                                                                                                                                                               |
| <b>Client</b>                                               | <b>HP OIL GAS PRIVATE LIMITED</b>                                                                                                                                            |
| <b>Investigated &amp; Prepared by</b>                       | <b>Swayin &amp; Associates.<br/>77, Satya Nagar, Bhubaneswar-751007</b>                                                                                                      |
| <b>Technical Consultant</b>                                 | <b>Shri. K.B Swayin<br/>(F.I.E)<br/><br/>Shri. S.N Swayin<br/>(F.I.E)</b>                                                                                                    |
| <b>Technical Assistant<br/>&amp;<br/>Report Prepared by</b> | <b>Narahari Singh<br/>B. Tech (Civil)<br/><br/>Amit Kumar<br/>M. Tech (Geotechnical Engineering)</b>                                                                         |

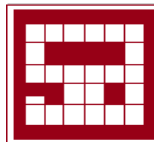
**Report Submitted by  
M/s Swayin & Associates.**

**Report Submitted to  
HP OIL PRIVATE LIMITED**

## **TABLE OF CONTENT**

| <b><u>SI No.</u></b> | <b><u>PARTICULARS</u></b>                      | <b><u>PAGE NO.</u></b> |
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| 1.                   | Route map of proposed alternates               | 1                      |
| 2.                   | Introduction                                   | 2                      |
| 3.                   | Survey methodology                             | 2                      |
| 4.                   | District falling along the route               | 3                      |
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| 7.                   | Guidelines for pipeline route selection        | 4-5                    |
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### RECONNAISSANCE SURVEY REPORT

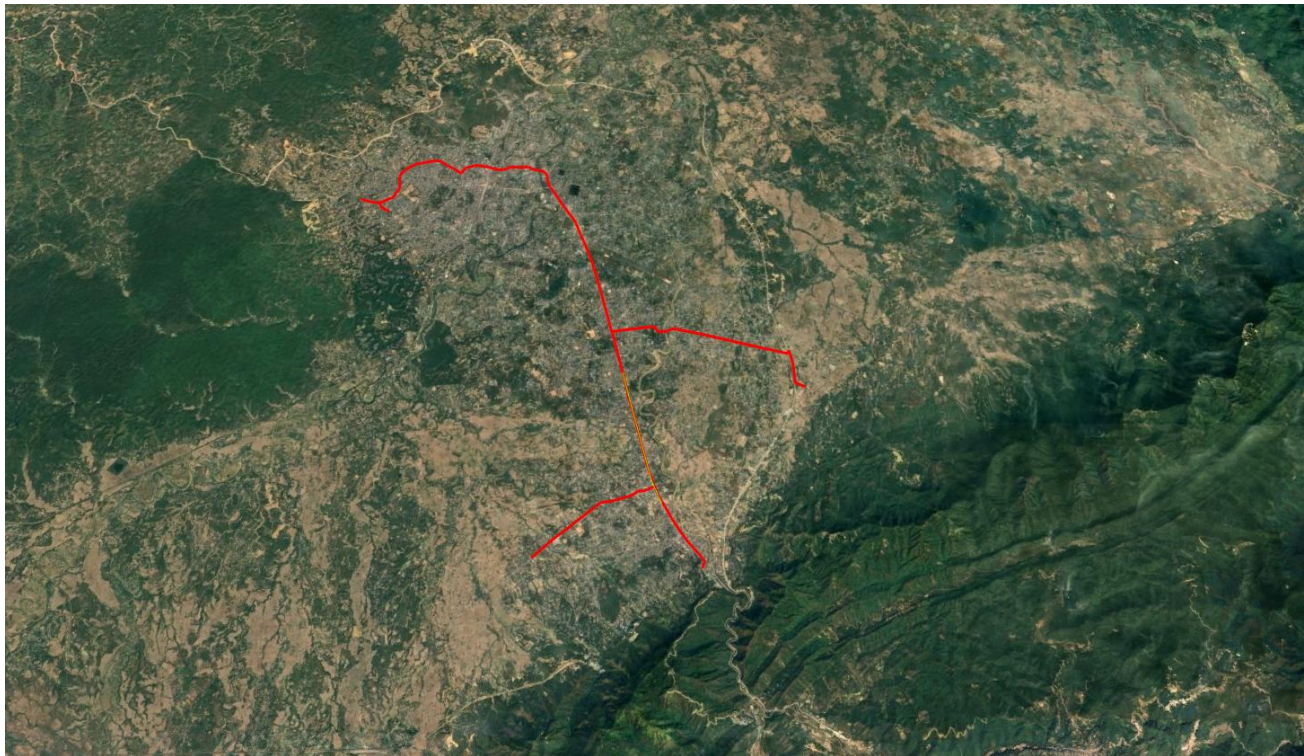


FIG.NO-1 ROUTE MAP OF PROPOSED ALTERNATES

#### Proposed Route: Length in km

Branch-1 - 18+916.66KM

Branch-2 - 7+419.72KM

Branch-3 - 3+824.71KM

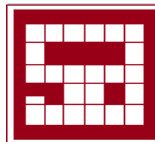
Branch-4 - 0+493.228KM

| Branch | Start Location                                               | End Location                                            |
|--------|--------------------------------------------------------------|---------------------------------------------------------|
| 1.     | Xelhozhe village, Dimapur district                           | Indisen Village, Dimapur district                       |
| 2.     | 4 <sup>th</sup> Mile Central Jail, Niuland, Dinapur District | HPCL Petrol Pump, Chumoukedima, Dimapur District        |
| 3.     | 7 <sup>th</sup> mile Chumoukdima, Dimapur district to        | HPCL Petrol pump, Virazouma, Dimapur district           |
| 4.     | Rongmei, Dimapur district                                    | Ummeed Prison Welfare Service Station, Dimapur District |





**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



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**JOB NO- SA-1146**

**INTRODUCTION**

HP OIL GAS PRIVATE LIMITED (HPOIL) is an Indian central public sector undertaking under the ownership of the Ministry of Petroleum and Natural Gas, Government of India and is one of the leading companies in the petroleum sector in India. HPOIL's business interests overlap the entire hydrocarbon value chain, including refining, pipeline transportation, and marketing of petroleum products, exploration and production of crude oil, natural gas and petrochemicals.

In response, W.O No. NGLS025T0002 date:19.11.2025. was submitted by M/s Swayin & Associates (S&A), Bhubaneswar, Odisha. HPOIL has approved the tender of S&A and was pleased to award to carry out the specified work in accordance with the Technical Specification and guidelines. The assignment was attended by Swayin & Associates, and completed in time. Periodical reports were submitted to the Client indicating the progress of Reconnaissance Survey work.

**SURVEY METHODOLOGY:**

**Desktop Study:**

Based on the various Topographical Maps of the Scale 1:10 Million, 1:250000 and 1:50000 Survey of India (SOI), Topographical Sheets, the locations of the Terminal to be connected have been marked and the Toposheet numbers through which the proposed pipelines are passing have been obtained. After obtaining these Toposheet numbers, the collection of the same have been done and the scanning of these Toposheets has been carried out.

The individual toposheet have been then merged and georeferenced and the Routes of the proposed pipelines were marked on them. After downloading Google Images from professional software version the necessary stitching has been carried out and section wise map of the pipeline was prepared. Based on the new developments marked on Google Image necessary digitization has been carried out and thereafter all such recent developments were transferred on Existing SOI map.

The same thing has been done in Digital copy by integrating images of toposheets with google images in Cad software and the printouts were taken for mobilizing the personnel to site.

**Field Reconnaissance:**

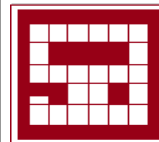
After desktop study is over, necessary changes at various locations were made and the final Desk Top Study Map is prepared.

Our Survey Teams have carried out the field reconnaissance along all the alternative routes for various sections of pipeline based on the origin and terminal point of the pipeline.

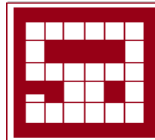
The Survey teams collected all necessary detail information for examining feasibility of all the possible alternative routes as per guidelines.

**Office work:**

After completion of the field survey, the team submitted all the formats duly filled and the maps provided to them with developments and markings and new topographical details marked on the toposheets to the office staff. Based on the final drawing all the necessary details as required for preparation of Reconnaissance Survey Report & Drawings are prepared.



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### **EXECUTIVE SUMMARY**

The objectives of the Reconnaissance pipeline route survey are as follows:

Gathering of the information about the details of the Pipeline Route after the survey and the most convenient route is selected and also collecting information about the existing sources along the proposed pipeline route. Details of the existing facilities etc. Located along and in the vicinity of the proposed pipeline Route.

### **SCOPE OF WORK FOR RECONNAISSANCE SURVEY WORK**

scope of work covered for the survey work is as follows:

- Obtaining information about the details of the Pipeline Location that is surveyed at the field.
- Shown the details of the route on the Route Map.
- Desktop study.
- Preparation of the Route Map in 1:1,000 Scales.
- Identification of the different Major Structures along the pipeline.
- Identification of crossings along location of major/minor crossings like rivers, drains, nala, national highways including approximate width and type of soil etc.,
- Identification of Collection of land use pattern along the pipeline route limited to identification of cultivated land, barren land and protected / reserved / social forest.
- The total Pipeline length is estimated from the Route Map.
- Identification of the reserved Forest areas and Government land & vacant land along the pipeline Route.
- Finalization of pipeline route for detailed route survey.
- Identification of other sources present, if any

### **DELIVERABLES**

- Topo maps in 1:50,000 Scale
- Reconnaissance Survey Report.
- Reconnaissance Survey Drawing.
- 

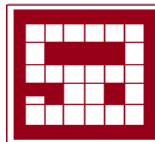
### **GUIDELINES FOR PIPELINE ROUTE SELECTION**

The Proposed pipeline route is optimized based on the following considerations:

- Safety of public lives and property and safety of the pipeline from engineering and other considerations.
- Shortest pipeline length. This criterion could not be followed as pipeline is to be routed through available road corridor.
- Easy and favorable terrain conditions free of large water bodies, low lying marshy lands, obstacles like ravines, depressions and unstable grounds, meandering rivers, etc.
- Ground profile for pipeline hydraulics avoiding steep rising and falling ground, avoiding hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Environmental impact and avoiding environmentally sensitive lands, such as reserved forests, marine parks,



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built-up areas, places of worship, burial and public events.

- Minimum crossing of existing pipelines, transmission lines, parallel alignment, etc.
- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and quarries.
- Scope for future expansion of the pipeline.

Existing and future developments in the region, such as roads, rail lines, Canal network, reservoirs, townships, industrial units, etc.

**APPROACH AND METHODOLOGY FOR PIPELINE ROUTE SELECTION**

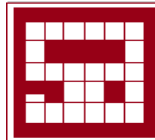
**OBJECTIVE:**

In consideration of the requirement of environmental parameters, construction methodology to be adopted for different terrain encountered, design and engineering factors, availability of logistic conditions during construction, operation and maintenance of the pipeline and specific geographical conditions to lay the pipeline is feasible and is identified based on the desktop study of topographical maps and as per guidelines the route is decided by and inspected by PML.

The present report covers Reconnaissance survey for Dimapur multiproduct petroleum pipeline project.

While identifying the Pipeline Route for the selection of optimum route following factors were considered.

- Compliance with environment regulations.
- Safety of people and property as far as possible.
- Shortest possible pipeline route is considered.
- Minimum number of bends as far as possible.
- Favourable ground profile for pipeline.
- Accessibility to pipeline route during construction, maintenance and operation as far as possible.
- Location of pipeline facilities and access there to.
- Avoidance of mining protected and Reserved Forest and other sensitive areas as far as possible.
- Avoidance of the difficult construction areas.
- Avoidance of sensitive areas such as designated areas of environmental sensitivity, forestry areas, etc.,
- Minimize the pipeline hazards to pipeline integrity.
- The optimum routes should be set on the maps and should indicate the pipeline route, positions of the proposed sites and National Highways, state Highways etc.
- Minimizing Road, canal, river and flood prone areas.
- Avoidance of areas reserved for planned future development.
- Flexibility of future expansion



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**GEOLOGICAL INFORMATION OF WILDLIFE SANCTUARIES OF EACH DISTRICT**

**DIMAPUR DISTRICT: -**

Dimapur district (including the newly carved **Chümoukedima district**) contains ecologically rich low-hills and plains that host several notified wildlife habitats. The **main wildlife sanctuary associated with the Dimapur region** is:

**Rangapahar Wildlife Sanctuary (Dimapur District):**

**Geological Information**

- The sanctuary lies on the alluvial plains and low-lying foothills at the junction of the Assam Valley and the Naga Hills.
- Geology is largely governed by:
  - Recent alluvium (silt, sand, clay) deposited by the Dhansiri River system.
  - Sub-recent terrace deposits with lateritic capping in elevated patches.
  - Underlying rocks belong mainly to the Disang and Barail Groups, forming the eastern hilly margins:
    - Shale, siltstone, and sandstone dominate.
    - Occasional ferruginous laterite occurs due to tropical weathering.
- Landform consists of:
  - Gently undulating plains in the north and west.
  - Foothill slopes to the east merging into the Naga Hills.
- Soil profile:
  - Alluvial loam in plains → fertile, porous, brown to yellowish.
  - Lateritic soil on upper slopes → reddish, iron-rich, moderately hard.

**Nagaland Zoological Park – Forest Zone (Chümoukedima Region):**

- Forms part of the Piedmont zone of the Naga Hills.
- Geology:
  - Disang shale with interbedded sandstone.
  - Weathered rock mantle forming colluvial soil at foothills.
  - Sandy loam in lower plains.

**Aosun & Ghaspani Reserved Forests (Dimapur–Chümoukedima Belt):**

- Transitional zone between plains and highlands.
- Geology:
  - Barail Sandstone Formation (hard, grey sandstone with shale layers).
  - Lateritic crusts developed due to intense tropical weathering.
  - Loose riverine sand and silt deposits along seasonal streams.

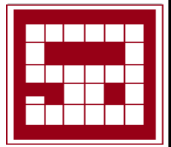
**Dhansiri River Corridor Eco-Sensitive Zone (Dimapur):**

*(Not a sanctuary but ecologically sensitive)*

- Dominated by:
  - Young alluvial deposits (sand, silt, clay).



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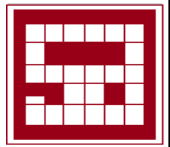
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- o Floodplain sediments created by Dhansiri meandering.
- o Occasional peaty soil in depressions.





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### SUMMARY OF PROPOSED ROUTE

#### TAP-OFF & TERMINAL POINT

##### Tap -off Point at Ch: 0.00 Km

The Station plot is located at Xelhozhe village, Dimapur district and Nagaland state.

The location area is situated at Latitude 25°50'54.31"N, Longitude 93°49'13.71"E.



#### TAP – OFF POINT OF ROUTE- 1

##### Terminal Point at Indisen Village Ch: 18+916.660 Km

The Terminal point is located at Indisen Village, Dimapur district, state of Nagaland.

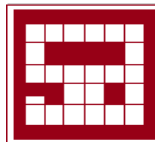
whose co-ordinates are as i.e. Latitude 25°54'11"E, Longitude 93°41'30"N.



#### TERMINAL POINT OF BRANCH 1



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**DETAILS OF BRANCH - 1:**

| Particulars                        | Chainage (km) | Latitude     | Longitude    | District | State    |
|------------------------------------|---------------|--------------|--------------|----------|----------|
| Xelhozhe village, Dimapur district | 0+000.00      | 25°50'54.31" | 93°49'13.71" | Dimapur  | Nagaland |
| Indisen Village, Dimapur district  | 18+916.66     | 25°54'11"    | 93°41'30"    | Dimapur  | Nagaland |

**SURVEY OF INDIA TOPO MAP BRANCH-1:**

| SL No. | Particulars | Scale    | Chainage (Km) |                | Length (Km) | Toposheet No. |
|--------|-------------|----------|---------------|----------------|-------------|---------------|
|        |             |          | Tap-off Point | Terminal Point |             |               |
| 1      | TOPO SHEETS | 1:50,000 | 0+000.00      | 18+916.66      | 18+916.66   | G46P9, G46P13 |

**LIST OF CROSSINGS FOR BRANCH-1**

| ABSTRACT OF CROSSINGS |                             |                     |
|-----------------------|-----------------------------|---------------------|
| SL.NO                 | TYPE OF CROSSING            | NUMBER OF CROSSINGS |
| 1.                    | Railway Crossing            | 1                   |
| 2.                    | River                       | 2                   |
| 3.                    | Canal/Nala/ Minor Waterways | 5                   |
| 4.                    | NH                          | 3                   |
| 5.                    | SH                          | -                   |
|                       | <b>Total</b>                | <b>11</b>           |

**TYPE OF TERRAIN/LAND USE (BRANCH-01):**

The Terrain and land use along Pipeline Branch-01 is described in the below table:

| SECTION                                                                                                                                               | TERRAIN AND LAND USE                                                                                                    | REMARKS                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Xelhozhe Village to Indisen Village of (Ch: 0+000.00km to Ch: 18+916.660Km).<br>Tap-off point Xelhozhe Village and Terminal point is Indisen Village. | Proposed Pipeline Route passes through the Railway, River, National Highway, asphalted Road, Cart track Road, Nala etc. | There are crossing of National Highway, Asphalted Road, Cart track Road, Nala, Future development plans are observed in the en-route of pipeline. |





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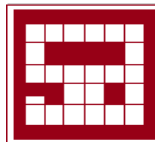
**CONSTRAINTS:**

Major Constraints for routing the pipeline are summarized below:

- **WATER NETWORKS**  
The proposed pipeline has crossing through Nala, River.
- **ROAD NETWORK**  
Along the proposed pipeline a consistent No. of Road crossings are noticed.



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**Summary of Detailed Route Survey Salient Features**

**SALIENT FEATURES (BRANCH-1):**

|            |                                        |                                              |
|------------|----------------------------------------|----------------------------------------------|
| <b>(A)</b> | <b><u>State wise Length (Km.)</u></b>  |                                              |
|            | (a) Nagaland                           | 18+916.66km                                  |
|            | <b><u>Revenue Details</u></b>          |                                              |
|            | (a) State                              | 1                                            |
|            | (b) District                           | 1                                            |
| <b>(B)</b> | <b><u>Road Crossing (No's)</u></b>     |                                              |
|            | (a) National Highway                   | 3                                            |
|            | (b) State Highway                      | -                                            |
|            | (c) Railway                            | 1                                            |
| <b>(C)</b> | <b><u>Water Bodies (No's)</u></b>      |                                              |
|            | (a) Canal                              | -                                            |
|            | (b) Rivers                             | 2                                            |
|            | (c) Nala                               | 4                                            |
| <b>(D)</b> | <b><u>Seismic Zone</u></b>             | Zone-V                                       |
| <b>(E)</b> | <b><u>Tap-Off GPS Coordinates</u></b>  |                                              |
|            | (a) BRANCH-1                           | Latitude-25°50'56"N<br>Longitude-93°49'14"E  |
| <b>(F)</b> | <b><u>Terminal GPS Coordinates</u></b> |                                              |
|            | (a) BRANCH-1                           | Latitude- 25°54'11"N<br>Longitude-93°41'30"E |

**ANNEXURES LIST:**

**Route: -**

|            |                                    |
|------------|------------------------------------|
| Annexure-A | List of TP'S/IP'S Details          |
| Annexure-B | List of all Crossings              |
| Annexure-C | List of Existing Railway Crossings |
| Annexure-D | List of River Crossings            |
| Annexure-E | List of National Highways          |
| Annexure-F | List of State Highways             |
| Annexure-G | List of Canal/Nala/Drain Crossings |



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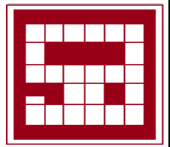
**ANNEXURE-A**

**List of TP's/IP's Details Falling on the Route of Pipeline (In UTM Co-ordinates):**

| TURNING POINTS, DISTANCES & BEARING STATEMENT |                  |            |          |                              |      |             |             |           |           |
|-----------------------------------------------|------------------|------------|----------|------------------------------|------|-------------|-------------|-----------|-----------|
| SL. NO                                        | TP-IP PILLAR NO. | CHAINAGE   | DISTANCE | DEFLECTION ANGLE DEG MIN SEC | SIDE | EASTING     | NORTHING    | LATITUDE  | LONGITUDE |
| 1                                             | TP-0             | 0+00.00    | 85.11    | 00°00'00"                    | L    | 582218.9587 | 2859216.494 | 25°50'56" | 93°49'14" |
| 2                                             | TP-1             | 0+085.1086 | 60.84    | 09°27'32"                    | L    | 582144.3974 | 2859257.532 | 25°50'58" | 93°49'11" |
| 3                                             | TP-2             | 0+145.9515 | 12.25    | 18°41'33"                    | L    | 582096.6404 | 2859295.23  | 25°50'59" | 93°49'09" |
| 4                                             | TP-3             | 0+158.1975 | 24.23    | 18°45'02"                    | L    | 582085.1039 | 2859299.337 | 25°50'59" | 93°49'09" |
| 5                                             | TP-4             | 0+182.4243 | 33.12    | 11°26'03"                    | L    | 582060.8797 | 2859299.694 | 25°50'59" | 93°49'08" |
| 6                                             | TP-5             | 0+215.5460 | 29.33    | 09°36'44"                    | L    | 582028.5156 | 2859306.737 | 25°50'59" | 93°49'07" |
| 7                                             | TP-6             | 0+244.8793 | 238.44   | 84°21'02"                    | L    | 581999.214  | 2859308.102 | 25°50'59" | 93°49'06" |
| 8                                             | IP-6/1           | 0+483.3162 | 239.54   | 00°00'00"                    | R    | 581986.8043 | 2859546.215 | 25°51'07" | 93°49'05" |
| 9                                             | IP-6/2           | 0+722.8512 | 130.45   | 00°00'00"                    | R    | 581962.8671 | 2859784.551 | 25°51'15" | 93°49'05" |
| 10                                            | TP-7             | 0+853.2977 | 158.03   | 05°24'17"                    | R    | 581946.2564 | 2859913.936 | 25°51'19" | 93°49'04" |
| 11                                            | IP-7/1           | 1+011.3304 | 133.00   | 00°00'00"                    | R    | 581911.4579 | 2860068.09  | 25°51'24" | 93°49'03" |
| 12                                            | TP-8             | 1+144.3350 | 53.48    | 70°50'58"                    | R    | 581879.7576 | 2860197.261 | 25°51'28" | 93°49'02" |
| 13                                            | TP-9             | 1+197.8113 | 42.63    | 15°42'18"                    | L    | 581826.5151 | 2860202.258 | 25°51'28" | 93°48'60" |
| 14                                            | TP-10            | 1+240.4426 | 46.13    | 05°16'05"                    | L    | 581786.7335 | 2860217.583 | 25°51'29" | 93°48'58" |
| 15                                            | IP-10/1          | 1+286.5686 | 198.45   | 00°00'00"                    | L    | 581742.3498 | 2860230.141 | 25°51'29" | 93°48'57" |
| 16                                            | TP-11            | 1+485.0190 | 23.43    | 05°19'04"                    | L    | 581548.5684 | 2860272.935 | 25°51'31" | 93°48'50" |
| 17                                            | IP-11/1          | 1+508.4522 | 153.16   | 00°00'00"                    | L    | 581526.2534 | 2860280.088 | 25°51'31" | 93°48'49" |
| 18                                            | IP-11/2          | 1+661.6165 | 112.61   | 00°00'00"                    | L    | 581377.0762 | 2860314.807 | 25°51'32" | 93°48'44" |
| 19                                            | TP-12            | 1+774.2276 | 49.82    | 08°01'23"                    | L    | 581267.2742 | 2860339.803 | 25°51'33" | 93°48'40" |
| 20                                            | TP-13            | 1+824.0493 | 48.82    | 10°32'17"                    | L    | 581217.6275 | 2860343.973 | 25°51'33" | 93°48'38" |
| 21                                            | IP-13/1          | 1+872.8715 | 67.88    | 00°00'00"                    | L    | 581170.5444 | 2860356.888 | 25°51'34" | 93°48'36" |
| 22                                            | IP-13/2          | 1+940.7479 | 64.88    | 00°00'00"                    | L    | 581105.1865 | 2860375.207 | 25°51'34" | 93°48'34" |
| 23                                            | IP-13/3          | 2+005.6255 | 77.39    | 00°00'00"                    | L    | 581042.212  | 2860390.805 | 25°51'35" | 93°48'32" |
| 24                                            | IP-13/4          | 2+083.0162 | 133.96   | 00°00'00"                    | L    | 580967.0107 | 2860409.083 | 25°51'35" | 93°48'29" |
| 25                                            | IP-13/5          | 2+216.9751 | 115.59   | 00°00'00"                    | L    | 580836.593  | 2860439.68  | 25°51'36" | 93°48'24" |
| 26                                            | IP-13/6          | 2+332.5675 | 131.09   | 00°00'00"                    | L    | 580723.7125 | 2860464.572 | 25°51'37" | 93°48'20" |
| 27                                            | IP-13/7          | 2+463.6616 | 92.10    | 00°00'00"                    | L    | 580596.1254 | 2860494.692 | 25°51'38" | 93°48'16" |
| 28                                            | IP-13/8          | 2+555.7615 | 84.64    | 00°00'00"                    | L    | 580506.6595 | 2860516.561 | 25°51'39" | 93°48'13" |
| 29                                            | IP-13/9          | 2+640.4035 | 104.70   | 00°00'00"                    | L    | 580424.213  | 2860535.714 | 25°51'40" | 93°48'10" |
| 30                                            | IP-13/10         | 2+745.1080 | 86.74    | 00°00'00"                    | L    | 580322.3689 | 2860560.02  | 25°51'40" | 93°48'06" |
| 31                                            | IP-13/11         | 2+831.8508 | 53.17    | 00°00'00"                    | L    | 580237.7896 | 2860579.273 | 25°51'41" | 93°48'03" |
| 32                                            | IP-14            | 2+885.0191 | 130.57   | 05°18'38"                    | L    | 580187.259  | 2860595.811 | 25°51'42" | 93°48'01" |
| 33                                            | IP-14/1          | 3+015.5925 | 110.94   | 00°00'00"                    | L    | 580059.9364 | 2860624.766 | 25°51'43" | 93°47'57" |
| 34                                            | IP-14/2          | 3+126.5345 | 99.97    | 00°00'00"                    | L    | 579951.9487 | 2860650.198 | 25°51'43" | 93°47'53" |
| 35                                            | IP-14/3          | 3+226.5016 | 112.67   | 00°00'00"                    | L    | 579854.5639 | 2860672.773 | 25°51'44" | 93°47'49" |
| 36                                            | IP-14/4          | 3+339.1763 | 126.34   | 00°00'00"                    | L    | 579744.9049 | 2860698.667 | 25°51'45" | 93°47'45" |
| 37                                            | IP-14/5          | 3+465.5187 | 103.00   | 00°00'00"                    | L    | 579621.6138 | 2860726.266 | 25°51'46" | 93°47'41" |
| 38                                            | IP-14/6          | 3+568.5187 | 67.25    | 00°00'00"                    | L    | 579521.2182 | 2860750.424 | 25°51'47" | 93°47'37" |
| 39                                            | IP-14/7          | 3+635.7719 | 102.61   | 00°00'00"                    | L    | 579455.6643 | 2860764.23  | 25°51'47" | 93°47'35" |
| 40                                            | IP-14/8          | 3+738.3807 | 137.85   | 00°00'00"                    | L    | 579355.3938 | 2860786.011 | 25°51'48" | 93°47'31" |
| 41                                            | IP-14/9          | 3+876.2276 | 119.35   | 00°00'00"                    | L    | 579220.8057 | 2860815.807 | 25°51'49" | 93°47'26" |
| 42                                            | IP-14/10         | 3+995.5818 | 145.59   | 00°00'00"                    | L    | 579104.2823 | 2860841.648 | 25°51'50" | 93°47'22" |
| 43                                            | IP-14/11         | 4+141.1723 | 101.37   | 00°00'00"                    | L    | 578961.3756 | 2860869.548 | 25°51'51" | 93°47'17" |
| 44                                            | IP-14/12         | 4+242.5445 | 89.40    | 00°00'00"                    | L    | 578862.2747 | 2860890.818 | 25°51'51" | 93°47'14" |
| 45                                            | IP-14/13         | 4+331.9428 | 91.15    | 00°00'00"                    | L    | 578774.762  | 2860909.082 | 25°51'52" | 93°47'10" |
| 46                                            | TP-15            | 4+423.0907 | 37.07    | 07°10'43"                    | L    | 578685.9506 | 2860929.005 | 25°51'53" | 93°47'07" |
| 47                                            | TP-16            | 4+460.1584 | 45.43    | 08°55'51"                    | L    | 578648.9268 | 2860932.572 | 25°51'53" | 93°47'06" |
| 48                                            | TP-17            | 4+505.5902 | 50.05    | 07°25'39"                    | L    | 578603.5778 | 2860929.828 | 25°51'53" | 93°47'04" |
| 49                                            | TP-18            | 4+555.6366 | 29.22    | 11°37'44"                    | L    | 578554.4326 | 2860920.374 | 25°51'52" | 93°47'02" |
| 50                                            | TP-19            | 4+584.8533 | 66.27    | 16°53'32"                    | L    | 578527.4435 | 2860909.185 | 25°51'52" | 93°47'02" |
| 51                                            | TP-20            | 4+651.1240 | 20.28    | 16°30'08"                    | L    | 578476.2417 | 2860867.111 | 25°51'51" | 93°46'60" |
| 52                                            | TP-21            | 4+671.4053 | 29.59    | 14°20'04"                    | L    | 578457.56   | 2860859.217 | 25°51'50" | 93°46'59" |
| 53                                            | IP-21/1          | 4+700.9939 | 152.83   | 00°00'00"                    | L    | 578428.302  | 2860854.805 | 25°51'50" | 93°46'58" |
| 54                                            | IP-21/2          | 4+853.8215 | 35.11    | 00°00'00"                    | L    | 578276.7253 | 2860835.292 | 25°51'50" | 93°46'52" |
| 55                                            | IP-21/3          | 4+888.9342 | 23.50    | 00°00'00"                    | L    | 578241.6178 | 2860834.689 | 25°51'50" | 93°46'51" |
| 56                                            | TP-22            | 4+912.4313 | 10.23    | 09°49'50"                    | L    | 578218.1324 | 2860835.426 | 25°51'50" | 93°46'50" |
| 57                                            | TP-23            | 4+922.6598 | 21.96    | 17°15'25"                    | L    | 578208.1137 | 2860837.488 | 25°51'50" | 93°46'50" |
| 58                                            | TP-24            | 4+944.6189 | 41.73    | 10°32'58"                    | L    | 578188.8866 | 2860848.096 | 25°51'50" | 93°46'49" |
| 59                                            | TP-25            | 4+986.3490 | 53.05    | 09°10'57"                    | L    | 578156.6569 | 2860874.603 | 25°51'51" | 93°46'48" |
| 60                                            | TP-26            | 5+039.3941 | 50.42    | 06°18'15"                    | L    | 578121.5896 | 2860914.403 | 25°51'52" | 93°46'47" |
| 61                                            | TP-27            | 5+089.8092 | 16.93    | 09°24'05"                    | L    | 578092.6166 | 2860955.662 | 25°51'54" | 93°46'46" |
| 62                                            | TP-28            | 5+106.7422 | 16.35    | 05°59'47"                    | L    | 578080.7524 | 2860967.744 | 25°51'54" | 93°46'45" |
| 63                                            | TP-29            | 5+123.0895 | 18.50    | 11°14'51"                    | L    | 578068.1429 | 2860978.147 | 25°51'54" | 93°46'45" |
| 64                                            | TP-30            | 5+141.5883 | 15.14    | 11°32'45"                    | L    | 578051.8516 | 2860986.91  | 25°51'55" | 93°46'44" |
| 65                                            | TP-31            | 5+156.7264 | 38.38    | 10°12'10"                    | L    | 578037.3543 | 2860991.268 | 25°51'55" | 93°46'44" |
| 66                                            | TP-32            | 5+195.1047 | 16.19    | 12°06'51"                    | L    | 577999.2782 | 2860995.633 | 25°51'55" | 93°46'43" |
| 67                                            | TP-33            | 5+211.2933 | 44.90    | 12°05'07"                    | L    | 577983.1129 | 2860994.056 | 25°51'55" | 93°46'42" |
| 68                                            | IP-33/1          | 5+256.1891 | 38.92    | 00°00'00"                    | L    | 577940.3554 | 2860980.432 | 25°51'55" | 93°46'40" |
| 69                                            | TP-34            | 5+295.1044 | 53.96    | 09°16'12"                    | L    | 577902.5305 | 2860971.199 | 25°51'54" | 93°46'39" |
| 70                                            | TP-35            | 5+349.0669 | 96.22    | 05°25'12"                    | L    | 577848.7303 | 2860967.014 | 25°51'54" | 93°46'37" |
| 71                                            | IP-35/1          | 5+445.2912 | 187.00   | 00°00'00"                    | L    | 577753.9296 | 2860950.524 | 25°51'54" | 93°46'34" |
| 72                                            | IP-35/2          | 5+632.2868 | 89.80    | 00°00'00"                    | L    | 577569.3165 | 2860920.769 | 25°51'53" | 93°46'27" |
| 73                                            | IP-35/3          | 5+722.0852 | 43.68    | 00°00'00"                    | L    | 577480.0165 | 2860911.321 | 25°51'52" | 93°46'24" |
| 74                                            | IP-35/4          | 5+765.7648 | 79.87    | 00°00'00"                    | L    | 577436.7309 | 2860905.468 | 25°51'52" | 93°46'22" |
| 75                                            | IP-35/5          | 5+845.6339 | 105.11   | 00°00'00"                    | L    | 577358.2633 | 2860890.571 | 25°51'52" | 93°46'19" |
| 76                                            | IP-35/6          | 5+950.7391 | 71.57    | 00°00'00"                    | L    | 577254.6085 | 2860873.17  | 25°51'51" | 93°46'16" |
| 77                                            | IP-35/7          | 6+022.3085 | 123.77   | 00°00'00"                    | L    | 577183.937  | 2860861.868 | 25°51'51" | 93°46'13" |
| 78                                            | IP-35/8          | 6+146.0772 | 135.96   | 00°00'00"                    | L    | 577061.8277 | 2860841.67  | 25°51'50" | 93°46'09" |
| 79                                            | TP-36            | 6+282.0421 | 26.72    | 06°14'25"                    | L    | 576927.7443 | 2860819.129 | 25°51'49" | 93°46'04" |
| 80                                            | IP-36/1          | 6+308.7641 | 21.79    | 00°00'00"                    | L    | 576902.0299 | 2860811.86  | 25°51'49" | 93°46'03" |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE  
AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER  
DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

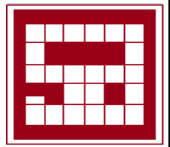
**JOB NO- SA-1146**

**TURNING POINTS, DISTANCES & BEARING STATEMENT**

| SL. NO | TP-IP<br>PILLAR<br>NO. | CHAINAGE    | DISTAN<br>CE | DEFLECTION<br>ANGLE DEG<br>MIN SEC | SIDE | EASTING     | NORTHING    | LATITUDE  | LONGIT<br>UDE |
|--------|------------------------|-------------|--------------|------------------------------------|------|-------------|-------------|-----------|---------------|
| 81     | TP-37                  | 6+330.5565  | 93.95        | 90°55'02"                          | L    | 576881.0593 | 2860805.933 | 25°51'49" | 93°46'02"     |
| 82     | IP-37/1                | 6+424.5079  | 117.96       | 00°00'00"                          | L    | 576856.9545 | 2860896.739 | 25°51'52" | 93°46'01"     |
| 83     | IP-37/2                | 6+542.4678  | 123.37       | 00°00'00"                          | L    | 576827.1188 | 2861010.863 | 25°51'56" | 93°46'00"     |
| 84     | IP-37/3                | 6+665.8391  | 173.37       | 00°00'00"                          | L    | 576794.7074 | 2861129.901 | 25°51'60" | 93°45'59"     |
| 85     | IP-37/4                | 6+839.2118  | 169.00       | 00°00'00"                          | L    | 576749.1418 | 2861297.179 | 25°52'05" | 93°45'58"     |
| 86     | IP-37/5                | 7+008.2095  | 165.40       | 00°00'00"                          | L    | 576702.1884 | 2861454.312 | 25°52'10" | 93°45'56"     |
| 87     | IP-37/6                | 7+173.6126  | 95.56        | 00°00'00"                          | L    | 576655.0687 | 2861618.07  | 25°52'15" | 93°45'54"     |
| 88     | IP-37/7                | 7+269.1721  | 101.45       | 00°00'00"                          | L    | 576627.4658 | 2861709.556 | 25°52'18" | 93°45'53"     |
| 89     | IP-37/8                | 7+370.6191  | 71.62        | 00°00'00"                          | L    | 576599.2925 | 2861807.013 | 25°52'22" | 93°45'52"     |
| 90     | IP-37/9                | 7+442.2369  | 143.67       | 00°00'00"                          | L    | 576578.1831 | 2861875.449 | 25°52'24" | 93°45'52"     |
| 91     | IP-37/10               | 7+585.9099  | 127.79       | 00°00'00"                          | L    | 576537.2305 | 2862013.162 | 25°52'28" | 93°45'50"     |
| 92     | IP-37/11               | 7+713.6984  | 89.09        | 00°00'00"                          | L    | 576501.4106 | 2862135.827 | 25°52'32" | 93°45'49"     |
| 93     | IP-37/12               | 7+802.7897  | -629.18      | 00°00'00"                          | L    | 576475.691  | 2862221.125 | 25°52'35" | 93°45'48"     |
| 94     | IP-37/13               | 7+173.6126  | 886.57       | 00°00'00"                          | L    | 576435.1203 | 2862357.508 | 25°52'40" | 93°45'47"     |
| 95     | IP-37/14               | 8+060.1827  | 140.19       | 00°00'00"                          | L    | 576402.5065 | 2862467.9   | 25°52'43" | 93°45'45"     |
| 96     | IP-37/15               | 8+200.3709  | 132.34       | 00°00'00"                          | L    | 576361.7825 | 2862602.038 | 25°52'48" | 93°45'44"     |
| 97     | IP-37/16               | 8+332.7073  | 90.87        | 00°00'00"                          | L    | 576322.6678 | 2862728.461 | 25°52'52" | 93°45'43"     |
| 98     | IP-37/17               | 8+423.5778  | 74.42        | 00°00'00"                          | L    | 576295.9969 | 2862815.33  | 25°52'54" | 93°45'42"     |
| 99     | IP-37/18               | 8+497.9975  | 145.25       | 00°00'00"                          | L    | 576270.745  | 2862885.334 | 25°52'57" | 93°45'41"     |
| 100    | IP-37/19               | 8+643.2444  | 134.24       | 00°00'00"                          | L    | 576224.7271 | 2863023.098 | 25°53'11" | 93°45'39"     |
| 101    | IP-37/20               | 8+777.4891  | 93.48        | 00°00'00"                          | L    | 576180.5475 | 2863149.865 | 25°53'05" | 93°45'38"     |
| 102    | IP-37/21               | 8+870.9696  | 84.01        | 00°00'00"                          | L    | 576150.4477 | 2863238.367 | 25°53'08" | 93°45'37"     |
| 103    | IP-37/22               | 8+954.9816  | 90.65        | 00°00'00"                          | L    | 576120.9311 | 2863317.023 | 25°53'11" | 93°45'36"     |
| 104    | IP-37/23               | 9+045.6320  | 123.08       | 00°00'00"                          | L    | 576087.061  | 2863401.108 | 25°53'14" | 93°45'34"     |
| 105    | IP-37/24               | 9+168.7114  | 138.72       | 00°00'00"                          | L    | 576038.597  | 2863514.326 | 25°53'17" | 93°45'33"     |
| 106    | IP-37/25               | 9+307.4283  | 116.85       | 00°00'00"                          | L    | 575982.5675 | 2863641.142 | 25°53'21" | 93°45'31"     |
| 107    | IP-37/26               | 9+424.2808  | 131.76       | 00°00'00"                          | L    | 575938.2195 | 2863749.252 | 25°53'25" | 93°45'29"     |
| 108    | IP-37/27               | 9+556.0364  | 131.23       | 00°00'00"                          | L    | 575887.0315 | 2863870.658 | 25°53'29" | 93°45'27"     |
| 109    | IP-37/28               | 9+687.2680  | 89.14        | 00°00'00"                          | L    | 575835.4368 | 2863991.321 | 25°53'33" | 93°45'25"     |
| 110    | IP-37/29               | 9+776.4078  | 110.89       | 00°00'00"                          | L    | 575801.1631 | 2864073.609 | 25°53'35" | 93°45'24"     |
| 111    | IP-37/30               | 9+887.3000  | 115.90       | 00°00'00"                          | L    | 575759.2633 | 2864176.28  | 25°53'39" | 93°45'23"     |
| 112    | IP-37/31               | 10+003.1979 | 152.72       | 00°00'00"                          | L    | 575714.9984 | 2864283.392 | 25°53'42" | 93°45'21"     |
| 113    | TP-38                  | 10+155.9182 | 44.64        | 06°52'48"                          | L    | 575656.2282 | 2864424.352 | 25°53'47" | 93°45'19"     |
| 114    | IP-38/1                | 10+200.5553 | 94.81        | 00°00'00"                          | L    | 575634.239  | 2864463.197 | 25°53'48" | 93°45'18"     |
| 115    | IP-38/2                | 10+295.37   | 182.47       | 00°00'00"                          | L    | 575580.6109 | 2864541.384 | 25°53'51" | 93°45'16"     |
| 116    | IP-38/3                | 10+477.84   | 215.99       | 00°00'00"                          | L    | 575473.3586 | 2864689.011 | 25°53'56" | 93°45'13"     |
| 117    | IP-38/4                | 10+693.83   | 128.42       | 00°00'00"                          | L    | 575347.8688 | 2864864.809 | 25°54'01" | 93°45'08"     |
| 118    | IP-38/5                | 10+822.25   | 119.96       | 00°00'00"                          | L    | 575273.3866 | 2864969.417 | 25°54'05" | 93°45'05"     |
| 119    | IP-38/6                | 10+942.21   | 162.6        | 00°00'00"                          | L    | 575207.6079 | 2865069.737 | 25°54'08" | 93°45'03"     |
| 120    | IP-38/7                | 11+104.81   | 189.25       | 00°00'00"                          | L    | 575117.222  | 2865204.898 | 25°54'12" | 93°44'60"     |
| 121    | IP-38/8                | 11+294.06   | 90.34        | 00°00'00"                          | L    | 575013.9085 | 2865363.494 | 25°54'18" | 93°44'56"     |
| 122    | IP-38/9                | 11+384.4    | 106.97       | 00°00'00"                          | L    | 574962.8997 | 2865438.019 | 25°54'20" | 93°44'54"     |
| 123    | IP-38/10               | 11+491.37   | 53.49        | 00°00'00"                          | L    | 574904.2134 | 2865527.492 | 25°54'23" | 93°44'52"     |
| 124    | TP-39                  | 11+544.86   | 60.53        | 17°21'28"                          | L    | 574874.1599 | 2865571.702 | 25°54'24" | 93°44'51"     |
| 125    | TP-40                  | 11+605.39   | 22.41        | 33°09'32"                          | L    | 574826.7424 | 2865609.332 | 25°54'26" | 93°44'50"     |
| 126    | TP-41                  | 11+627.8    | 89.61        | 00°00'00"                          | L    | 574821.1293 | 2865631.03  | 25°54'26" | 93°44'49"     |
| 127    | IP-41/1                | 11+717.41   | 54.76        | 00°00'00"                          | L    | 574792.8386 | 2865716.05  | 25°54'29" | 93°44'48"     |
| 128    | IP-41/2                | 11+772.17   | 42.47        | 06°31'37"                          | L    | 574774.5751 | 2865767.74  | 25°54'31" | 93°44'48"     |
| 129    | TP-42                  | 11+814.64   | 29.34        | 11°43'27"                          | L    | 574755.9559 | 2865805.921 | 25°54'32" | 93°44'47"     |
| 130    | TP-43                  | 11+843.98   | 61.35        | 06°27'22"                          | L    | 574748.7403 | 2865834.358 | 25°54'33" | 93°44'47"     |
| 131    | IP-43/1                | 11+905.33   | 115.24       | 00°00'00"                          | L    | 574740.4035 | 2865895.154 | 25°54'35" | 93°44'46"     |
| 132    | IP-43/2                | 12+020.57   | 26.7         | 00°00'00"                          | L    | 574728.8207 | 2866009.791 | 25°54'39" | 93°44'46"     |
| 133    | TP-44                  | 12+047.27   | 13.39        | 09°57'15"                          | L    | 574723.815  | 2866035.955 | 25°54'39" | 93°44'46"     |
| 134    | TP-45                  | 12+060.66   | 35.68        | 11°19'41"                          | L    | 574719.0522 | 2866048.539 | 25°54'40" | 93°44'46"     |
| 135    | IP-45/1                | 12+096.34   | 37.55        | 00°00'00"                          | L    | 574700.135  | 2866078.719 | 25°54'41" | 93°44'45"     |
| 136    | IP-45/1                | 12+133.89   | 36.09        | 00°00'00"                          | L    | 574678.1805 | 2866109.182 | 25°54'42" | 93°44'44"     |
| 137    | TP-46                  | 12+169.98   | 45.81        | 10°14'15"                          | L    | 574655.4406 | 2866137.286 | 25°54'43" | 93°44'43"     |
| 138    | TP-47                  | 12+215.79   | 51.1         | 17°24'51"                          | L    | 574620.9677 | 2866167.012 | 25°54'44" | 93°44'42"     |
| 139    | IP-47/1                | 12+266.89   | 52.8         | 00°00'00"                          | L    | 574573.8827 | 2866187.437 | 25°54'44" | 93°44'41"     |
| 140    | TP-48                  | 12+319.69   | 137.16       | 14°57'36"                          | L    | 574525.4391 | 2866208.589 | 25°54'45" | 93°44'39"     |
| 141    | IP-48/1                | 12+456.85   | 38.33        | 00°00'00"                          | L    | 574389.8918 | 2866229.141 | 25°54'46" | 93°44'34"     |
| 142    | IP-48/2                | 12+495.18   | 60.45        | 00°00'00"                          | L    | 574351.8881 | 2866234.182 | 25°54'46" | 93°44'33"     |
| 143    | TP-49                  | 12+555.63   | 73.86        | 17°23'31"                          | L    | 574292.2121 | 2866243.826 | 25°54'46" | 93°44'30"     |
| 144    | IP-49/1                | 12+629.49   | 17.96        | 00°00'00"                          | L    | 574226.1572 | 2866276.863 | 25°54'47" | 93°44'28"     |
| 145    | TP-50                  | 12+647.45   | 79.79        | 08°04'45"                          | L    | 574210.7719 | 2866286.241 | 25°54'48" | 93°44'28"     |
| 146    | TP-51                  | 12+727.24   | 19.42        | 11°10'12"                          | L    | 574149.1994 | 2866336.901 | 25°54'49" | 93°44'25"     |
| 147    | TP-52                  | 12+746.66   | 15.35        | 30°06'50"                          | L    | 574132.039  | 2866346.13  | 25°54'50" | 93°44'25"     |
| 148    | TP-53                  | 12+762.01   | 25.43        | 17°33'46"                          | L    | 574116.6903 | 2866345.605 | 25°54'50" | 93°44'24"     |
| 149    | TP-54                  | 12+787.44   | 38.81        | 07°56'57"                          | L    | 574092.7724 | 2866337.159 | 25°54'49" | 93°44'23"     |
| 150    | IP-54/1                | 12+826.25   | 18.76        | 00°00'00"                          | L    | 574058.3056 | 2866319.327 | 25°54'49" | 93°44'22"     |
| 151    | TP-55                  | 12+845.01   | 40.35        | 21°07'39"                          | L    | 574042.2776 | 2866309.574 | 25°54'48" | 93°44'21"     |
| 152    | TP-56                  | 12+885.36   | 86.31        | 13°54'12"                          | L    | 574002.4996 | 2866302.423 | 25°54'48" | 93°44'20"     |
| 153    | IP-56/1                | 12+971.67   | 79.44        | 00°00'00"                          | L    | 573916.445  | 2866308.02  | 25°54'48" | 93°44'17"     |
| 154    | IP-56/2                | 13+051.11   | 71.91        | 00°00'00"                          | L    | 573837.1686 | 2866313.325 | 25°54'49" | 93°44'14"     |
| 155    | IP-56/3                | 13+123.02   | 128.04       | 00°00'00"                          | L    | 573765.4345 | 2866319.103 | 25°54'49" | 93°44'12"     |
| 156    | IP-56/4                | 13+251.06   | 13.74        | 00°00'00"                          | L    | 573637.6877 | 2866326.79  | 25°54'49" | 93°44'07"     |
| 157    | TP-57                  | 13+264.8    | 19.11        | 10°15'56"                          | L    | 573623.9395 | 2866326.68  | 25°54'49" | 93°44'06"     |
| 158    | TP-58                  | 13+283.91   | 13.01        | 08°55'33"                          | L    | 573605.1643 | 2866323.125 | 25°54'49" | 93°44'06"     |
| 159    | TP-59                  | 13+296.92   | 43.98        | 07°01'09"                          | L    | 573593.8593 | 2866316.691 | 25°54'49" | 93°44'05"     |
| 160    | IP-59/1                | 13+340.9    | 18.72        | 00°00'00"                          | L    | 573558.6851 | 2866290.504 | 25°54'48" | 93°44'04"     |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

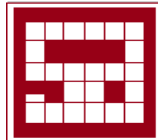
**TURNING POINTS, DISTANCES & BEARING STATEMENT**

| SL. NO | TP-IP PILLAR NO. | CHAINAGE  | DISTANCE | DEFLECTION ANGLE DEG MIN SEC | SIDE | EASTING     | NORTHING    | LATITUDE  | LONGITUDE |
|--------|------------------|-----------|----------|------------------------------|------|-------------|-------------|-----------|-----------|
| 161    | IP-59/2          | 13+359.62 | 23.46    | 00°00'00"                    | L    | 573544.4511 | 2866278.144 | 25°54'48" | 93°44'04" |
| 162    | IP-59/3          | 13+383.08 | 28.53    | 00°00'00"                    | L    | 573526.6516 | 2866262.864 | 25°54'47" | 93°44'03" |
| 163    | TP-60            | 13+411.61 | 42.57    | 20°36'53"                    | L    | 573504.4737 | 2866244.82  | 25°54'46" | 93°44'02" |
| 164    | TP-61            | 13+454.18 | 58.21    | 11°08'47"                    | L    | 573464.1613 | 2866231.341 | 25°54'46" | 93°44'01" |
| 165    | IP-61/1          | 13+512.39 | 70.75    | 00°00'00"                    | L    | 573406.4269 | 2866223.872 | 25°54'46" | 93°43'59" |
| 166    | IP-61/2          | 13+583.14 | 33.93    | 00°00'00"                    | L    | 573335.7444 | 2866220.707 | 25°54'46" | 93°43'56" |
| 167    | TP-62            | 13+617.07 | 25.87    | 06°37'35"                    | L    | 573302.0043 | 2866217.209 | 25°54'46" | 93°43'55" |
| 168    | TP-63            | 13+642.94 | 27.95    | 19°01'10"                    | L    | 573276.6894 | 2866211.576 | 25°54'45" | 93°43'54" |
| 169    | TP-64            | 13+670.89 | 80.83    | 11°45'03"                    | L    | 573248.9129 | 2866214.749 | 25°54'46" | 93°43'53" |
| 170    | TP-65            | 13+751.72 | 146.1    | 06°14'12"                    | L    | 573172.1388 | 2866240.042 | 25°54'46" | 93°43'50" |
| 171    | TP-66            | 13+897.82 | 62.14    | 17°57'07"                    | L    | 573029.2218 | 2866270.384 | 25°54'47" | 93°43'45" |
| 172    | TP-67            | 13+959.96 | 45.2     | 15°41'24"                    | L    | 572975.3836 | 2866301.416 | 25°54'48" | 93°43'43" |
| 173    | TP-68            | 14+005.16 | 158.89   | 07°12'01"                    | L    | 572931.5742 | 2866312.525 | 25°54'49" | 93°43'42" |
| 174    | TP-69            | 14+164.05 | 127.4    | 05°29'08"                    | L    | 572773.941  | 2866332.013 | 25°54'49" | 93°43'36" |
| 175    | TP-70            | 14+291.45 | 60.81    | 08°55'41"                    | L    | 572649.5169 | 2866359.68  | 25°54'50" | 93°43'31" |
| 176    | TP-71            | 14+352.26 | 31.38    | 16°17'18"                    | L    | 572588.8862 | 2866363.493 | 25°54'50" | 93°43'29" |
| 177    | IP-71/1          | 14+383.64 | 58.12    | 00°00'00"                    | L    | 572558.2775 | 2866356.606 | 25°54'50" | 93°43'28" |
| 178    | IP-71/2          | 14+441.76 | 79.3     | 00°00'00"                    | L    | 572502.3437 | 2866340.821 | 25°54'50" | 93°43'26" |
| 179    | IP-71/3          | 14+521.06 | 24.35    | 00°00'00"                    | L    | 572427.3148 | 2866315.142 | 25°54'49" | 93°43'23" |
| 180    | IP-71/4          | 14+545.41 | 124.85   | 00°00'00"                    | L    | 572404.0797 | 2866307.848 | 25°54'49" | 93°43'23" |
| 181    | TP-72            | 14+670.26 | 13.77    | 17°00'06"                    | L    | 572282.6204 | 2866278.952 | 25°54'48" | 93°43'18" |
| 182    | TP-73            | 14+684.03 | 20.06    | 22°13'03"                    | L    | 572270.7419 | 2866271.988 | 25°54'48" | 93°43'18" |
| 183    | TP-74            | 14+704.09 | 34.97    | 09°26'58"                    | L    | 572258.5605 | 2866256.055 | 25°54'47" | 93°43'17" |
| 184    | IP-74/1          | 14+739.06 | 111.58   | 00°00'00"                    | L    | 572242.1688 | 2866225.161 | 25°54'46" | 93°43'17" |
| 185    | IP-74/2          | 14+850.64 | 23.26    | 00°00'00"                    | L    | 572192.2047 | 2866125.395 | 25°54'43" | 93°43'15" |
| 186    | TP-75            | 14+873.9  | 40.04    | 17°26'06"                    | L    | 572183.1782 | 2866103.95  | 25°54'42" | 93°43'15" |
| 187    | TP-76            | 14+913.94 | 29.57    | 83°49'56"                    | L    | 572179.4166 | 2866064.095 | 25°54'41" | 93°43'14" |
| 188    | TP-77            | 14+943.51 | 28.59    | 41°55'40"                    | L    | 572149.8498 | 2866063.696 | 25°54'41" | 93°43'13" |
| 189    | TP-78            | 14+972.1  | 103      | 05°24'37"                    | L    | 572128.2705 | 2866082.554 | 25°54'41" | 93°43'13" |
| 190    | IP-78/1          | 15+075.1  | 110.82   | 00°00'00"                    | L    | 572044.7186 | 2866142.677 | 25°54'43" | 93°43'10" |
| 191    | IP-78/2          | 15+185.92 | 95.94    | 00°00'00"                    | L    | 571954.601  | 2866207.184 | 25°54'46" | 93°43'06" |
| 192    | IP-78/3          | 15+281.86 | 44.93    | 00°00'00"                    | L    | 571873.2369 | 2866258.022 | 25°54'47" | 93°43'03" |
| 193    | TP-79            | 15+326.79 | 96.51    | 05°02'11"                    | L    | 571833.5531 | 2866279.09  | 25°54'48" | 93°43'02" |
| 194    | TP-80            | 15+423.3  | 84.31    | 12°58'53"                    | L    | 571744.671  | 2866316.685 | 25°54'49" | 93°42'59" |
| 195    | IP-80/1          | 15+507.61 | 78.09    | 00°00'00"                    | L    | 571676.3839 | 2866366.131 | 25°54'51" | 93°42'56" |
| 196    | TP-81            | 15+585.7  | 95.15    | 07°23'59"                    | L    | 571609.6808 | 2866406.733 | 25°54'52" | 93°42'54" |
| 197    | IP-81/1          | 15+680.85 | 31.79    | 00°00'00"                    | L    | 571535.4513 | 2866466.262 | 25°54'54" | 93°42'51" |
| 198    | TP-82            | 15+712.64 | 26.51    | 15°23'52"                    | L    | 571509.6507 | 2866484.827 | 25°54'55" | 93°42'50" |
| 199    | IP-82/1          | 15+739.15 | 47.48    | 00°00'00"                    | L    | 571484.7874 | 2866494.044 | 25°54'55" | 93°42'50" |
| 200    | TP-83            | 15+786.63 | 37.73    | 10°22'54"                    | L    | 571439.08   | 2866506.876 | 25°54'55" | 93°42'48" |
| 201    | TP-84            | 15+824.36 | 40.25    | 08°04'30"                    | L    | 571401.5111 | 2866510.361 | 25°54'55" | 93°42'47" |
| 202    | IP-84/1          | 15+864.61 | 46.16    | 00°00'00"                    | L    | 571361.3083 | 2866508.412 | 25°54'55" | 93°42'45" |
| 203    | IP-84/2          | 15+910.77 | 97.49    | 00°00'00"                    | L    | 571315.4445 | 2866503.191 | 25°54'55" | 93°42'43" |
| 204    | IP-84/3          | 16+008.26 | 100.4    | 00°00'00"                    | L    | 571219.5539 | 2866485.724 | 25°54'55" | 93°42'40" |
| 205    | IP-84/4          | 16+108.66 | 78.31    | 00°00'00"                    | L    | 571122.3187 | 2866460.603 | 25°54'54" | 93°42'37" |
| 206    | IP-84/5          | 16+186.97 | 86.47    | 00°00'00"                    | L    | 571045.5957 | 2866444.935 | 25°54'53" | 93°42'34" |
| 207    | IP-84/6          | 16+273.44 | 98.59    | 00°00'00"                    | L    | 570961.813  | 2866423.537 | 25°54'53" | 93°42'31" |
| 208    | IP-84/7          | 16+372.03 | 80.1     | 00°00'00"                    | L    | 570864.678  | 2866406.647 | 25°54'52" | 93°42'27" |
| 209    | TP-85            | 16+452.13 | 28.54    | 10°56'59"                    | L    | 570787.0728 | 2866386.85  | 25°54'52" | 93°42'24" |
| 210    | TP-86            | 16+480.67 | 31.96    | 08°14'19"                    | L    | 570761.2025 | 2866374.643 | 25°54'51" | 93°42'24" |
| 211    | IP-86/1          | 16+512.63 | 61.17    | 00°00'00"                    | L    | 570734.6105 | 2866357.031 | 25°54'51" | 93°42'23" |
| 212    | IP-86/2          | 16+573.8  | 142.02   | 00°00'00"                    | L    | 570685.9365 | 2866319.981 | 25°54'49" | 93°42'21" |
| 213    | IP-86/3          | 16+715.82 | 53.95    | 00°00'00"                    | L    | 570569.7164 | 2866238.348 | 25°54'47" | 93°42'17" |
| 214    | IP-86/4          | 16+769.77 | 115.61   | 00°00'00"                    | L    | 570527.1662 | 2866205.19  | 25°54'46" | 93°42'15" |
| 215    | TP-87            | 16+885.38 | 41.09    | 06°09'52"                    | L    | 570441.1449 | 2866127.948 | 25°54'43" | 93°42'12" |
| 216    | TP-88            | 16+926.47 | 47.03    | 08°43'44"                    | L    | 570413.6949 | 2866097.369 | 25°54'42" | 93°42'11" |
| 217    | TP-89            | 16+973.5  | 65.43    | 06°05'33"                    | L    | 570387.9559 | 2866058.012 | 25°54'41" | 93°42'10" |
| 218    | TP-90            | 17+038.93 | 71.09    | 07°04'30"                    | L    | 570358.1576 | 2865999.762 | 25°54'39" | 93°42'09" |
| 219    | TP-91            | 17+110.02 | 36.5     | 16°56'53"                    | L    | 570333.8208 | 2865932.958 | 25°54'37" | 93°42'08" |
| 220    | TP-92            | 17+146.52 | 81.78    | 08°58'00"                    | L    | 570331.8662 | 2865896.511 | 25°54'36" | 93°42'08" |
| 221    | IP-92/1          | 17+228.3  | 128.8    | 00°00'00"                    | L    | 570340.27   | 2865815.164 | 25°54'33" | 93°42'08" |
| 222    | IP-92/2          | 17+357.1  | 60.36    | 00°00'00"                    | L    | 570362.0047 | 2865688.21  | 25°54'29" | 93°42'09" |
| 223    | IP-92/3          | 17+417.46 | 91.56    | 00°00'00"                    | L    | 570368.9682 | 2865628.259 | 25°54'27" | 93°42'09" |
| 224    | TP-93            | 17+509.02 | 48.66    | 06°08'37"                    | L    | 570376.2563 | 2865536.929 | 25°54'24" | 93°42'10" |
| 225    | TP-94            | 17+557.68 | 130.55   | 26°57'56"                    | L    | 570374.9072 | 2865488.281 | 25°54'22" | 93°42'09" |
| 226    | IP-94/1          | 17+688.23 | 106.55   | 00°00'00"                    | L    | 570312.5267 | 2865373.671 | 25°54'19" | 93°42'07" |
| 227    | IP-94/2          | 17+794.78 | 49       | 00°00'00"                    | L    | 570264.7482 | 2865278.43  | 25°54'16" | 93°42'05" |
| 228    | TP-95            | 17+843.78 | 50.37    | 09°54'53"                    | L    | 570244.5447 | 2865233.787 | 25°54'14" | 93°42'05" |
| 229    | TP-96            | 17+894.15 | 22.22    | 12°38'15"                    | L    | 570216.1521 | 2865192.109 | 25°54'13" | 93°42'04" |
| 230    | TP-97            | 17+916.37 | 44.15    | 08°25'20"                    | L    | 570199.9112 | 2865176.931 | 25°54'12" | 93°42'03" |
| 231    | TP-98            | 17+960.52 | 77.31    | 05°42'43"                    | L    | 570163.6529 | 2865151.858 | 25°54'12" | 93°42'02" |
| 232    | IP-98/1          | 18+037.83 | 138.5    | 00°00'00"                    | L    | 570096.0122 | 2865114.42  | 25°54'10" | 93°41'59" |
| 233    | IP-98/2          | 18+176.33 | 64.21    | 00°00'00"                    | L    | 569977.1609 | 2865043.306 | 25°54'08" | 93°41'55" |
| 234    | IP-98/3          | 18+240.54 | 32.75    | 00°00'00"                    | L    | 569921.3696 | 2865011.518 | 25°54'07" | 93°41'53" |
| 235    | TP-99            | 18+273.29 | 30.8     | 12°53'05"                    | L    | 569892.0141 | 2864997.003 | 25°54'07" | 93°41'52" |
| 236    | TP-100           | 18+304.09 | 50.66    | 06°57'01"                    | L    | 569862.0554 | 2864989.851 | 25°54'06" | 93°41'51" |
| 237    | IP-100/1         | 18+354.75 | 48.07    | 00°00'00"                    | L    | 569811.7208 | 2864984.138 | 25°54'06" | 93°41'49" |
| 238    | TP-101           | 18+402.82 | 96.45    | 18°10'44"                    | L    | 569763.8652 | 2864979.558 | 25°54'06" | 93°41'47" |
| 239    | IP-101/1         | 18+499.27 | 89.85    | 00°00'00"                    | L    | 569669.7834 | 2865000.783 | 25°54'07" | 93°41'44" |
| 240    | TP-102           | 18+589.12 | 59.77    | 05°08'22"                    | L    | 569580.8315 | 2865013.475 | 25°54'07" | 93°41'41" |
| 241    | IP-102/1         | 18+648.89 | 103.57   | 00°00'00"                    | R    | 569522.6596 | 2865027.183 | 25°54'08" | 93°41'39" |
| 242    | TP-103           | 18+752.46 | 50.26    | 06°03'49"                    | R    | 569422.6751 | 2865054.209 | 25°54'08" | 93°41'35" |
| 243    | IP-103/1         | 18+802.72 | 45.28    | 00°00'00"                    | R    | 569375.8117 | 2865072.376 | 25°54'09" | 93°41'33" |
| 244    | TP-104           | 18+848.00 | 68.66    | 09°31'15"                    | R    | 569334.3934 | 2865090.673 | 25°54'10" | 93°41'32" |
| 245    | TP-105           | 18+916.66 | -        | 00°00'00"                    | R    | 569277.0444 | 2865128.425 | 25°54'11" | 93°41'30" |





**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

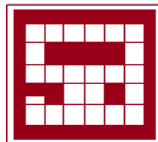
**ANNEXURE-B**

**List of All Crossing Falling on the Route of Pipeline:**

| LIST OF ALL CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE |       |                  |               |                         |          |                    |             |             |
|------------------------------------------------------------|-------|------------------|---------------|-------------------------|----------|--------------------|-------------|-------------|
| Sr.No                                                      | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |          | Crossing Width (m) | EASTING     | NORTHING    |
| 1                                                          | CS-01 | ASPHALT ROAD     | 0+246.3199    | TP-6                    | IP-6/1   | 2.67               | 581999.139  | 2859309.54  |
| 2                                                          | CS-02 | CART RACK ROAD   | 0+648.0959    | IP-6/1                  | IP-6/2   | 3.79               | 581970.3375 | 2859710.17  |
| 3                                                          | CS-03 | CART RACK ROAD   | 0+688.9435    | IP-6/1                  | IP-6/2   | 4.12               | 581966.2555 | 2859750.813 |
| 4                                                          | CS-04 | NH-29            | 1+147.2671    | TP-8                    | TP-9     | 3.08               | 581876.8382 | 2860197.535 |
| 5                                                          | CS-05 | ASPHALT ROAD     | 1+339.5381    | IP-10/1                 | TP-11    | 1.12               | 581690.6318 | 2860241.562 |
| 6                                                          | CS-06 | ASPHALT ROAD     | 1710.8229     | IP-11/2                 | TP-12    | 2.89               | 581329.0972 | 2860325.729 |
| 7                                                          | CS-07 | ASPHALT ROAD     | 1+932.781     | IP-13/1                 | IP-13/2  | 4.15               | 581112.8579 | 2860373.057 |
| 8                                                          | CS-08 | ASPHALT ROAD     | 2+208.9075    | IP-13/4                 | IP-13/5  | 1.89               | 580844.4474 | 2860437.838 |
| 9                                                          | CS-09 | ASPHALT ROAD     | 2+477.2521    | IP-13/7                 | IP-13/8  | 2.05               | 580582.9236 | 2860497.919 |
| 10                                                         | CS-10 | NALA             | 2+572.3562    | TP-13/8                 | IP-13/9  | 1.79               | 580490.4951 | 2860520.315 |
| 11                                                         | CS-11 | ASPHALT ROAD     | 2+696.2326    | IP-13/9                 | IP-13/10 | 1.08               | 580369.9086 | 2860548.672 |
| 12                                                         | CS-12 | ASPHALT ROAD     | 2+832.7636    | IP-13/11                | TP-14    | 1.83               | 580236.8422 | 2860579.583 |
| 13                                                         | CS-13 | ASPHALT ROAD     | 3+214.1757    | IP-14/2                 | IP-14/3  | 1.49               | 579866.5714 | 2860669.99  |
| 14                                                         | CS-14 | ASPHALT ROAD     | 3+644.435     | IP-14/07                | IP-14/08 | 1.83               | 579447.1984 | 2860766.069 |
| 15                                                         | CS-15 | NALA             | 3+678.1442    | IP-14/07                | IP-14/08 | 2.91               | 579414.2575 | 2860773.224 |
| 16                                                         | CS-16 | ASPHALT ROAD     | 3+759.2265    | IP-14/08                | IP-14/09 | 2.62               | 579335.0409 | 2860790.517 |
| 17                                                         | CS-17 | NALA             | 3+981.6973    | IP-14/09                | IP-14/10 | 1.19               | 579117.8376 | 2860838.642 |
| 18                                                         | CS-18 | ASPHALT ROAD     | 4+224.9883    | IP-14/11                | IP-14/12 | 1.76               | 578879.44   | 2860887.134 |
| 19                                                         | CS-19 | ASPHALT ROAD     | 4+676.3501    | TP-21                   | IP-21/1  | 2.74               | 578452.6704 | 2860858.479 |
| 20                                                         | CS-20 | BANK RIVER       | 4+731.5003    | IP-21/1                 | IP-21/2  | 19.98              | 578398.0454 | 2860850.91  |
| 21                                                         | CS-21 | ASPHALT ROAD     | 4+990.9111    | TP-25                   | TP-26    | 9.22               | 578153.9576 | 2860877.666 |
| 22                                                         | CS-22 | ASPHALT ROAD     | 5+430.8524    | TP-35                   | IP-35/01 | 1.84               | 577768.1548 | 2860952.998 |
| 23                                                         | CS-23 | ASPHALT ROAD     | 5+827.0354    | IP-35/04                | IP-35/05 | 2.56               | 577376.5354 | 2860894.04  |
| 24                                                         | CS-24 | NH-29            | 6+310.8113    | IP-36/1                 | TP-37    | 6.06               | 576900.0599 | 2860811.303 |
| 25                                                         | CS-25 | ASPHALT ROAD     | 6+364.5402    | TP-37                   | IP-37/1  | 8.33               | 576872.3401 | 2860838.779 |
| 26                                                         | CS-26 | DRAIN            | 6+628.467     | IP-37/2                 | IP-37/3  | 1.02               | 576804.5256 | 2861093.842 |
| 27                                                         | CS-27 | ASPHALT ROAD     | 6+725.1456    | IP-37/3                 | IP-37/4  | 1.87               | 576779.1204 | 2861187.123 |
| 28                                                         | CS-28 | ASPHALT ROAD     | 6+856.6448    | IP-37/4                 | IP-37/5  | 1.28               | 576744.1506 | 2861313.882 |
| 29                                                         | CS-29 | ASPHALT ROAD     | 7+010.3135    | IP-37/5                 | IP-37/6  | 1.93               | 576700.224  | 2861461.138 |
| 30                                                         | CS-30 | ASPHALT ROAD     | 7+185.193     | IP-37/6                 | IP-37/7  | 3.29               | 576651.7236 | 2861629.157 |
| 31                                                         | CS-31 | ASPHALT ROAD     | 7+397.9543    | IP-37/8                 | IP-37/9  | 5.15               | 576591.2354 | 2861833.134 |
| 32                                                         | CS-32 | ASPHALT ROAD     | 7+854.8378    | IP-37/12                | IP-37/13 | 4.41               | 576460.8505 | 2862271.013 |
| 33                                                         | CS-33 | ASPHALT ROAD     | 8+255.8813    | IP-37/15                | IP-37/16 | 7.74               | 576345.3753 | 2862655.068 |
| 34                                                         | CS-34 | ASPHALT ROAD     | 8+504.3847    | IP-37/18                | IP-37/19 | 9.42               | 576268.7214 | 2862891.392 |
| 35                                                         | CS-35 | ASPHALT ROAD     | 8+666.0803    | IP-37/19                | IP-37/20 | 3.74               | 576217.2119 | 2863044.662 |
| 36                                                         | CS-36 | NALA             | 9+073.7829    | IP-37/23                | IP-37/24 | 3.94               | 576075.9832 | 2863426.988 |
| 37                                                         | CS-37 | ASPHALT ROAD     | 9+088.5573    | IP-37/23                | IP-37/24 | 4.15               | 576070.1692 | 2863440.571 |
| 38                                                         | CS-38 | ASPHALT ROAD     | 9+473.5149    | IP-37/26                | IP-37/27 | 2.67               | 575919.0917 | 2863794.619 |
| 39                                                         | CS-39 | ASPHALT ROAD     | 9+871.5465    | IP-37/29                | IP-37/30 | 3.77               | 575765.2156 | 2864161.695 |
| 40                                                         | CS-40 | ASPHALT ROAD     | 10+181.1104   | TP-38                   | IP-38/1  | 4.81               | 575643.8179 | 2864446.275 |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

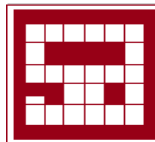
**JOB NO- SA-1146**

**LIST OF ALL CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |          | Crossing Width (m) | EASTING     | NORTHING    |
|-------|-------|------------------|---------------|-------------------------|----------|--------------------|-------------|-------------|
| 41    | CS-41 | ASPHALT ROAD     | 10+242.899    | IP-38/1                 | IP-38/2  | 1.82               | 575610.2882 | 2864498.116 |
| 42    | CS-42 | ASPHALT ROAD     | 10+513.423    | IP-38/3                 | IP-38/4  | 8.20               | 575452.6349 | 2864717.935 |
| 43    | CS-43 | ASPHALT ROAD     | 10+892.307    | IP-38/5                 | IP-38/6  | 12.59              | 575235.0233 | 2865028.04  |
| 44    | CS-44 | ASPHALT ROAD     | 11+297.816    | IP-38/8                 | IP-38/9  | 11.35              | 575011.8531 | 2865366.606 |
| 45    | CS-45 | ASPHALT ROAD     | 11+464.838    | IP-38/9                 | IP-38/10 | 4.51               | 574918.781  | 2865505.282 |
| 46    | CS-46 | ASPHALT ROAD     | 11+605.391    | TP-40                   | IP-40/0  | 18.14              | 574826.6939 | 2865609.371 |
| 47    | CS-47 | SOIL ROAD        | 12+038.810    | IP-43/2                 | IP-45/1  | 24.20              | 574725.3961 | 2866027.649 |
| 48    | CS-48 | SOIL ROAD        | 12+204.093    | TP-46                   | TP-47    | 9.17               | 574629.6327 | 2866159.486 |
| 49    | CS-49 | DHANSARI RIVER   | 12+374.179    | TP-48                   | IP-48/1  | 44.59              | 574471.6242 | 2866216.739 |
| 50    | CS-50 | ASPHALT ROAD     | 12+510.389    | IP-48/2                 | TP-49    | 31.42              | 574336.8779 | 2866236.607 |
| 51    | CS-51 | SOIL ROAD        | 12+633.233    | IP-49/1                 | TP-50    | 12.42              | 574222.9615 | 2866278.811 |
| 52    | CS-52 | SOIL ROAD        | 12+829.505    | IP-54/1                 | TP-55    | 9.24               | 574055.5198 | 2866317.632 |
| 53    | CS-53 | SOIL ROAD        | 12+950.706    | TP-56                   | IP-56/1  | 10.43              | 573937.3521 | 2866306.664 |
| 54    | CS-54 | SOIL ROAD        | 13+108.049    | IP-56/2                 | IP-56/3  | 9.12               | 573780.4137 | 2866317.897 |
| 55    | CS-55 | ASPHALT ROAD     | 13+341.668    | IP-59/1                 | IP-59/2  | 6.15               | 573558.0031 | 2866289.924 |
| 56    | CS-56 | ASPHALT ROAD     | 13+384.316    | IP-59/3                 | TP-60    | 13.75              | 573525.6947 | 2866262.086 |
| 57    | CS-57 | ASPHALT ROAD     | 13+648.622    | TP-63                   | TP-64    | 27.89              | 573271.102  | 2866212.231 |
| 58    | CS-58 | RAILWAY LINE     | 13+820.496    | TP-65                   | TP-66    | 1.68               | 573104.9251 | 2866254.309 |
| 59    | CS-59 | ASPHALT ROAD     | 13+976.42     | TP-67                   | TP-68    | 14.35              | 572959.4897 | 2866305.435 |
| 60    | CS-60 | ASPHALT ROAD     | 14+530.534    | IP-71/3                 | IP-71/4  | 19.95              | 572437.2204 | 2866318.53  |
| 61    | CS-61 | ASPHALT ROAD     | 14+908.073    | TP-75                   | TP-76    | 5.86               | 572179.9053 | 2866069.937 |
| 62    | CS-62 | NH-229A          | 14+917.196    | TP-76                   | TP-77    | 34.20              | 572176.1675 | 2866064.094 |
| 63    | CS-63 | ASPHALT ROAD     | 15+432.032    | TP-80                   | IP-80/1  | 12.74              | 571737.5987 | 2866321.805 |
| 64    | CS-64 | ASPHALT ROAD     | 15+800.931    | TP-83                   | TP-84    | 8.82               | 571424.9436 | 2866508.187 |
| 65    | CS-65 | ASPHALT ROAD     | 15+995.739    | IP-84/2                 | IP-84/3  | 9.22               | 571231.8356 | 2866488.029 |
| 66    | CS-66 | ASPHALT ROAD     | 16+273.442    | IP-84/6                 | IP-84/7  | 22.08              | 570961.8023 | 2866423.599 |
| 67    | CS-67 | ASPHALT ROAD     | 16+623.154    | IP-86/2                 | IP-86/3  | 4.80               | 570645.5464 | 2866291.611 |
| 68    | CS-68 | ASPHALT ROAD     | 16+827.571    | IP-86/4                 | TP-87    | 7.32               | 570484.1135 | 2866166.615 |
| 69    | CS-69 | ASPHALT ROAD     | 17+054.432    | TP-90                   | TP-91    | 14.88              | 570352.8493 | 2865985.192 |
| 70    | CS-70 | ASPHALT ROAD     | 17+433.795    | IP-92/3                 | TP-93    | 29.44              | 570370.2673 | 2865611.974 |
| 71    | CS-71 | ASPHALT ROAD     | 17+505.755    | IP-92/3                 | TP-94    | 48.65              | 570375.9919 | 2865540.242 |
| 72    | CS-72 | ASPHALT ROAD     | 17+627.866    | TP-94                   | IP-94/1  | 9.83               | 570341.3699 | 2865426.692 |
| 73    | CS-73 | ASPHALT ROAD     | 17+897.407    | TP-96                   | TP-97    | 15.71              | 570213.8367 | 2865189.902 |
| 74    | CS-74 | ASPHALT ROAD     | 17+948.825    | TP-97                   | TP-98    | 4.41               | 570173.2708 | 2865158.512 |
| 75    | CS-75 | ASPHALT ROAD     | 18+125.2827   | IP-98/1                 | IP-98/2  | 6.53               | 570020.9674 | 2865069.517 |
| 76    | CS-76 | ASPHALT ROAD     | 18+276.5505   | TP-99                   | TP-100   | 20.33              | 569888.8429 | 2864996.246 |



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PREPARED BY: M/s SWAYIN & ASSOCIATES

JOB NO- SA-1146

**ANNEXURE-C**

**List of Railway Crossings Falling Along the Route:**

| <b>LIST OF RAILWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</b> |       |                  |               |                         |       |                    |
|-----------------------------------------------------------------------|-------|------------------|---------------|-------------------------|-------|--------------------|
| Sr.No                                                                 | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |       | Crossing Width (m) |
| 1                                                                     | CS-58 | RAILWAY LINE     | 13+820.496    | TP-65                   | TP-66 | 1.68               |

**ANNEXURE-D**

**List of River Crossings Falling Along the Route:**

| <b>LIST OF RIVER CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</b> |       |                  |               |                         |         |                    |
|---------------------------------------------------------------------|-------|------------------|---------------|-------------------------|---------|--------------------|
| Sr.No                                                               | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |         | Crossing Width (m) |
| 1                                                                   | CS-20 | BANK RIVER       | 4+731.5003    | IP-21/1                 | IP-21/2 | 19.98              |
| 2                                                                   | CS-49 | DHANSARI RIVER   | 12+374.179    | TP-48                   | IP-48/1 | 44.593             |

**ANNEXURE-E**

**List of National Highway Crossings Falling Along the Route:**

| <b>LIST OF NATIONAL HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</b> |       |                  |               |                         |       |                    |
|--------------------------------------------------------------------------------|-------|------------------|---------------|-------------------------|-------|--------------------|
| Sr.No                                                                          | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |       | Crossing Width (m) |
| 1                                                                              | CS-04 | NH-29            | 1+147.2671    | TP-8                    | TP-9  | 3.075              |
| 2                                                                              | CS-24 | NH-29            | 6+310.8113    | IP-36/1                 | TP-37 | 6.058              |
| 3                                                                              | CS-62 | NH-229A          | 14+917.196    | TP-76                   | TP-77 | 34.195             |

**ANNEXURE-F:**

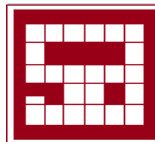
**List of State Highway Crossings Falling Along the Route:**

| <b>LIST OF STATE HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</b> |       |                  |               |             |                         |                    |
|-----------------------------------------------------------------------------|-------|------------------|---------------|-------------|-------------------------|--------------------|
| Sr.No                                                                       | Cs.No | Type of Crossing | Chainage (Km) | Description | Between Pillar Location | Crossing Width (m) |
| THERE IS NO STATE HIGHWAY CROSSING ALONG THE ROUTE                          |       |                  |               |             |                         |                    |





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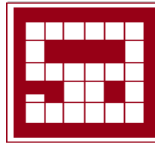
JOB NO- SA-1146

**ANNEXURE-G:**

**List of Nala Crossings Falling Along the Route:**

**LIST OF NALA, CANAL, DRAIN CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr. No | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |          | Crossing Width (m) |
|--------|-------|------------------|---------------|-------------------------|----------|--------------------|
| 1      | CS-10 | NALA             | 2+572.3562    | TP-13/8                 | IP-13/9  | 1.79               |
| 2      | CS-15 | NALA             | 3+678.1442    | IP-14/07                | IP-14/08 | 2.91               |
| 3      | CS-17 | NALA             | 3+981.6973    | IP-14/09                | IP-14/10 | 1.19               |
| 4      | CS-26 | DRAIN            | 6+628.467     | IP-37/2                 | IP-37/3  | 1.02               |
| 5      | CS-36 | NALA             | 9+073.7829    | IP-37/23                | IP-37/24 | 3.94               |



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### SUMMARY OF PROPOSED BRANCH-2

#### TAP-OFF & TERMINAL POINT

##### Tap -off Point at 4<sup>th</sup> MILE CENTRAL JAIL, NIULAND, DINAPUR DISTRICT Ch: 0.00 Km:

This route starts 4<sup>th</sup> Mile Central Jail, Niuland, Dinapur District state, whose coordinates are as mentioned above i.e. Latitude 25°51'49" E, Longitude 93°46'03" N.



#### TAP – OFF POINT OF BRANCH- 2

##### Terminal Point at HPCL Petrol Pump, Chumoukedima Ch: 7+419.72 Km:

The proposed pipe line terminal point is located at HPCL Petrol Pump, Chumoukedima, Dimapur District, Nagaland. whose co-ordinates are as i.e. Latitude 25°48'08" E Longitude 93°47'36" N.

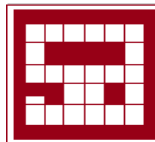
The concerned route is the in length among all the alternates i.e. 7+419.72km. In total there are some major crossings which are Major District Road, Nala.



#### TERMINAL POINT OF BRANCH- 2



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE  
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**DETAILS OF BRANCH-2:**

| Particulars                                                     | Chainage<br>(km) | Latitude  | Longitude | District | State    |
|-----------------------------------------------------------------|------------------|-----------|-----------|----------|----------|
| 4 <sup>th</sup> Mile Central Jail,<br>Niuland, Dimapur District | 0+000.00         | 25°51'49" | 93°46'03" | Dimapur  | Nagaland |
| HPCL Petrol Pump,<br>Chumoukedima, Dimapur<br>District          | 7+419.72         | 25°48'08" | 93°47'36" | Dimapur  | Nagaland |

**SURVEY OF INDIA TOPO MAP BRANCH-2:**

| SL<br>No. | Particulars | Scale    | Chainage (Km)    |                   | Length<br>(Km) | Toposheet<br>No. |
|-----------|-------------|----------|------------------|-------------------|----------------|------------------|
|           |             |          | Tap-off<br>Point | Terminal<br>Point |                |                  |
| 1         | TOPO SHEETS | 1:50,000 | 0+000.00         | 7+419.72          | 7+419.72       | G46P13           |

**LIST OF CROSSINGS BRANCH-2:**

| ABSTRACT OF CROSSINGS |                             |                        |
|-----------------------|-----------------------------|------------------------|
| SL.NO                 | TYPE OF CROSSING            | NUMBER OF<br>CROSSINGS |
| 1.                    | Railway Crossing            | 0                      |
| 2.                    | River                       | 0                      |
| 3.                    | Canal/Nala/ Minor Waterways | 1                      |
| 4.                    | NH                          | 0                      |
| 5.                    | SH                          | 0                      |
|                       | <b>Total</b>                | <b>1</b>               |

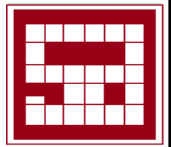
**TYPE OF TERRAIN/LAND USE (BRANCH-02):**

The Terrain and land use along Pipeline Branch-02 is described in the below table:

| SECTION                                                                                                                                                                  | TERRAIN AND LAND USE                                                                                           | REMARKS                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 4 <sup>th</sup> Mile, Central Jail, Niuland,<br>Dinapur District to HPCL Petrol<br>Pump, Chumoukedima, Dimapur<br>District of<br>(Ch: 0+000.00km to<br>Ch: 7+419.721Km). | Proposed Pipeline Route passes<br>through the State Highway,<br>Asphalted Road, Cart track Road,<br>Nala, etc. | There are crossing of Asphalted<br>Road, CC Road, Nala, Future<br>development plans are observed in<br>the en-route of pipeline. |



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**JOB NO- SA-1146**

Tap-off point at 4<sup>th</sup> Mile, Central Jail  
and Terminal point at HPCL Petrol  
Pump.

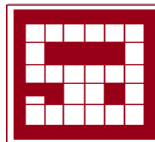
**CONSTRAINTS:**

Major Constraints for routing the pipeline are summarized below:

- **WATER NETWORKS**  
The proposed pipeline has crossing through Nala and Asphalt Road.
- **ROAD NETWORK**  
Along the proposed pipeline a consistent No. of Road crossings are noticed.



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**Summary of Detailed Route Survey Salient Features**

**SALIENT FEATURES (BRANCH-2):**

|            |                                        |                                              |
|------------|----------------------------------------|----------------------------------------------|
| <b>(A)</b> | <b><u>State wise Length (Km.)</u></b>  |                                              |
|            | (a) Nagaland                           | 7+419.721km                                  |
|            | <b><u>Revenue Details</u></b>          |                                              |
|            | (a) State                              | 1                                            |
|            | (b) District                           | 1                                            |
| <b>(B)</b> | <b><u>Road Crossing (No's)</u></b>     |                                              |
|            | (a) National Highway                   | 0                                            |
|            | (b) State Highway                      | 0                                            |
|            | (c) Railway                            | 0                                            |
| <b>(C)</b> | <b><u>Water Bodies (No's)</u></b>      |                                              |
|            | (a) Canal                              | 0                                            |
|            | (b) Rivers                             | 0                                            |
|            | (c) Nala                               | 1                                            |
| <b>(D)</b> | <b><u>Seismic Zone</u></b>             | Zone-V                                       |
| <b>(E)</b> | <b><u>Tap-Off GPS Coordinates</u></b>  |                                              |
|            | (a) BRANCH-2                           | Latitude-25°51'49"N<br>Longitude-93°46'03"E  |
| <b>(F)</b> | <b><u>Terminal GPS Coordinates</u></b> |                                              |
|            | (a) BRANCH-2                           | Latitude- 25°48'08"N<br>Longitude-93°47'36"E |

**ANNEXURES LIST:**

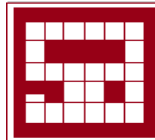
**Route: -2**

|            |                                    |
|------------|------------------------------------|
| Annexure-A | List of TP'S/IP'S Details          |
| Annexure-B | List of all Crossings              |
| Annexure-C | List of Existing Railway Crossings |
| Annexure-D | List of River Crossings            |
| Annexure-E | List of National Highways          |
| Annexure-F | List of State Highways             |
| Annexure-G | List of Canal/Nala/Drain Crossings |





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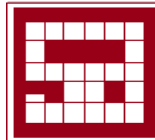
**ANNEXURE-A**

**List of TP's/IP's Details Falling on the Route of Pipeline (In UTM Co-ordinates):**

| <b><u>TURNING POINTS, DISTANCES &amp; BEARING STATEMENT</u></b> |                         |                 |                 |                                     |             |                |                 |                 |                  |
|-----------------------------------------------------------------|-------------------------|-----------------|-----------------|-------------------------------------|-------------|----------------|-----------------|-----------------|------------------|
| <b>SL. NO</b>                                                   | <b>TP-IP PILLAR NO.</b> | <b>CHAINAGE</b> | <b>DISTANCE</b> | <b>DEFLECTION ANGLE DEG MIN SEC</b> | <b>SIDE</b> | <b>EASTING</b> | <b>NORTHING</b> | <b>LATITUDE</b> | <b>LONGITUDE</b> |
| 1                                                               | TP-0                    | 0+000.00        | 246.51          | 00°00'00"                           | L           | 576902.0299    | 2860811.8600    | 25°51'49"       | 93°46'03"        |
| 2                                                               | IP-0/1                  | 0+246.5147      | 246.42          | 00°00'00"                           | L           | 576966.6907    | 2860573.9768    | 25°51'41"       | 93°46'05"        |
| 3                                                               | IP-0/2                  | 0+492.9382      | 247.79          | 00°00'00"                           | L           | 577031.1696    | 2860336.1263    | 25°51'34"       | 93°46'08"        |
| 4                                                               | IP-0/3                  | 0+740.7322      | 249.12          | 00°00'00"                           | L           | 577095.6937    | 2860097.2035    | 25°51'26"       | 93°46'10"        |
| 5                                                               | IP-0/4                  | 0+989.8526      | 248.21          | 00°00'00"                           | L           | 577162.4538    | 2859856.8837    | 25°51'18"       | 93°46'12"        |
| 6                                                               | IP-0/5                  | 1+238.0615      | 138.37          | 00°00'00"                           | L           | 577229.7743    | 2859617.9786    | 25°51'10"       | 93°46'15"        |
| 7                                                               | IP-0/6                  | 1+376.4358      | 108.90          | 00°00'00"                           | L           | 577268.2237    | 2859485.0537    | 25°51'06"       | 93°46'16"        |
| 8                                                               | IP-0/7                  | 1+485.3349      | 111.41          | 00°00'00"                           | L           | 577295.7453    | 2859379.6895    | 25°51'03"       | 93°46'17"        |
| 9                                                               | IP-0/8                  | 1+596.7455      | 169.67          | 00°00'00"                           | L           | 577326.9501    | 2859272.7383    | 25°50'59"       | 93°46'18"        |
| 10                                                              | IP-0/9                  | 1+766.4161      | 163.39          | 00°00'00"                           | L           | 577371.7003    | 2859109.0753    | 25°50'54"       | 93°46'20"        |
| 11                                                              | IP-0/10                 | 1+929.8020      | 164.15          | 00°00'00"                           | L           | 577415.1164    | 2858951.5635    | 25°50'49"       | 93°46'21"        |
| 12                                                              | IP-0/11                 | 2+093.9491      | 155.52          | 00°00'00"                           | L           | 577459.0259    | 2858793.3983    | 25°50'44"       | 93°46'23"        |
| 13                                                              | IP-0/12                 | 2+249.4725      | 182.58          | 00°00'00"                           | L           | 577500.7025    | 2858643.5630    | 25°50'39"       | 93°46'24"        |
| 14                                                              | IP-0/13                 | 2+432.0518      | 132.28          | 00°00'00"                           | L           | 577550.6521    | 2858467.9492    | 25°50'33"       | 93°46'26"        |
| 15                                                              | IP-0/14                 | 2+564.3332      | 123.51          | 00°00'00"                           | L           | 577585.5278    | 2858340.3359    | 25°50'29"       | 93°46'27"        |
| 16                                                              | IP-0/15                 | 2+687.8449      | 110.07          | 00°00'00"                           | L           | 577620.2794    | 2858221.8261    | 25°50'25"       | 93°46'28"        |
| 17                                                              | IP-0/16                 | 2+797.9142      | 111.17          | 00°00'00"                           | L           | 577649.8747    | 2858115.7978    | 25°50'21"       | 93°46'29"        |
| 18                                                              | IP-0/17                 | 2+909.0804      | 214.35          | 00°00'00"                           | L           | 577681.5064    | 2858009.2394    | 25°50'18"       | 93°46'31"        |
| 19                                                              | IP-0/18                 | 3+123.4268      | 153.21          | 00°00'00"                           | L           | 577740.5726    | 2857803.1919    | 25°50'11"       | 93°46'33"        |
| 20                                                              | IP-0/19                 | 3+276.6326      | 159.12          | 00°00'00"                           | L           | 577782.7185    | 2857655.8976    | 25°50'06"       | 93°46'34"        |
| 21                                                              | IP-0/20                 | 3+435.7514      | 138.82          | 00°00'00"                           | L           | 577825.3376    | 2857502.5922    | 25°50'01"       | 93°46'36"        |
| 22                                                              | IP-0/21                 | 3+574.5745      | 108.03          | 00°00'00"                           | L           | 577863.4934    | 2857369.1157    | 25°49'57"       | 93°46'37"        |
| 23                                                              | IP-0/22                 | 3+682.6054      | 114.02          | 00°00'00"                           | L           | 577893.7131    | 2857265.3849    | 25°49'54"       | 93°46'38"        |
| 24                                                              | IP-0/23                 | 3+796.6232      | 138.85          | 00°00'00"                           | L           | 577924.1738    | 2857155.5239    | 25°49'50"       | 93°46'39"        |
| 25                                                              | IP-0/24                 | 3+935.4700      | 142.66          | 00°00'00"                           | L           | 577962.7079    | 2857022.1314    | 25°49'46"       | 93°46'40"        |
| 26                                                              | IP-0/25                 | 4+078.1283      | 103.91          | 00°00'00"                           | L           | 578002.8887    | 2856885.2487    | 25°49'41"       | 93°46'42"        |
| 27                                                              | IP-0/26                 | 4+182.0387      | 90.32           | 00°00'00"                           | L           | 578031.3235    | 2856785.3046    | 25°49'38"       | 93°46'43"        |
| 28                                                              | IP-0/27                 | 4+272.3624      | 120.42          | 00°00'00"                           | L           | 578056.1908    | 2856698.4714    | 25°49'35"       | 93°46'44"        |
| 29                                                              | IP-0/28                 | 4+392.7854      | 103.69          | 00°00'00"                           | L           | 578089.2089    | 2856582.6633    | 25°49'32"       | 93°46'45"        |
| 30                                                              | IP-0/29                 | 4+496.4768      | 82.92           | 00°00'00"                           | L           | 578117.2526    | 2856482.7396    | 25°49'28"       | 93°46'46"        |
| 31                                                              | IP-0/30                 | 4+579.4013      | 77.53           | 00°00'00"                           | L           | 578142.8428    | 2856403.9602    | 25°49'26"       | 93°46'47"        |
| 32                                                              | IP-0/31                 | 4+656.9344      | 134.09          | 00°00'00"                           | L           | 578169.1472    | 2856331.0255    | 25°49'23"       | 93°46'48"        |
| 33                                                              | IP-0/32                 | 4+791.0214      | 190.34          | 00°00'00"                           | L           | 578223.9358    | 2856208.6428    | 25°49'19"       | 93°46'50"        |
| 34                                                              | IP-0/33                 | 4+981.3654      | 109.01          | 00°00'00"                           | L           | 578302.4779    | 2856035.2477    | 25°49'14"       | 93°46'52"        |
| 35                                                              | IP-0/34                 | 5+090.3716      | 96.04           | 00°00'00"                           | L           | 578347.1566    | 2855935.8297    | 25°49'10"       | 93°46'54"        |
| 36                                                              | IP-0/35                 | 5+186.4144      | 71.22           | 00°00'00"                           | L           | 578386.7957    | 2855848.3309    | 25°49'08"       | 93°46'55"        |
| 37                                                              | IP-0/36                 | 5+257.6364      | 123.43          | 00°00'00"                           | L           | 578418.5832    | 2855784.6140    | 25°49'06"       | 93°46'57"        |
| 38                                                              | IP-0/37                 | 5+381.0698      | 92.22           | 00°00'00"                           | L           | 578481.3844    | 2855678.3510    | 25°49'02"       | 93°46'59"        |
| 39                                                              | IP-0/38                 | 5+473.2925      | 83.70           | 00°00'00"                           | L           | 578532.3511    | 2855601.4914    | 25°48'60"       | 93°47'01"        |
| 40                                                              | IP-0/39                 | 5+556.9956      | 85.17           | 00°00'00"                           | L           | 578579.5258    | 2855532.3236    | 25°48'57"       | 93°47'02"        |
| 41                                                              | IP-0/40                 | 5+642.1648      | 81.86           | 00°00'00"                           | L           | 578625.6628    | 2855460.7342    | 25°48'55"       | 93°47'04"        |
| 42                                                              | IP-0/41                 | 5+724.0245      | 107.20          | 00°00'00"                           | L           | 578671.7574    | 2855393.0851    | 25°48'53"       | 93°47'06"        |
| 43                                                              | IP-0/42                 | 5+831.2260      | 128.95          | 00°00'00"                           | L           | 578730.7163    | 2855303.5771    | 25°48'50"       | 93°47'08"        |
| 44                                                              | IP-0/43                 | 5+960.1788      | 114.75          | 00°00'00"                           | L           | 578803.0026    | 2855196.7899    | 25°48'46"       | 93°47'10"        |
| 45                                                              | IP-0/44                 | 6+074.9335      | 131.29          | 00°00'00"                           | L           | 578866.5733    | 2855101.2383    | 25°48'43"       | 93°47'12"        |
| 46                                                              | IP-0/45                 | 6+206.2279      | 112.47          | 00°00'00"                           | L           | 578939.5306    | 2854992.0945    | 25°48'40"       | 93°47'15"        |
| 47                                                              | IP-0/46                 | 6+318.6951      | 102.49          | 00°00'00"                           | L           | 579001.7198    | 2854898.3616    | 25°48'37"       | 93°47'17"        |
| 48                                                              | IP-0/47                 | 6+421.1820      | 75.83           | 00°00'00"                           | L           | 579059.5285    | 2854813.7588    | 25°48'34"       | 93°47'19"        |
| 49                                                              | IP-0/48                 | 6+497.0143      | 59.37           | 00°00'00"                           | L           | 579104.4517    | 2854752.6499    | 25°48'32"       | 93°47'21"        |
| 50                                                              | TP-01                   | 6+556.3875      | 119.36          | 04°46'03"                           | L           | 579139.9184    | 2854705.0491    | 25°48'30"       | 93°47'22"        |
| 51                                                              | IP-1/1                  | 6+675.7464      | 103.94          | 00°00'00"                           | L           | 579218.9560    | 2854615.5779    | 25°48'27"       | 93°47'25"        |
| 52                                                              | IP-1/2                  | 6+779.6864      | 111.33          | 00°00'00"                           | L           | 579287.9653    | 2854537.8834    | 25°48'25"       | 93°47'27"        |
| 53                                                              | IP-1/3                  | 6+891.0189      | 149.50          | 00°00'00"                           | L           | 579362.7994    | 2854455.4351    | 25°48'22"       | 93°47'30"        |
| 54                                                              | IP-1/4                  | 7+040.5184      | 110.55          | 00°00'00"                           | L           | 579533.5058    | 2854259.2779    | 25°48'16"       | 93°47'36"        |
| 55                                                              | IP-1/5                  | 7+151.0708      | 41.45           | 00°00'00"                           | L           | 579561.2291    | 2854228.4856    | 25°48'15"       | 93°47'37"        |
| 56                                                              | TP-02                   | 7+192.5173      | 24.29           | 06°09'33"                           | L           | 579575.5828    | 2854208.8898    | 25°48'14"       | 93°47'38"        |
| 57                                                              | TP-03                   | 7+216.8078      | 20.66           | 27°58'58"                           | L           | 579578.5443    | 2854188.4382    | 25°48'13"       | 93°47'38"        |
| 58                                                              | TP-04                   | 7+237.4727      | 26.44           | 17°02'44"                           | L           | 579574.4974    | 2854162.3145    | 25°48'13"       | 93°47'38"        |
| 59                                                              | TP-05                   | 7+263.9082      | 38.13           | 09°32'40"                           | L           | 579562.4948    | 2854126.1289    | 25°48'11"       | 93°47'37"        |
| 60                                                              | IP-5/1                  | 7+302.0387      | 68.81           | 00°00'00"                           | L           | 579539.6731    | 2854061.2063    | 25°48'09"       | 93°47'36"        |
| 61                                                              | TP-06                   | 7+370.8492      | 15.87           | 07°41'50"                           | L           | 579539.6731    | 2854061.2063    | 25°48'09"       | 93°47'36"        |
| 62                                                              | TP-07                   | 7+386.7227      | 33.00           | 05°04'35"                           | L           | 579536.4621    | 2854045.6610    | 25°48'09"       | 93°47'36"        |
| 63                                                              | TP-08                   | 7+419.7217      | 0.00            | 00°00'00"                           | L           | 579532.6727    | 2854012.8803    | 25°48'08"       | 93°47'36"        |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE  
AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER  
DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

**ANNEXURE-B**

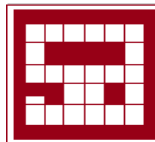
**List of All Crossing Falling on the Route of Pipeline:**

**LIST OF ALL CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |         | Crossing Width (m) | EASTING     | NORTHING    |
|-------|-------|------------------|---------------|-------------------------|---------|--------------------|-------------|-------------|
| 1     | CS-01 | ROAD             | 0+307.9409    | IP-0/1                  | IP-0/2  | 7.724              | 576982.7627 | 2860514.69  |
| 2     | CS-02 | CC ROAD          | 0+495.1661    | IP-0/2                  | IP-0/3  | 6.019              | 577031.8675 | 2860333.542 |
| 3     | CS-03 | ROAD             | 0+680.6845    | IP-0/2                  | IP-0/3  | 2.984              | 577080.1843 | 2860154.633 |
| 4     | CS-04 | ROAD             | 0+918.2078    | IP-0/3                  | IP-0/4  | 4.952              | 577143.2986 | 2859925.837 |
| 5     | CS-05 | ROAD             | 1+219.6382    | IP-0/4                  | IP-0/5  | 5.444              | 577224.8606 | 2859635.416 |
| 6     | CS-06 | ROAD             | 2+256.5869    | IP-0/12                 | IP-0/13 | 5.401              | 577502.7238 | 2858636.456 |
| 7     | CS-07 | ROAD             | 2+920.5251    | IP-0/17                 | IP-0/18 | 4.49               | 577684.7417 | 2857997.953 |
| 8     | CS-08 | NALA             | 3+147.4775    | IP-0/18                 | IP-0/19 | 1.827              | 577747.4357 | 2857779.206 |
| 9     | CS-09 | ROAD             | 3+506.9191    | IP-0/20                 | IP-0/21 | 7.028              | 577844.9601 | 2857433.949 |
| 10    | CS-10 | ROAD             | 3+690.7575    | IP-0/22                 | IP-0/23 | 4.274              | 577895.9256 | 2857257.405 |
| 11    | CS-11 | ROAD             | 3+896.4449    | IP-0/23                 | IP-0/24 | 5.133              | 577951.9533 | 2857059.36  |
| 12    | CS-12 | ROAD             | 3+980.3302    | IP-0/24                 | IP-0/25 | 4.242              | 577975.4504 | 2856978.722 |
| 13    | CS-13 | ROAD             | 5+147.0166    | IP-0/34                 | IP-0/35 | 3.457              | 578370.6527 | 2855883.965 |
| 14    | CS-14 | ROAD             | 5+193.2746    | IP-0/35                 | IP-0/36 | 2.932              | 578390.0234 | 2855841.861 |
| 15    | CS-15 | ROAD             | 5+269.8980    | IP-0/36                 | IP-0/37 | 8.284              | 578424.9786 | 2855773.793 |
| 16    | CS-16 | ROAD             | 5+717.7072    | IP-0/40                 | IP-0/41 | 4.208              | 578668.4234 | 2855397.978 |
| 17    | CS-17 | ROAD             | 6+707.1681    | IP-1/1                  | IP-1/2  | 4.094              | 579240.0204 | 2854591.862 |
| 18    | CS-18 | ROAD             | 6+942.7802    | IP-1/3                  | IP-1/4  | 10.374             | 579397.4705 | 2854416.364 |
| 19    | CS-19 | ROAD             | 7+177.4559    | IP-1/5                  | TP-02   | 6.081              | 579551.5003 | 2854239.292 |
| 20    | CS-20 | ROAD             | 7+349.5022    | IP-5/1                  | TP-06   | 14.981             | 579546.5982 | 2854080.907 |



PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA



CLIENT: HP OIL GAS PRIVATE LIMITED

PREPARED BY: M/s SWAYIN & ASSOCIATES

JOB NO- SA-1146

**ANNEXURE-C**

List of Railway Crossings Falling Along the Route:

**LIST OF RAILWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                        | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|----------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO RAILWAY CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-D**

List of river crossings falling on the route of the pipeline:

**LIST OF RIVER CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                      | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|--------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO RIVER CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-E**

List of National Highway Crossings Falling Along the Route:

**LIST OF NATIONAL HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                                 | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|-------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO NATIONAL HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-F:**

List of State Highway Crossings Falling Along the Route:

**LIST OF STATE HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                              | Cs.No | Type of Crossing | Chainage (Km) | Description | Between Pillar Location | Crossing Width (m) |
|----------------------------------------------------|-------|------------------|---------------|-------------|-------------------------|--------------------|
| THERE IS NO STATE HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |             |                         |                    |

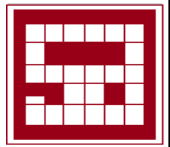
**ANNEXURE-G:**

List of nala, canal, drain crossings falling on the route of the pipeline:

**LIST OF NALA, CANAL, DRAIN CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |         | Crossing Width (m) |
|-------|-------|------------------|---------------|-------------------------|---------|--------------------|
| 1     | CS-08 | NALA             | 3+147.4775    | IP-0/18                 | IP-0/19 | 1.827              |





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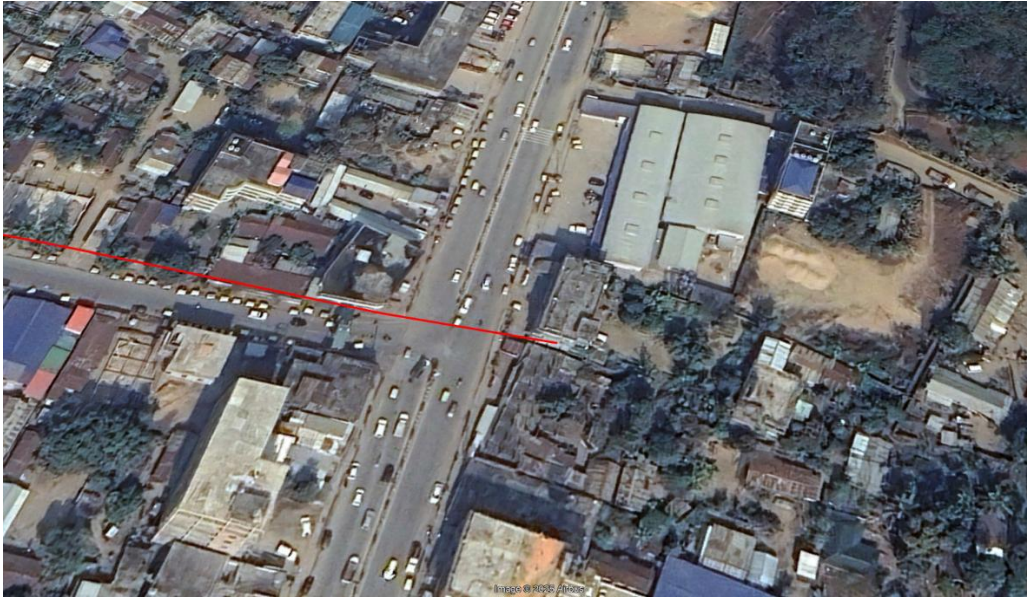
JOB NO- SA-1146

### SUMMARY OF PROPOSED BRANCH-3

#### TAP-OFF & TERMINAL POINT

##### Tap -off Point at 7<sup>th</sup> mile Chumoukdima Ch: 0.00 Km:

The proposed pipe line takes off point is located at 7<sup>th</sup> mile Chumoukdima, Dimapur district, Nagaland state. whose co-ordinates are as i.e. Latitude 25°49'15"E Longitude 93°58'18"N.



#### TAP-OFF POINT OF BRANCH- 3

##### Terminal Point at HPCL Petrol pump, Virazouma Ch: 281+984.35Km:

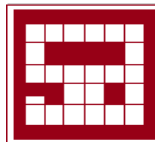
The Terminal point is located at HPCL Petrol pump, Virazouma, Dimapur district, State of Nagaland. whose co-ordinates are as i.e. Latitude 25°48'10"E Longitude 93°56'25"N.



#### TERMINAL POINT OF BRANCH- 3



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



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**JOB NO- SA-1146**

**DETAILS OF BRANCH-3:**

| Particulars                                        | Chainage (km) | Latitude  | Longitude | District | State    |
|----------------------------------------------------|---------------|-----------|-----------|----------|----------|
| 7 <sup>th</sup> mile Chumoukdima, Dimapur district | 0+000.00      | 25°49'15" | 93°58'18" | Dimapur  | Nagaland |
| HPCL Petrol pump, Virazouma, Dimapur district      | 3+824.71      | 25°48'10" | 93°56'25" | Dimapur  | Nagaland |

**SURVEY OF INDIA TOPO MAP BRANCH-3:**

| SL No. | Particulars | Scale    | Chainage (Km) |                | Length (Km) | Toposheet No. |
|--------|-------------|----------|---------------|----------------|-------------|---------------|
|        |             |          | Tap-off Point | Terminal Point |             |               |
| 1      | TOPO SHEETS | 1:50,000 | 0+000.00      | 3+824.71       | 3.824       | G46P9, G46P13 |

**LIST OF CROSSINGS BRANCH-3:**

| ABSTRACT OF CROSSINGS |                             |                     |
|-----------------------|-----------------------------|---------------------|
| SL.NO                 | TYPE OF CROSSING            | NUMBER OF CROSSINGS |
| 1.                    | Railway Crossing            | 0                   |
| 2.                    | River                       | 0                   |
| 3.                    | Canal/Nala/ Minor Waterways | 0                   |
| 4.                    | NH                          | 0                   |
| 5.                    | SH                          | 0                   |
| 6.                    | Asphalt Road                | 9                   |
| 7.                    | Soil Road                   | 5                   |
|                       | <b>Total</b>                | <b>14</b>           |

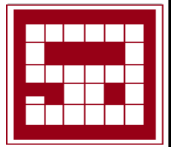
**TYPE OF TERRAIN/LAND USE (BRANCH-03):**

The Terrain and land use along Pipeline BRANCH-03 is described in the below table:

| SECTION                                                                                                                                      | TERRAIN AND LAND USE                                                                                  | REMARKS                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 7 <sup>th</sup> mile Chumoukdima, Dimapur district to HPCL Petrol pump, Virazouma, Dimapur district of (Ch: 0+000.00km to Ch: 3+810.009 Km). | Proposed Pipeline Route passes through the State Highway, Asphalted Road, Cart track Road, Nala, etc. | There are crossing of Asphalted Road, Soil Road. Future development plans are observed in the en-route of pipeline. |



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**JOB NO- SA-1146**

Tap-off point 7<sup>th</sup> mile Chumoukdima and Terminal point is HPCL Petrol pump, Virazouma.

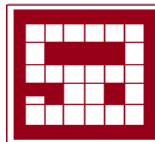
**CONSTRAINTS:**

Major Constraints for routing the pipeline are summarized below:

- **WATER NETWORKS**  
The proposed pipeline has crossing through Nala River .
- **ROAD NETWORK**  
Along the proposed pipeline a consistent No. of Road crossings are noticed.



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

**Summary of Detailed Route Survey Salient Features**

**SALIENT FEATURES (BRANCH-3):**

|            |                                        |                                              |
|------------|----------------------------------------|----------------------------------------------|
| <b>(A)</b> | <b><u>State wise Length (Km.)</u></b>  |                                              |
|            | (a) Nagaland                           | 3+810.009 Km                                 |
|            | <b><u>Revenue Details</u></b>          |                                              |
|            | (a) State                              | 1                                            |
|            | (b) District                           | 1                                            |
| <b>(B)</b> | <b><u>Road Crossing (No's)</u></b>     |                                              |
|            | (a) National Highway                   | 0                                            |
|            | (b) State Highway                      | 0                                            |
|            | (c) Railway                            | 0                                            |
| <b>(C)</b> | <b><u>Water Bodies (No's)</u></b>      |                                              |
|            | (a) Canal                              | 0                                            |
|            | (b) Rivers                             | 0                                            |
|            | (c) Nala                               | 0                                            |
| <b>(D)</b> | <b><u>Seismic Zone</u></b>             | Zone-V                                       |
| <b>(E)</b> | <b><u>Tap-Off GPS Coordinates</u></b>  |                                              |
|            | (a) <b>BRANCH: -3</b>                  | Latitude 25°49'15"E<br>Longitude 93°58'18"N. |
| <b>(F)</b> | <b><u>Terminal GPS Coordinates</u></b> |                                              |
|            | (a) <b>BRANCH: -3</b>                  | Latitude 25°48'10"E Longitude 93°56'25"N.    |

**ANNEXURES LIST:**

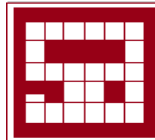
**BRANCH: -3**

|            |                                    |
|------------|------------------------------------|
| Annexure-A | List of TP'S/IP'S Details          |
| Annexure-B | List of all Crossings              |
| Annexure-C | List of Existing Railway Crossings |
| Annexure-D | List of River Crossings            |
| Annexure-E | List of National Highways          |
| Annexure-F | List of State Highways             |
| Annexure-G | List of Canal/Nala/Drain Crossings |





**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITES OF PIPELINE ROUTE  
AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER  
DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

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**JOB NO- SA-1146**

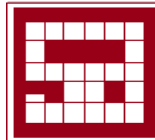
**ANNEXURE-A**

**List of TP's/IP's Details Falling on the Route of Pipeline (In UTM Co-ordinates):**

| TURNING POINTS, DISTANCES & BEARING STATEMENT |                        |          |          |                                 |      |             |             |           |           |
|-----------------------------------------------|------------------------|----------|----------|---------------------------------|------|-------------|-------------|-----------|-----------|
| SL. NO                                        | TP-IP<br>PILLAR<br>NO. | CHAINAGE | DISTANCE | DEFLECTION ANGLE<br>DEG MIN SEC | SIDE | EASTING     | NORTHING    | LATITUDE  | LONGITUDE |
| 1                                             | TP-0                   | 0+000.00 | 160.89   | 00°00'00"                       | R    | 597383.8235 | 2856208.643 | 25°49'15" | 93°58'18" |
| 2                                             | IP-0/1                 | 0+160.89 | 50.92    | 00°00'00"                       | R    | 597239.7277 | 2856137.072 | 25°49'13" | 93°58'13" |
| 3                                             | IP-0/2                 | 0+211.81 | 74.11    | 00°00'00"                       | R    | 597193.4468 | 2856115.684 | 25°49'12" | 93°58'11" |
| 4                                             | TP-1                   | 0+285.92 | 19.35    | 07°06'26"                       | R    | 597125.4992 | 2856086.112 | 25°49'11" | 93°58'08" |
| 5                                             | TP-2                   | 0+305.27 | 28.33    | 05°01'29"                       | R    | 597106.9332 | 2856080.651 | 25°49'11" | 93°58'08" |
| 6                                             | IP-2/1                 | 0+333.6  | 23.94    | 00°00'00"                       | R    | 597079.2213 | 2856075.076 | 25°49'11" | 93°58'07" |
| 7                                             | TP-3                   | 0+357.54 | 18.49    | 09°28'02"                       | R    | 597055.4377 | 2856072.306 | 25°49'11" | 93°58'06" |
| 8                                             | IP-3/1                 | 0+376.03 | 40.54    | 00°00'00"                       | R    | 597036.9127 | 2856073.22  | 25°49'11" | 93°58'05" |
| 9                                             | TP-4                   | 0+416.57 | 24.56    | 11°28'55"                       | R    | 596996.5458 | 2856076.226 | 25°49'11" | 93°58'04" |
| 10                                            | TP-5                   | 0+441.13 | 22.36    | 11°41'04"                       | R    | 596972.1777 | 2856073.137 | 25°49'11" | 93°58'03" |
| 11                                            | TP-6                   | 0+463.49 | 35.87    | 16°29'25"                       | R    | 596951.0219 | 2856065.889 | 25°49'11" | 93°58'02" |
| 12                                            | IP-6/1                 | 0+499.36 | 77.21    | 00°00'00"                       | R    | 596921.8459 | 2856045.027 | 25°49'10" | 93°58'01" |
| 13                                            | IP-6/2                 | 0+576.57 | 52.61    | 00°00'00"                       | R    | 596862.3265 | 2855995.752 | 25°49'08" | 93°57'59" |
| 14                                            | IP-6/3                 | 0+629.18 | 31.83    | 00°00'00"                       | R    | 596819.1538 | 2855965.679 | 25°49'07" | 93°57'57" |
| 15                                            | TP-7                   | 0+661.01 | 26.19    | 07°33'05"                       | R    | 596792.5946 | 2855948.25  | 25°49'07" | 93°57'56" |
| 16                                            | IP-7/1                 | 0+687.2  | 45.26    | 00°00'00"                       | R    | 596769.0304 | 2855936.705 | 25°49'07" | 93°57'56" |
| 17                                            | IP-7/2                 | 0+732.46 | 63.30    | 00°00'00"                       | R    | 596727.0194 | 2855920.032 | 25°49'06" | 93°57'54" |
| 18                                            | IP-7/3                 | 0+795.76 | 82.32    | 00°00'00"                       | R    | 596666.5706 | 2855901.266 | 25°49'05" | 93°57'52" |
| 19                                            | IP-7/4                 | 0+878.08 | 95.44    | 00°00'00"                       | R    | 596587.6802 | 2855877.732 | 25°49'05" | 93°57'49" |
| 20                                            | IP-7/5                 | 0+973.52 | 86.12    | 00°00'00"                       | R    | 596496.1575 | 2855850.701 | 25°49'04" | 93°57'46" |
| 21                                            | IP-7/6                 | 1+059.64 | 96.86    | 00°00'00"                       | R    | 596414.636  | 2855822.935 | 25°49'03" | 93°57'43" |
| 22                                            | IP-7/7                 | 1+156.5  | 38.74    | 00°00'00"                       | R    | 596323.0455 | 2855791.398 | 25°49'02" | 93°57'40" |
| 23                                            | IP-7/8                 | 1+195.24 | 33.83    | 00°00'00"                       | R    | 596285.5823 | 2855781.531 | 25°49'02" | 93°57'38" |
| 24                                            | IP-7/9                 | 1+229.07 | 79.19    | 00°00'00"                       | R    | 596252.4617 | 2855774.376 | 25°49'01" | 93°57'37" |
| 25                                            | IP-7/10                | 1+308.26 | 77.23    | 00°00'00"                       | R    | 596174.1018 | 2855763.349 | 25°49'01" | 93°57'34" |
| 26                                            | IP-7/11                | 1+385.49 | 41.75    | 00°00'00"                       | R    | 596097.2155 | 2855756.111 | 25°49'01" | 93°57'31" |
| 27                                            | TP-8                   | 1+427.24 | 32.09    | 05°42'57"                       | R    | 596055.697  | 2855751.1   | 25°49'01" | 93°57'30" |
| 28                                            | IP-8/1                 | 1+459.33 | 43.08    | 00°00'00"                       | R    | 596024.4475 | 2855744.121 | 25°49'00" | 93°57'29" |
| 29                                            | TP-9                   | 1+502.41 | 62.68    | 25°34'27"                       | R    | 595983.5647 | 2855730.513 | 25°49'00" | 93°57'27" |
| 30                                            | TP-10                  | 1+565.09 | 100.03   | 05°17'56"                       | R    | 595938.4656 | 2855686.984 | 25°48'59" | 93°57'26" |
| 31                                            | IP-10/1                | 1+665.12 | 113.62   | 00°00'00"                       | R    | 595860.3402 | 2855624.425 | 25°48'57" | 93°57'23" |
| 32                                            | IP-10/2                | 1+778.74 | 51.09    | 00°00'00"                       | R    | 595776.0709 | 2855548.302 | 25°48'54" | 93°57'20" |
| 33                                            | IP-10/3                | 1+829.83 | 99.54    | 00°00'00"                       | R    | 595738.7361 | 2855513.428 | 25°48'53" | 93°57'18" |
| 34                                            | IP-10/4                | 1+929.37 | 37.69    | 00°00'00"                       | R    | 595661.6977 | 2855450.3   | 25°48'51" | 93°57'16" |
| 35                                            | IP-10/5                | 1+967.06 | 61.13    | 00°00'00"                       | R    | 595633.0276 | 2855425.928 | 25°48'50" | 93°57'15" |
| 36                                            | IP-10/6                | 2+028.19 | 140.69   | 00°00'00"                       | R    | 595587.3267 | 2855385.319 | 25°48'49" | 93°57'13" |
| 37                                            | IP-10/7                | 2+168.88 | 91.69    | 00°00'00"                       | R    | 595481.9911 | 2855292.06  | 25°48'46" | 93°57'09" |
| 38                                            | IP-10/8                | 2+260.57 | 90.62    | 00°00'00"                       | R    | 595414.4084 | 2855230.097 | 25°48'44" | 93°57'07" |
| 39                                            | IP-10/9                | 2+351.19 | 58.90    | 00°00'00"                       | R    | 595345.2377 | 2855171.561 | 25°48'42" | 93°57'04" |
| 40                                            | IP-10/10               | 2+410.09 | 110.46   | 00°00'00"                       | R    | 595300.8615 | 2855132.83  | 25°48'41" | 93°57'03" |
| 41                                            | IP-10/11               | 2+520.55 | 84.22    | 00°00'00"                       | R    | 595220.1679 | 2855057.386 | 25°48'38" | 93°56'60" |
| 42                                            | IP-10/12               | 2+604.77 | 58.03    | 00°00'00"                       | R    | 595155.493  | 2855003.44  | 25°48'37" | 93°56'57" |
| 43                                            | IP-10/13               | 2+662.8  | 53.89    | 00°00'00"                       | R    | 595109.9116 | 2854967.542 | 25°48'35" | 93°56'56" |
| 44                                            | IP-10/14               | 2+716.69 | 68.03    | 00°00'00"                       | R    | 595067.1295 | 2854934.773 | 25°48'34" | 93°56'54" |
| 45                                            | IP-10/15               | 2+784.72 | 84.13    | 00°00'00"                       | R    | 595014.7867 | 2854891.315 | 25°48'33" | 93°56'52" |
| 46                                            | IP-10/16               | 2+868.85 | 109.68   | 00°00'00"                       | R    | 594951.4374 | 2854835.945 | 25°48'31" | 93°56'50" |
| 47                                            | IP-10/17               | 2+978.53 | 120.90   | 00°00'00"                       | R    | 594870.4267 | 2854762.017 | 25°48'29" | 93°56'47" |
| 48                                            | IP-10/18               | 3+099.43 | 94.64    | 00°00'00"                       | R    | 594780.1427 | 2854681.603 | 25°48'26" | 93°56'44" |
| 49                                            | IP-10/19               | 3+194.07 | 140.75   | 00°00'00"                       | R    | 594709.5421 | 2854618.569 | 25°48'24" | 93°56'41" |
| 50                                            | IP-10/20               | 3+334.82 | 88.78    | 00°00'00"                       | R    | 594610.2821 | 2854518.782 | 25°48'21" | 93°56'38" |
| 51                                            | IP-10/21               | 3+423.6  | 104.26   | 00°00'00"                       | R    | 594547.1962 | 2854456.325 | 25°48'19" | 93°56'35" |
| 52                                            | IP-10/22               | 3+527.86 | 93.49    | 00°00'00"                       | R    | 594471.5561 | 2854384.562 | 25°48'17" | 93°56'33" |
| 53                                            | IP-10/23               | 3+621.35 | 90.58    | 00°00'00"                       | R    | 594405.7794 | 2854318.126 | 25°48'14" | 93°56'30" |
| 54                                            | IP-10/24               | 3+711.93 | 112.78   | 00°00'00"                       | R    | 594342.3401 | 2854253.48  | 25°48'12" | 93°56'28" |
| 55                                            | TP-11                  | 3+824.71 | -        | 00°00'00"                       | R    | 594260.619  | 2854175.744 | 25°48'10" | 93°56'25" |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

**ANNEXURE-B**

**List of All Crossing Falling on the Route of Pipeline:**

**LIST OF ALL CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |          | Crossing Width (m) | EASTING     | NORTHING    |
|-------|-------|------------------|---------------|-------------------------|----------|--------------------|-------------|-------------|
| 1     | CS-01 | SOIL ROAD        | 0+101.336     | TP-0                    | IP-0/1   | 5.13               | 597293.066  | 2856163.565 |
| 2     | CS-02 | SOIL ROAD        | 0+181.890     | IP-0/1                  | IP-0/2   | 6.53               | 597220.687  | 2856128.204 |
| 3     | CS-03 | ASPHALT ROAD     | 0+290.906     | TP-1                    | TP-2     | 11.50              | 597120.7701 | 2856084.727 |
| 4     | CS-04 | ASPHALT ROAD     | 0+580.577     | IP-6/2                  | IP-6/3   | 8.77               | 596859.0855 | 2855993.5   |
| 5     | CS-05 | ASPHALT ROAD     | 1+463.603     | IP-8/1                  | TP-9     | 16.18              | 596020.4743 | 2855742.799 |
| 6     | CS-06 | ASPHALT ROAD     | 1+503.984     | TP-9                    | TP-10    | 29.77              | 595982.4789 | 2855729.378 |
| 7     | CS-07 | ASPHALT ROAD     | 1+672.372     | IP-10/1                 | IP-10/2  | 3.92               | 595855.0476 | 2855619.556 |
| 8     | CS-08 | SOIL ROAD        | 1+872.876     | IP-10/3                 | IP-10/4  | 11.59              | 595705.4404 | 2855486.144 |
| 9     | CS-09 | ASPHALT ROAD     | 1+966.722     | IP-10/5                 | IP-10/6  | 10.76              | 595633.2843 | 2855426.146 |
| 10    | CS-10 | SOIL ROAD        | 2+424.028     | IP-10/10                | IP-10/11 | 18.82              | 595290.7204 | 2855123.263 |
| 11    | CS-11 | SOIL ROAD        | 2+745.575     | IP-10/14                | IP-10/15 | 12.93              | 595044.9018 | 2854916.318 |
| 12    | CS-12 | ASPHALT ROAD     | 3+234.966     | IP-10/19                | IP-10/20 | 14.53              | 594680.7042 | 2854589.578 |
| 13    | CS-13 | ASPHALT ROAD     | 3+476.844     | IP-10/21                | IP-10/22 | 6.04               | 594508.5674 | 2854419.676 |
| 14    | CS-14 | ASPHALT ROAD     | 3+810.009     | IP-10/24                | TP-11    | 10.24              | 594271.2735 | 2854185.879 |

**ANNEXURE-C**

**List of Railway Crossings Falling Along the Route:**

**LIST OF RAILWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                        | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|----------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO RAILWAY CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-D**

**List of River Crossings Falling Along the Route:**

**LIST OF RIVER CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                      | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|--------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO RIVER CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |



PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA



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JOB NO- SA-1146

**ANNEXURE-E**

**List of National Highway Crossings Falling Along the Route:**

**LIST OF NATIONAL HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                                 | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|-------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO NATIONAL HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-F:**

**List of State Highway Crossings Falling Along the Route:**

**LIST OF STATE HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                              | Cs.No | Type of Crossing | Chainage (Km) | Description | Between Pillar Location | Crossing Width (m) |
|----------------------------------------------------|-------|------------------|---------------|-------------|-------------------------|--------------------|
| THERE IS NO STATE HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |             |                         |                    |

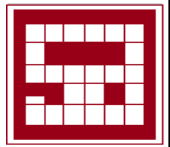
**ANNEXURE-G:**

**List of Canal Crossings Falling Along the Route:**

**LIST OF NALA, CANAL, DRAIN CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                                   | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|---------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO NALA, CANAL, DRAIN CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |





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JOB NO- SA-1146

#### SUMMARY OF PROPOSED BRANCH-4

##### TAP-OFF & TERMINAL POINT

##### Tap -off Point at Ch: 0.00 Km:

The proposed pipe line takes off point is located at Rongmei, Dimapur district, Nagaland state. whose co-ordinates are as i.e. Latitude 25°54'3''E Longitude 93°53'21''N.



##### TAP-OFF POINT OF BRANCH- 4

##### Terminal Point at Ummeed Prison Welfare Service Station, Dimapur District Ch: 0+493.228Km:

The Terminal point is located at Ummeed Prison Welfare Service Station, Dimapur District, State of Nagaland. whose co-ordinates are as i.e. Latitude 25°53'53''E Longitude 93°53'31''N.

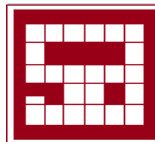


##### TERMINAL POINT OF BRANCH- 4





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**JOB NO- SA-1146**

**DETAILS OF BRANCH-4:**

| Particulars                                             | Chainage (km) | Latitude   | Longitude  | District | State    |
|---------------------------------------------------------|---------------|------------|------------|----------|----------|
| Rongmei, Dimapur district                               | 0+000.00      | 25°54'3''  | 93°53'21'' | Dimapur  | Nagaland |
| Ummeed Prison Welfare Service Station, Dimapur District | 0+493.228     | 25°53'53'' | 93°53'31'' | Dimapur  | Nagaland |

**SURVEY OF INDIA TOPO MAP BRANCH-4:**

| SL No. | Particulars | Scale    | Chainage (Km) |                | Length (Km) | Toposheet No. |
|--------|-------------|----------|---------------|----------------|-------------|---------------|
|        |             |          | Tap-off Point | Terminal Point |             |               |
| 1      | TOPO SHEETS | 1:50,000 | 0+000.00      | 0+493.228      | 0.493       | G46P9         |

**LIST OF CROSSINGS BRANCH-4:**

| ABSTRACT OF CROSSINGS |                             |                     |
|-----------------------|-----------------------------|---------------------|
| SL.NO                 | TYPE OF CROSSING            | NUMBER OF CROSSINGS |
| 1.                    | Railway Crossing            | 0                   |
| 2.                    | River                       | 0                   |
| 3.                    | Canal/Nala/ Minor Waterways | 0                   |
| 4.                    | NH                          | 0                   |
| 5.                    | SH                          | 0                   |
| 6.                    | Asphalt Road                | 2                   |
|                       | <b>Total</b>                | <b>2</b>            |

**TYPE OF TERRAIN/LAND USE (BRANCH-04):**

The Terrain and land use along Pipeline BRANCH-04 is described in the below table:

| SECTION                                                                                                                                                                                                                                            | TERRAIN AND LAND USE                                       | REMARKS                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Rongmei, Dimapur district to Ummeed Prison Welfare Service Station, Dimapur District of (Ch: 0+000.00km to Ch: 0+493.228Km). Tap-off point Rongmei, Dimapur district and Terminal point is Ummeed Prison Welfare Service Station, Dimapur District | Proposed Pipeline Route passes through the Asphalted Road. | There are crossing of Asphalted Road, Future development plans are observed in the en-route of pipeline. |



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



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**JOB NO- SA-1146**

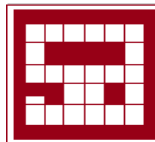
**CONSTRAINTS:**

Major Constraints for routing the pipeline are summarized below:

- **WATER NETWORKS**  
The proposed pipeline has crossing through Nala River
- **ROAD NETWORK**  
Along the proposed pipeline a consistent No. of Road crossings are noticed.



**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

**Summary of Detailed Route Survey Salient Features**

**SALIENT FEATURES (BRANCH-4):**

|            |                                        |                                                |
|------------|----------------------------------------|------------------------------------------------|
| <b>(A)</b> | <b><u>State wise Length (Km.)</u></b>  |                                                |
|            | (a) Nagaland                           | 0+493.228km                                    |
|            | <b><u>Revenue Details</u></b>          |                                                |
|            | (a) State                              | 1                                              |
|            | (b) District                           | 1                                              |
| <b>(B)</b> | <b><u>Road Crossing (No's)</u></b>     |                                                |
|            | (a) National Highway                   | -                                              |
|            | (b) State Highway                      | -                                              |
|            | (c) Railway                            | -                                              |
| <b>(C)</b> | <b><u>Water Bodies (No's)</u></b>      |                                                |
|            | (a) Canal                              | -                                              |
|            | (b) Rivers                             | -                                              |
|            | (c) Nala                               | -                                              |
| <b>(D)</b> | <b><u>Seismic Zone</u></b>             | Zone-V                                         |
| <b>(E)</b> | <b><u>Tap-Off GPS Coordinates</u></b>  |                                                |
|            | (a) BRANCH-4                           | Latitude-25°54'3''N<br>Longitude-93°53'21''E   |
| <b>(F)</b> | <b><u>Terminal GPS Coordinates</u></b> |                                                |
|            | (a) BRANCH-4                           | Latitude- 25°53'53''N<br>Longitude-93°53'31''E |

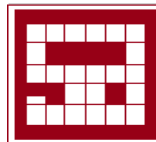
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**BRANCH-4**

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**PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA**



**CLIENT: HP OIL GAS PRIVATE LIMITED**

**PREPARED BY: M/s SWAYIN & ASSOCIATES**

**JOB NO- SA-1146**

**ANNEXURE-A**

**List of TP's/IP's Details Falling on the Route of Pipeline (In UTM Co-ordinates):**

| <b><u>TURNING POINTS, DISTANCES &amp; BEARING STATEMENT</u></b> |                  |            |          |                              |      |             |             |           |           |
|-----------------------------------------------------------------|------------------|------------|----------|------------------------------|------|-------------|-------------|-----------|-----------|
| SL. NO                                                          | TP-IP PILLAR NO. | CHAINAGE   | DISTANCE | DEFLECTION ANGLE DEG MIN SEC | SIDE | EASTING     | NORTHING    | LATITUDE  | LONGITUDE |
| 1                                                               | TP-00            | 0+000.00   | 0.00     | 00°00'00"                    | L    | 589052.0152 | 2864996.906 | 25°54'3"  | 93°53'21" |
| 2                                                               | TP-1             | 0+043.7816 | 44.07    | 14°25'32"                    | L    | 589031.8485 | 2864957.72  | 25°54'2"  | 93°53'20" |
| 3                                                               | TP-2             | 0+069.2694 | 29.19    | 21°30'0"                     | L    | 589025.3776 | 2864929.254 | 25°54'1"  | 93°53'20" |
| 4                                                               | TP-3             | 0+084.3033 | 14.66    | 12°40'18"                    | L    | 589027.594  | 2864914.759 | 25°54'0"  | 93°53'20" |
| 5                                                               | TP-4             | 0+115.9911 | 32.24    | 12°22'20"                    | L    | 589039.3395 | 2864884.734 | 25°53'59" | 93°53'20" |
| 6                                                               | TP-5             | 0+130.6581 | 14.76    | 8°21'45"                     | L    | 589047.5394 | 2864872.456 | 25°53'59" | 93°53'20" |
| 7                                                               | IP-5/1           | 0+158.4163 | 27.15    | 00°00'00"                    | L    | 589065.7388 | 2864852.315 | 25°53'58" | 93°53'21" |
| 8                                                               | TP-6             | 0+204.2489 | 46.81    | 8°40'50"                     | L    | 589098.0641 | 2864818.453 | 25°53'57" | 93°53'22" |
| 9                                                               | TP-7             | 0+262.8162 | 58.63    | 5°42'12"                     | L    | 589144.4872 | 2864782.64  | 25°53'56" | 93°53'24" |
| 10                                                              | IP-7/1           | 0+321.2823 | 57.87    | 00°00'00"                    | L    | 589193.5908 | 2864752.021 | 25°53'55" | 93°53'26" |
| 11                                                              | TP-8             | 0+355.6271 | 33.86    | 12°55'37"                    | L    | 589222.9322 | 2864735.128 | 25°53'54" | 93°53'27" |
| 12                                                              | IP-8/1           | 0+435.4604 | 80.40    | 00°00'00"                    | L    | 589299.8206 | 2864711.615 | 25°53'53" | 93°53'29" |
| 13                                                              | TP-9             | 0+493.2284 | 53.58    | 00°00'00"                    | L    | 589351.5056 | 2864697.5   | 25°53'53" | 93°53'31" |

**ANNEXURE-B**

**List of All Crossing Falling on the Route of Pipeline:**

| <b><u>LIST OF ALL CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</u></b> |       |                  |               |                         |      |                    |             |
|--------------------------------------------------------------------------|-------|------------------|---------------|-------------------------|------|--------------------|-------------|
| Sr.No                                                                    | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location |      | Crossing Width (m) | NORTHING    |
| 1                                                                        | CS-01 | ASPHALT ROAD     | 0+78.0880     | TP-2                    | TP-3 | 5.629 M            | 2864916.984 |
| 2                                                                        | CS-02 | ASPHALT ROAD     | 0+170.9551    | IP-5/1                  | TP-6 | 11.224 M           | 2864845.384 |

**ANNEXURE-C**

**List of Railway Crossings Falling Along the Route:**

| <b><u>LIST OF RAILWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</u></b> |       |                  |               |                         |                    |
|------------------------------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| Sr.No                                                                        | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
| <b>THERE IS NO RAILWAY CROSSING ALONG THE ROUTE</b>                          |       |                  |               |                         |                    |

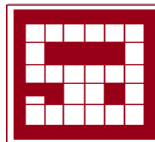
**ANNEXURE-D**

**List of River Crossings Falling Along the Route:**

| <b><u>LIST OF RIVER CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE</u></b> |       |                  |               |                         |                    |
|----------------------------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| Sr.No                                                                      | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
| <b>THERE IS NO RIVER CROSSING ALONG THE ROUTE</b>                          |       |                  |               |                         |                    |



PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA



CLIENT: HP OIL GAS PRIVATE LIMITED

PREPARED BY: M/s SWAYIN & ASSOCIATES

JOB NO- SA-1146

**ANNEXURE-E**

**List of National Highway Crossings Falling Along the Route:**

**LIST OF NATIONAL HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                                 | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|-------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO NATIONAL HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |

**ANNEXURE-F:**

**List of State Highway Crossings Falling Along the Route:**

**LIST OF STATE HIGHWAY CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                              | Cs.No | Type of Crossing | Chainage (Km) | Description | Between Pillar Location | Crossing Width (m) |
|----------------------------------------------------|-------|------------------|---------------|-------------|-------------------------|--------------------|
| THERE IS NO STATE HIGHWAY CROSSING ALONG THE ROUTE |       |                  |               |             |                         |                    |

**ANNEXURE-G:**

**List of Canal Crossings Falling Along the Route:**

**LIST OF NALA, CANAL, DRAIN CROSSINGS FALLING ON THE ROUTE OF THE PIPELINE**

| Sr.No                                                   | Cs.No | Type of Crossing | Chainage (Km) | Between Pillar Location | Crossing Width (m) |
|---------------------------------------------------------|-------|------------------|---------------|-------------------------|--------------------|
| THERE IS NO NALA, CANAL, DRAIN CROSSING ALONG THE ROUTE |       |                  |               |                         |                    |





PROJECT: ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA



CLIENT: HP OIL GAS PRIVATE LIMITED

PREPARED BY: M/s SWAYIN & ASSOCIATES

JOB NO- SA-1146

PHOTOGRAPHS







**LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS**

**TOTAL SHEETS**

61

**DOCUMENT NO**

VCS-00-00-VL-0001

**LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS**

|            |             |                    |               |            |               |
|------------|-------------|--------------------|---------------|------------|---------------|
| 16         | 31.12.2025  | Issued as Standard | Ramveer Singh | Safdar Ali | Rachna Shukla |
| <b>REV</b> | <b>DATE</b> | <b>DESCRIPTION</b> | <b>PREP</b>   | <b>CHK</b> | <b>APPR</b>   |

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## **A. MECHANICAL & PIPELINE**

### **1.0 CARBON STEEL PIPES**

#### **1.1 PIPE CARBON STEEL TO INDIAN STANDARDS**

- a. A.S.T. Pipes Pvt. Ltd. (AST Group)
- b. Advance Steel Tube Ltd.
- c. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.
- d. Asian Mills Pvt. Ltd.
- e. Asrani Tubes Limited
- f. Dadu Pipes (P) Ltd.
- g. Essar Steel Limited(Er Hazira Pipes Mill)
- h. Gaurang Products Pvt Ltd. (Ast Group)
- i. Goodluck Steel Tubes Ltd.
- j. Hi-Tech Pipes Limited
- k. Indus Tube Limited
- l. Jindal Industries Ltd
- m. Jindal Pipes Ltd.
- n. Jindal Saw Ltd (Kosi Works)
- o. Jotindra Steel & Tube Ltd
- p. Lalit Pipes And Pipes Ltd.
- q. Maharashtra Seamless Ltd.
- r. Man Industries (India) Ltd. – Pithampur
- s. Man Industries (India) Ltd. Anjar
- t. Mukat Tanks & Vessels Ltd.
- u. Nezone Tubes Limited
- v. North Eastern Tubes Limited
- w. Pratibha Industries Limited
- x. Pratibha Pipes & Structural Ltd.



- y. Psl Ltd (Chennai)
- z. Psl Ltd (V1, V2 & NC)
- aa. Rama Steel Tubes Ltd.
- bb. Ratnamani Metals And Tubes Ltd.
- cc. Ravindra Tubes Limited
- dd. Samshi Pipe Industries Limited
- ee. Surya Roshni Ltd.
- ff. Swastik Pipes Ltd.
- gg. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
- hh. Welspun Corp. Limited (Dahej)
- ii. Zenith Birla (India) Limited

## **1.2 PIPE & TUBULARS TO A.P.I. STANDARDS**

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Dalmine Spa (Enquiry To Tenaris), Uae
- d. Eewkorea Co. Ltd (Germany), Korea
- e. Eew Korea Co. Ltd. (Korea), Korea
- f. Eisenbau Kramer Gmbh, Germany
- g. Hyundai Rb Co. Ltd. South Korea
- h. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy)
- i. Inox Tech. Spa, Italy
- j. ISMT Ltd. Ahmedngr, India
- k. TATA Steel, India
- l. PSL
- m. Jindal Pipes Ltd., India
- n. Jindal Saw Ltd. (Kosi Works), India
- o. Jindal Saw Ltd. (Nashik Works), India
- p. Lalit Pipes And Pipes Ltd. India
- q. Maharashtra Seamless Ltd., India
- r. Man Industries (I) Ltd. (Pithampur), India
- s. Mukat Tanks & Vessels Ltd., India
- t. Pratibha Industries Limited, India
- u. Ratnamani Metals And Tubes Ltd., India
- v. Siderca S.A.I.C (Enquiry Totenaris), Uae



- w. Sumitomo Metal Ind. Ltd., India
- x. Surya Roshni Ltd., India
- y. Swastik Pipes Ltd, India
- z. Tata Steel Uk Limited (Formerly C702)
- aa. Tubos De Acero De Mexico Sa (Enq. Tenaris), Uae
- bb. Tubos Reunidos Sa Spain
- cc. Umran Steel Pipe Inc (Turkey), Turkey
- dd. Valcovny Trub Chomutov, Czech Republic
- ee. Vallourec And Mannesmann Tubes, France
- ff. Welspun Corp Limited (Dahej), India

### **1.3 PIPE/TUBE CS (SEAMLESS) TO ASTM STANDARDS**

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Changshu Seamless Steel Tube Co. Ltd., China
- d. Dalmine Spa (Enquiry To Tenaris, Uae
- e. Heavy Metals & Tubes Limited (Mehsana), India
- f. Ismt Ltd. Ahmedngr, India
- g. Ismt Ltd. Baramati India
- h. Jfe Steel Corporation, Uae
- i. Jindal Sdaw Ltd (Nashik Works) India
- j. Klt Automotive And Tubular Products Ltd., India
- k. Mahalaxmi Seamless Limited, India
- l. Maharashtra Seamless Ltd, India
- m. Products Tubulares S.A.U, Spain
- n. Ratnadeep Metal Tubes Ltd., India
- o. Staineest Tubes Pvt Ltd., India
- p. Sumitomo Metal Ind. Ltd., India
- q. Tubos Reunidos Sa Spain
- r. Valcovny Trub Chomutov, Czech Republic
- s. Vallourec Andmannesmann Tubes France
- t. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)
- u. Jindal SAW Ltd Kosi Kalan Mathura

### **1.4 PIPE CARBON STEEL (WELDED) TO ASTM STANDARDS**

- a. Eew Korea Co. Ltd. (Germany), Korea



- b. Eew Korea Co. Ltd. (Korea), Korea
- c. Eisenbau Kramer Gmbh, Germany
- d. Hyundai Rb Co. Ltd., South Korea
- e. Inox Tech. Spa, Italy
- f. Jindal Saw Ltd (Kosi Works), India
- g. Lalit Pipes and Pipes Ltd., India
- h. Man Industries (I) Ltd.(Pithampur), India
- i. Man Industries (India) Ltd. Anjar, India
- j. Mukat Tanks & Vessels Ltd., India
- k. Ratnamani Metals And Tubes Ltd., India
- l. Sumitomo Metal India Ltd., India
- m. Tata Steel Uk Limited

## **2.0 VALVES**

### **2.1 GLOBE VALVES**

- a. BDK (New Delhi)
- b. Datre Corpn (Calcutta)
- c. KSB Pumps (New Delhi)
- d. L&T (New Delhi)
- e. Neco Schuber & Salzer Ltd. (New Delhi)
- f. Niton Valve (Mumbai)
- g. Ornate Valves (Mumbai)
- h. Panchavati Valves (Mumbai)
- i. AV Valves Ltd.
- j. BHEL (Trichy), India
- k. Econo Valves Pvt Ltd, India
- l. Fouress Engg (I) Ltd (Aurangabad)
- m. Guru Industrial Valves Pvt Ltd
- n. Leader Valves Ltd, India
- o. NSSL Ltd. (Neco Schubert & Salzerltd)
- p. Oswal Industries Ltd, India
- q. Petrochemical Engineering Enterprises, India
- r. Sakhi Engineers Pvt Ltd
- s. Shalimar Valves Pvt Ltd
- t. Steel Strong Valves India Pvt Ltd, India





- u. Petro Valves Pvt. Limited, Ahmedabad
- v. Hawa Engineers Limited, Ahmedabad (Non API)
- w. G M Engineering PVT LTD (Non API)

## **2.2 CHECK VALVES**

- a. Advance Valves Pvt. Ltd., Noida
- b. Aksons & Mechanical Enterprises, Mumbai
- c. Larsen & Toubro Limited ( Audco India Limited, Chennai)
- d. AV valves Ltd., Agra
- e. BDK engineering India Ltd., Hubli
- f. BHEL, OFE&OE Group, New Delhi
- g. Datre Coroportion Limited, Calcutta
- h. Leader Valves Ltd., Jalandhar
- i. Neco schubert & Salzer Ltd., New Delhi
- j. Niton Valves Industries (P) Ltd., Mumbai
- k. Precision Engg. Co., Mumbai
- l. Econo Valves Pvt Ltd, India
- m. Fouress Engg (I) Ltd (Aurangabad)
- n. KSB Pumps Ltd (Coimbatore), India
- o. NSSL Ltd. (Neco Schubert & Salzer Ltd)
- p. Oswal Industries Ltd, India
- q. Panchvati Valves & Flanges Pvt Ltd, India
- r. Petrochemical Engineering Enterprises, India
- s. Sakhi Engineers Pvt Ltd
- t. Shalimar Valves Pvt Ltd
- u. Steel Strong Valves India Pvt Ltd, India
- v. Shiv Shakti Engineering Works (Approved up to 06 inch)
- x. Hawa Engineers Limited, Ahmedabad
- y. G M Engineering PVT LTD (Non API)

## **2.3 PLUG VALVES**

- a. Breda Energia Sesto Industria Spa, Italy
- b. Fisher Sanmar Ltd., Chennai
- c. Larsen & Toubro Ltd., New Delhi
- d. Nordstrom Valves, USA



- e. Serck Audco Valves, UK
- f. Sumitomo Corporation India Pvt. Ltd., New Delhi
- g. Z Corporation, Korea
- h. Hawa Valves (India) Pvt. Ltd., Mumbai
- i. Steel Strong Valves India Pvt. Ltd., Navi Mumbai
- j. Econo Valves
- k. Flow-Serve PTE (Mfr. SERCK), India

## **2.4 BALL VALVES**

- a. Hawa Valves (India) Pvt. Ltd, Navi Mumbai
- b. Larsen & Toubro, Delhi
- c. Microfinish Valves Pvt. Ltd., Noida
- d. Oswal Industries Ltd., Gandhi nagar
- e. Virgo Engineers Ltd., Delhi
- f. Boteli Valve Group Co. Ltd., China
- g. Cameron (Malaysia) SDN BHD, Malaysia
- h. Dafram S.P.A., Italy
- i. Fangyuan Valve Group Co. Ltd., China
- j. Franz Schuck GmbH, Germany
- k. O.M.S. Saleri (Italy)
- l. Pibi Viesse S.P.A (Italy)
- m. Nuovo Pignone (Italy)
- n. Perar S.P.A (Italy)
- o. Pietro Fiorentini (Italy)
- p. Cooper Cameron Valv Italy SRL-FRM, Italy
- q. Petrol Valves SRL
- r. Tormene Gas Technology S.P.A (VALVITALIA)
- s. Petro Valves Pvt. Limited, Ahmedabad
- t. Shiv Shakti Engineering Works (Approved up to 08 inch)
- u. Hawa Engineers Limited, Ahmedabad
- v. G M Engineering PVT LTD.
- w. DelVal Flow Controls Pvt. Ltd

**3.0 TEE****3.1 FLOW TEE**

- a. Coprosider SPA, Italy
- b. GEA Energy System India Limited, Chennai
- c. Multitex Filtration
- d. Pipeline Engineering, UK
- e. Scomark Engg. Limited (U.K.)
- f. Skeltonhall Limited, Engaland(U.K.)
- g. Technospecial SPA, Italy
- h. Tectubi SPA, Italy
- i. RMA Germany
- j. Pipefit Engineers Pvt. Ltd.
- k. Vee Kay Vikram & Co.

**3.2 SPLIT TEE**

- a. IPSCO, Canda
- b. TD Willamsons, USA
- c. Plant-Tech Power Technical Services Pvt Ltd
- d. Teemans, UK
- e. Vee Kay Vikram & CO.

**4.0 FLANGES**

- a. Aditya Forge Ltd., Vadodara
- b. Amforge Industries Ltd., Mumbai
- c. CD Engineering Co., Ghaziabad
- d. Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
- e. Echjay Industries Ltd., Rajkot
- f. Forge & Forge Pvt. Ltd., Rajkot
- g. Golden Iron & Steel Works, New Delhi
- h. JK Forgings, New Delhi
- i. Metal Forgings Pvt. Ltd., Mumbai
- j. Perfect Marketings Pvt. Ltd., New Delhi
- k. Sky Forge, Faridabad
- l. S&G, Faridabad
- m. Chaudhry Hammer Works Ltd, India



- n. JAV Forgings (P) Ltd, India
- o. Kunj Forgings Pvt Ltd, India
- p. MS Fittings
- q. R.N. Gupta & Co. Ltd, India
- r. R.P. Engineering Pvt Ltd, India
- s. Sanghvi Forgings & Engineering Ltd
- t. Shri Ganesh Forgings Ltd., India
- u. Uma Shankar Khandelwal & Co., India
- v. Sawan Engineers, Baroda
- w. Stewarts & Lloyds of India Ltd., Kolkata
- x. Engineering Services Enterprises
- y. Pipefit Engineers Pvt. Ltd.
- z. Jindal Forging
- aa. Vivial Forges
- bb. N J Engineers (Up to 12 Inch Class 600 Only)

## **5.0 FITTINGS**

- a. Commercial Supplying Agency, Mumbai
- b. Dee Development Engineers Ltd.
- c. Eby Industries, Mumbai
- d. Flash Forge Pvt. Ltd., Vishakhapatnam
- e. Gujarat Infra Pipes Pvt. Ltd., Vadodara
- f. M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
- g. Stewarts & Lloyds of India Ltd., Kolkata
- h. Teekay Tubes Pvt. Ltd., Mumbai
- i. Pipe Fit, Baroda
- j. Sky Forge, Faridabad
- k. S&G, Faridabad
- l. Sawan Engineers, Baroda
- m. Eby Fasteners, India
- n. Leader Valves Ltd, India
- o. R.N. Gupta & Co. Ltd, India
- p. Exten Engg Pvt Ltd
- q. Sivananda Pipe & Fittings Ltd
- r. Jindal Forging



- s. Vivial Forges
- t. PK Tubes Rajasthan
- u. CSA Fitting
- v. Gujarat Infrapipes pvt ltd, Vadodara
- w. KS Pipes Fitting Pvt Ltd, Palwal
- x. Tube Bend, Kolkata

## **6.0 PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS**

- a. Bassi Luigi Fittings B.V., Holland
- b. BRAUN STAHL PIPE TEC, GERMANY
- c. FORAIN, ITALY
- d. Fluidel SRL, ITALY
- e. RMA Maschinen- und, GERMANY
- f. Siirtec Nigi, Itlay
- g. SCHUCK ARMATUREN, GERMANY
- h. T.D. Williamson Inc., USA
- i. Tectubi SPA, Italy
- j. Taylor Forge Engineering System INC, USA
- k. Tormene Americana S.A. (Argentina)
- l. Tormene Gas Technology S.p.A., Italy
- m. PIPELINE ENGINEERING, UNITED KINGDOM
- n. Krohne, Oil & Gas BV, Drive Houston,
- o. Multitex Filtration Engrs. Ltd, New Delhi
- p. BGR ENERGY SYSTEMS LIMITED New Delhi
- q. Glapwell Contracting Services Ltd. UK
- r. FULGOSI GIOVANNI S.n.c di Corrado & C, ITALY
- s. VEEKAY VIKRAM & CO, GUJRAT
- t. GBM S.R.L, ITALY
- u. Cardew Ltd., Alexeander
- v. Forain S.R.L.
- w. GD Engineering, India
- x. Pipeline Engineering, UK
- y. Siirtec Nigi SPA
- z. Control Plus



- aa. Oswal Infrastructure

## **7.0 LONG RADIUS BENDS**

- a. Jindal Saw Ltd. (Kosi Works), India
- b. PSL Limited (Gandhidham – Mfrg), India
- c. BHEL, Trichy, Tamilnadu
- d. Welspun, Gujarat
- e. Sawan
- f. Gujarat Infra
- g. P K Tubes
- h. DEE Development
- i. Pipefit Engineers Pvt. Ltd.

## **8.0 CLEAN AGENT SYSTEM**

- a. ADN Fire Safety Pvt Ltd (Vashi East, Thane)
- b. Chetan Corporation (Ahmedabad)
- c. Chetan Engineers (Ahmedabad)
- d. Mx Systems International Pvt. Ltd. (Mumbai)
- e. New Fire Engineers (P) Ltd (Sil Vassa)
- f. Nitin Fire Protection Industries Ltd (New Bombay)
- g. Nohmi Bosai (India) Private Limited
- h. Tyco Fire & Security India Pvt. Ltd (Bangalore)
- i. Vimal Fire Controls Pvt Ltd (Vadodara)

## **9.0 INSULATING JOINTS**

- a. IGP Engineers
- b. V K Vikram
- c. Advance Electronics
- d. Nupros INC

## **10.0 GASKETS**

- a. IGP Engineers (P) Ltd., Madras
- b. Madras Industrial Products, Madras
- c. Dikson & Company, Bombay
- d. Banco Products (P) Ltd., Vadodara
- e. Goodrich Gaskets Pvt Ltd
- f. Starflex Sealing India Pvt Ltd, India



- g. Teekay Meta Flex Pvt Ltd
- h. UNIKLINGER Ltd
- i. HEM Engg. Corp.
- j. Unique Industrial Packing Pvt. Ltd.

**11.0 FASTENERS**

- a. Nireka Engg. Co. (P) Ltd., Calcutta
- b. Precision Taps & Dies, Bombay
- c. AEP Company, Vithal Udyoug Nagar
- d. Fix Fit Fasteners, Calcutta
- e. Precision Engg. Industries, Baroda
- f. Echjay Forgings Pvt. Ltd., Bombay
- g. Capital Industries, Bombay
- h. Boltmaster India Pvt Ltd, India
- i. Deepak Fasteners Limited, India
- j. Fasteners & Allied Products Pvt Ltd, India
- k. Hardwin Fasteners Pvt Ltd, India
- l. J.J. Industries, India
- m. Multi Fasteners Pvt Ltd, India
- n. Nexo Industries, India
- o. Pacific Forging & Fasteners Pvt Ltd, India
- p. Pioneer Nuts & Bolts Pvt Ltd, India
- q. Precision Auto Engineers, India
- r. President Engineering Works, India
- s. Sandeep Engineering Works, India
- t. Syndicate Engineering Industries, India

**12.0 WELDING ELECTRODES FOR PIPELINE/PIPING WORK**

- a. For Mainline – Lincoln/ Bohler make
- b. For Terminal – For root pass –Lincoln/ Bohler make  
For other passes – Lincoln, D&H or equivalent make Lincon
- c. D & H SECHERON ELECTRODE PVT. LTD. (For Mainline & Terminal- Root & Other pass)

**13.0 STRAINERS**

- a. Bombay Chemical Equipments
- b. Gujarat Auto filed



- c. Multitex Filtration Engineering Limited
- d. Grand Prix Engineering Limited

**14.0 COLD APPLIED TAPES**

- a. Denso GmbH
- b. Raychem

**15.0 HEAT SHRINKABLE SLEEVE/ FIBREGLAS REINFORCED SLEEVE**

- a. Covalence - Seal For Life India Pvt. Ltd. (Formerly Covalence Raychem- Berry Plastics Corporation)
- b. Canussa-CPS
- c. Rigil Techno India(Distributor for M/s CYG Changtong New Material Co Ltd,China)
- d. M/s Shri Narayan Impac-India LLP

**16.0 STUD BOLTS WITH NUTS**

- a. Multi Thread Fasteners, Baroda
- b. Darukhanwala
- c. Precision Engineers, Baroda
- d. Unbrako
- e. TVC

**17.0 WARNING MAT**

- a. Sparco Multiplast Pvt. Ltd., Ahmedabad
- b. Singhal Industries , Ahemdabad
- c. Puja Packing, Mumbai
- d. Bina Enterprises, Mumbai
- e. Shree Vijay Wire & Cable Industries

**18.0 HDPE PIPES/DUCT**

- a. Climax Synthetics (P) Ltd., Vadodra
- b. Indian Poly Pipes, Calcutta
- c. Jain Irrigation Systems Ltd., Jalgaon
- d. Kirti Industries (India) Ltd., Indore
- e. Ori Plast Limited, Calcutta
- f. Phoel Industries Limited, Delhi
- g. Sangir Plastics (P) Ltd., Mumbai
- h. Veekay Plast,Jaipur





- i. Kisan Irrigation
- j. Dutron Polymers Ltd.
- k. Manikya Plastichem (P) Ltd
- l. Himalyan Pipe Industries
- m. NorthEast Polypipes LLP
- n. Mukand Poly Products (for Duct)

**19.0 DRY GAS FILTER & FILTER SEPERATOR**

- a. Grand Prix Fab (Pvt.) Ltd. (New Delhi)
- b. Perry Equipment, USA
- c. Faudi Filter, Germany
- d. Forain S.r.l., Italy
- e. ABB, Faridabad
- f. Burgess Manning, USA
- g. Multitex Filtration Engineers India
- h. Triveni Plenty Engg. Ltd. (New Delhi)
- i. Siirtec International Contractor S.P.A (Italy)
- j. Flashpoint, Pune india
- k. Filtration Engineers (I) Pvt Ltd, India
- l. Gujarat Otofilt, India
- m. Tormene Gas Technology
- n. Ultrafilter (India) Pvt Ltd, India
- o. Ravi Techno Systems Pvt Ltd, India
- p. Siirtec Nigi S.P.A
- q. Filtan Filter Anlagenbau Gmbh
- r. Fairley Arlon BV
- s. PECO Facet
- t. EPE Epenstenner GMBH
- u. Filtrex srl
- v. Petromar Engineered Soln
- w. Plenty Filter
- x. Eurofiltec
- y. PTI Technologies Inc
- z. R S Instrumentation and Services
- aa. Inel Gas Control Pvt Ltd

**20.0 FILTER ELEMENT**

- a. Peco – Facet
- b. Velcon
- c. Pall – Filterite
- d. Burgess Manning

**21.0 NDT AGENCY**

- a. NDT Services, Ahmedabad
- b. GEECY Industrial Services Pvt. Ltd., Mumbai
- c. Corrosion Control Services, Mumbai
- d. Perfect Metal Testing & Inspection Agency, Calcutta
- e. Inter Ocean Shipping Co., New Delhi
- f. RTD, Mumbai
- g. Sievert, Mumbai
- h. X-Tech, Vizag
- i. Industrial X Ray and Allied Radiographers (I) Pvt. Ltd.
- j. Inspection Technology
- k. IXAR
- l. Aditya NDT Services
- m. Riya NDT Engineers
- n. Star NDT Services
- o. Technical testing & Inspection Services
- p. PD Engineering Inspection Services
- q. Victor Engineering & Testing

**22.0 Cold Applied Tapes**

- a. Denso GmbH
- b. Polyken (Berry Plastics Corporation)

**22.1 End Seal Tape-PVC**

- a. MAASH Industries

**23.0 PUR Coating**

- a. Powercrete (Berry Plastics Corporation)

**24.0 Casing End Closure**



- a. Raci, Italy
- b. Raychem RPG Limited

## **25.0 Casing Insulators**

- a. Raci, Italy
- b. Raychem RPG Limited
- c. VeekayVikram

## **26.0 FIRE FIGHTING EQUIPMENT**

### **26.1 FIRE EXTINGUISHERS**

- a. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
- b. Kooverji Devshi & Co., Bombay
- c. Reliable (Fire Protection) India Ltd., Bombay
- d. Zenith Fire Services, Bombay
- e. Safex Fire Services, Bombay
- f. Brij Basi Hi
- g. tech Udyog
- h. Bharat Engg Works, India
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Industries Ltd, India
- k. Supremex Equipments, India
- l. Vimal Fire Controls Pvt Ltd., India

### **26.2 FIRE HYDRANTS, MONITORS, DELUGE VALVE, NOZZLES**

- a. Zenith
- b. Minimax
- c. Newage
- d. HD Fire
- e. Vijay Fire
- f. Asco Strumech Pvt Ltd, India
- g. Brij Basi Hi
- h. tech Udyog
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Pvt Ltd
- k. Shah Bhogilal Jethamal & Brothers
- l. Pumps & Engineering Works

**26.3 FIRE & GAS DETECTION & ALARM**

- a. Ambetronics Engineers PVT LTD.

**26.4 RRL Hose**

- a. Jayshree  
b. Newage

**26.5 HOSES**

- a. Ashit Sales Corporation, Bombay  
b. Royal India Corporation, Bombay  
c. Gayatri Industrial Corporation  
d. Simplex Rubber Products Ltd., Ahmedabad  
e. Zaverchand Marketing Pvt. Ltd., Baroda  
f. Presidency Rubber Mill, Calcutta  
g. The Cosmopolite, Calcutta  
h. Simplex Rubber Products, Thane

**NOTE:**

- 1) For procuring bought out items from vendors other than those listed above, the same may be acceptable subject to the following: -
  - a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.
  - b) The vendor / supplier should not be in the Holiday list of CLIENT / VCS / other PSU.
  - c) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum 01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.
- 2) For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT / VCS.
- 3) The details of vendors indicated in this list are based on the information available with VCS, Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

**B. CIVIL AND STRUCTURAL**

| Sr. No. | Items/ Name of Products                                                                 | Make/ Brands/ Manufactures                                                                                                                                                                                               |
|---------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | Reinforcement Steel                                                                     | TATA, SAIL, RINL, JSW.                                                                                                                                                                                                   |
| 2.      | Cement                                                                                  | Ambuja, ACC, JK, Grasim, Ultratech, Birla, L&T, Cement Corporation of India                                                                                                                                              |
| 3.      | Structural Steel                                                                        | TATA, SAIL, RINL, IISCO, ESSAR                                                                                                                                                                                           |
| 4.      | Structural Steel Tubes ISI Marked                                                       | TATA, JINDAL, SURYA                                                                                                                                                                                                      |
| 5.      | Mineral wool for thermal insulation of ceilings (Under deck insulation)                 | Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation.                                                                                                                                                       |
| 6.      | Synthetic Enamel Paint (1st quality only)                                               | ICI Paint (Dulux), Asian Paint (Apolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac)                                                                              |
| 7.      | G.I SHEET                                                                               | ESSAR, JSW, SAIL                                                                                                                                                                                                         |
| 8.      | Sheeting Screw                                                                          | Corroshield, Buildex,                                                                                                                                                                                                    |
| 9.      | Chemical for Antitermite treatment                                                      | DE- NOCIL Bombay, Pest Control of India, Trishul                                                                                                                                                                         |
| 10.     | Factory made Panelled Door shutter                                                      | Century; Godrej ; M/s Hindustan Housing factory Ltd., New Delhi ; M/s Delhi Construction Eqp, Sadar Bazar, Delhi ; M/s Joinery manufacturing Co., Calcutta;                                                              |
| 11.     | PVC Panel Door (Solid Core)                                                             | Rajshri Plastiwood Limited, Sintex, Hindopan, Marino                                                                                                                                                                     |
| 12.     | Pressed steel door frames/ cupboard and window frames (manufacturers)                   | M/s SAIL, M/s TATA                                                                                                                                                                                                       |
| 13.     | Pressed steel door frames/ cupboard and window frames (fabricators)                     | M/s Loyal safe works Mayapuri, N/Delhi M/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi<br>M/s Chhabra Steel Udyog, 260 Sadar Bazar, Meerut Cantt. M/s Delite safe works, Rani Jhansi Road, N/Delhi |
| 14.     | Steel Windows, Ventilators (as per IS- 1038 of 1983) & frames pressed steel door/window | M/S Multiwyn Industrial Corpn, Calcutta ; M/S Metal Window Corp, N/ Delhi ; M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt ; Agent steel MFG Pvt Ltd, Ahmedabad ; Godrej ;                                       |
| 15.     | AI Section for AI Door/ Window/ Partitions                                              | Hindalco, Ajit India, Jindal                                                                                                                                                                                             |
| 16.     | AluminumI Door/ Window/ Glazing Fabricated and Anodized                                 | M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s Ramniklal S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela, Delhi, M/s VR Associates, GH-14/242 Paschim Vihar,                     |



ENERGISING QUALITY

## LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

**DOC NO: VCS-00-00-VL-0001**  
**Rev No : 16**

|     |                                                                                              |                                                                                                                                                                                                                                                                               |
|-----|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                                                                                              | Delhi                                                                                                                                                                                                                                                                         |
| 17. | Aluminium door and windows Fittings                                                          | M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s Mohan Metal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032. Mepro, Argent New Delhi, Classic, New Delhi. Jindal, Argent New Delhi, Golden Industries Pvt. Ltd. ECIE |
| 18. | Aluminium Grill                                                                              | Alu Grill, Arihant Aluminium Corporation, Decogrille                                                                                                                                                                                                                          |
| 19. | Door Closer                                                                                  | Everite, Golden, Gandhi,                                                                                                                                                                                                                                                      |
| 20. | Floor Spring                                                                                 | Prabhat, Everite                                                                                                                                                                                                                                                              |
| 21. | Plywood for general purpose (IS-303)                                                         | National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor, Calcutta-700001, Merino Plywood, Archid Ply, Ply, Swastik, Universal, Century, Greenply, National.                                                                                                                    |
| 22. | Pre laminated Particle board                                                                 | Kitply, Bhutan board, Ecoboard, Novapan, Archid ply, Merinova, Merino                                                                                                                                                                                                         |
| 23. | Laminated Sheets                                                                             | Formica, Merino Lam, Greenlam, National, Century                                                                                                                                                                                                                              |
| 24. | Modular Partitions                                                                           | Godrej, Blowplast                                                                                                                                                                                                                                                             |
| 25. | False Ceiling (Mineral Fibre Board)                                                          | Armstrong, Daiken, Luxalon, Llyods, Gypboard, Trac, Aerolite                                                                                                                                                                                                                  |
| 26. | Aluminium False Ceiling                                                                      | Lloyds, Armstrong, Luxlon, Trac                                                                                                                                                                                                                                               |
| 27. | Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only)                                  | Kajaria Ceramics, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries, Ultra Tiles                                                                                                                                                                |
| 28. | Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1st quality only)                              | Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite),                                                                                                                                                                                    |
| 29. | Vitrified/ Designer Vitrified Tiles (1st quality only)                                       | Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient                                                                                                                                                                                                                |
| 30. | PVC Tiles/Flooring (IS 3461) (1st quality only)                                              | Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor.                                                                                                                                                                                                               |
| 31. | False Flooring                                                                               | Godrej or equivalent                                                                                                                                                                                                                                                          |
| 32. | Glass Mosaic Tiles (1st quality only)                                                        | Paladio, Coral, Accura, Bisazza, Italia, Mridul.                                                                                                                                                                                                                              |
| 33. | Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles. (1st quality only) | Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles, Gem, Unistone, Konkrete, Unitile                                                                                                                                                                                     |
| 34. | Wall care Putty for Base preparation (1st quality only)                                      | Birla Wall care putty, Berger, Jenson & Nicholson, JK White                                                                                                                                                                                                                   |



ENERGISING QUALITY

## LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

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|     |                                                        |                                                                                                                                                                                                                        |
|-----|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35. | White Cement (1st quality only)                        | Birla, JK                                                                                                                                                                                                              |
| 36. | Cement based Paints (1st quality only)                 | Super Snowcem, Duracem, Super Acrocem.                                                                                                                                                                                 |
| 37. | Dry Distemper / Oil bound Distemper (1st quality only) | Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI Dulux                                                                                                                             |
| 38. | Acrylic Washable Distemper (1st quality only)          | Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac, Shalimar, Garware & Goodlass                                                                                                                                    |
| 39. | Plastic Emulsion Paint (1st quality only)              | Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar, Garware & Goodlass                                                                                                                                          |
| 40. | Exterior Acrylic Emulsion (1st quality only)           | ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar, Garware & Goodlass                                                                                                             |
| 41. | Polymer based Paint                                    | STP, CICO                                                                                                                                                                                                              |
| 42. | Textured Paint / Wall Tile (1st quality only)          | Unitile, Heritage, Spectrum, Iokos, Acropaints, Asian                                                                                                                                                                  |
| 43. | Flexible board for Expansion joint                     | STP or equivalent                                                                                                                                                                                                      |
| 44. | Grout                                                  | Shrinkomp, Fosroc, Fairmate                                                                                                                                                                                            |
| 45. | Integral water proofing compound                       | STP, Pidilite, Fosroc, CICO, Sika.                                                                                                                                                                                     |
| 46. | Concrete Admixture                                     | Pidilite, Fosroc, CICO, Sika.                                                                                                                                                                                          |
| 47. | Water proofing for cementations surface IS-2645        | Acrocrete & Acrocote, CICO, Fosroc, STP                                                                                                                                                                                |
| 48. | Bituminous Product                                     | M/s Faridabad Spinning & Woolen Mills Pvt Ltd, 837, SP Mukherjee Marg Delhi,<br>M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd, Multiplas |
| 49. | Hardeners                                              | Ironite, Ferrok, Hardonate                                                                                                                                                                                             |
| 50. | Construction Chemicals                                 | Choksey, CICO, Forsroc, Sika                                                                                                                                                                                           |
| 51. | Stainless Steel Cladding                               | Jindal                                                                                                                                                                                                                 |
| 52. | Punch Tape Concertina Coil                             | Global Technocrat, S.G. Engineers Delhi                                                                                                                                                                                |
| 53. | Stainless Steel Railing                                | Jindal                                                                                                                                                                                                                 |
| 54. | FRP/ HDPE Garbage Bins                                 | Sintex, Swift, Nutech, Sheetal                                                                                                                                                                                         |
| 55. | Sanitary ware                                          | Neycer Kermag (standard), Hindustan Sanitary Ware (1st quality), Parryware (superfine), Cera (1st quality), Classica (1st / standard)                                                                                  |



ENERGISING QUALITY

## LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

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|     |                                                                                   |                                                                                                                                                                                                     |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 56. | WC seat cover ISI Marked                                                          | Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Cera (Ist quality), Classica (Ist / standard)                                                                           |
| 57. | PVC Flushing Cistern IS: 774-1984 (ISI Certified)                                 | Parryware, Hindustan Sanitary Wares, Cera.                                                                                                                                                          |
| 58. | Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc. | Gem, Parko, Parryware, HSW, Jaquar                                                                                                                                                                  |
| 59. | Kitchen Stainless Steel Sink                                                      | Diamond, Nirali, Neel Kanth, Jayna                                                                                                                                                                  |
| 60. | Looking Mirror                                                                    | Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul.                                                                                                                                         |
| 61. | Readymade Bathroom Cabinets                                                       | Commander Gratings (I) Pvt Ltd, Gratolite Cabinet, A- 4 Sector VIII Noida-202701, Alpina, Cera.                                                                                                     |
| 62. | Float Valve                                                                       | Leader, Bombay Metal & Alloy Co, Bombay superflow.                                                                                                                                                  |
| 63. | SGSW Pipes (IS-651) ISI Marked                                                    | Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince,                                                                                                                                               |
| 64. | CI (Centrifugally Cast) Pipes for sewage disposal ISI marked                      | NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram, NECO                                                                                                                                 |
| 65. | PVC rain water/sewage pipes (IS-4985)                                             | Reliance, Finolex, Supreme, Kisan, Prince, Hindustan Plastic & machine corporation, Polypack industries (P) Ltd.                                                                                    |
| 66. | HDPE Water storage tanks (Rotational Moulded)                                     | Sintex, Swift, Nutech, Sheetal                                                                                                                                                                      |
| 67. | Cast Iron Pipes and Fittings                                                      | Hindustan Engineering Products Company Calcutta, S.L.C., Standard approved manufacturers of any other brand of fittings having ISI marking, RIF, BIS                                                |
| 68. | RCC Pipes                                                                         | Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan Pressure Pipes, Kolhapur; Dhere Concrete Products, Pune or any other approved manufacturer conforming B.I.S. Standard |
| 69. | Brass Fittings                                                                    | Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar                                                        |
| 70. | C.P. Fittings                                                                     | Ego Metal Works, Ballabgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd., Delhi; Essco Sanitations, Delhi.                                |
| 71. | Stone Ware (Salt-Glazed) Pipes                                                    | Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur.                            |
| 72. | Asbestos Cement Pipes and Fittings                                                | Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super Pipe Industries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay.     |





**List of Recommended Vender/Suppliers of Major Bought-Out Items:** Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the RECOMMENDED list for structural items thereon.

| <b>Sl. No.</b> | <b>Items/Name of Products</b>           | <b>Makes/Brands/Manufactures</b>                                                                                       |
|----------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 1              | Structural Steel                        | SAIL / TATA / RINL / IISCO / ESSAR / ISPAT                                                                             |
| 2              | Structural Steel Tubes ISI Marked       | TATA / JINDAL / SURYA / SWASTIK                                                                                        |
| 3              | Synthetic Enamel Paint 1st Quality only | ICI Paint (Deluxe), Asian Paint (Apolite), Shalimar Paint (Superlac), Goodlass, Nerolac Paint (Nerolac), Berger Paints |

Any materials not fully specified in these specifications and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.

**C. ELECTRICAL****LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS****1.0 AIR CONDITIONER**

- a. Blue Star
- b. O General.
- c. Daikin.
- d. Carrier
- e. Hitachi.
- f. LG.
- g. Lloyds
- h. Mitsubishi
- i. Panasonic
- j. Sharp
- k. Samsung.
- l. Blue star.
- m. Haier.
- n. Voltas.
- o. Videocon.

**2.0 BATTERIES (LEAD ACID)**

- a. Amco Batteries Ltd.
- b. Exide Industries Ltd.
- c. HBL Power System Ltd.
- d. Amara Raja Batteries Ltd.
- e. Su-Kam Power Systems Ltd.
- f. Base Corporation Ltd.
- g. Okaya Power Ltd.
- h. Southern Batteries Pvt Ltd.
- i. True Power International Ltd.
- j. Evolute Solutions Pvt Ltd.
- k. Greenvision Technologies Pvt Ltd.
- l. Artheon Electronics Ltd.

**3.0 BATTERIES (NICKEL CADMIUM)**

- a. Amco Saft Batteries Ltd.
- b. HBL Power Systems Ltd.

**4.0 BATTERIES (Lithium-ion)**

- a. PROSTARM INFO SYSTEMS LTD.

**5.0 BATTERY CHARGER/DC-DC CONVERTER**

- a. Amara Raja Power System(P)Ltd.
- b. BCH.
- c. Chhabi Electricals Pvt. Ltd.
- d. Caldynes Automatics Limited.
- e. HBL Nife Power Systems Ltd..
- f. Universal Instrument Mfg. Co Pvt Ltd.
- g. Hitachi HI-REL Power Electronics P. Ltd
- h. Mass-Tech Controls Pvt Ltd
- i. Dubas Engineering Pvt Ltd
- j. Chloride Power Systems & Solutions Ltd
- k. Synergee
- l. Enertech
- m. Vertiv

**6.0 CABLE – FIRE ALARM & COMMUNICATION CABLES**

- a. Cords Cable Industries Ltd.
- b. CMI.
- c. Delton cables Ltd.
- d. ELKAY Telcelinks.
- e. KEI Industries Ltd.
- f. Elkay Telcelinks

**7.0 CABLE – HT(XLPE)**

- a. Universal Cable Ltd.
- b. KEI Industries Ltd.
- c. Industrial Cables.
- d. NICCO Corporation Ltd.



- e. Uniflex.
- f. Polycab.
- g. Torrent cables Ltd.

## **8.0 CABLE – LT / MV POWER AND CONTROL**

- a. Cords Cable Industries Ltd.
- b. Universal Cable Ltd.
- c. KEI Industries Ltd.
- d. Havells.
- e. Delton.
- f. Elkay Telelinks.
- g. Evershine Electricals.
- h. Ecko.
- i. Ravin.
- j. Rallison.
- k. Suyog.
- l. Netco.
- m. Uniflex.
- n. Paramount.
- o. Gloster.
- p. Associated cables Pvt Ltd.
- q. CMI.
- r. Gemscab.
- s. Industrial cables.
- t. NICCO.
- u. Polycab.
- v. Torrent.

## **9.0 CABLE – GLAND**

- a. Baliga.
- b. Comet.
- c. Flexpro.
- d. Flameproof.
- e. FCG.



- f. Electro Werke.
- g. Dowels.
- h. CCI.
- i. Sudhir Switchgear
- j. Keyson Techno Equipments,
- k. RAY Flameproof Pvt Ltd

**10.0 CABLE – LUGS & TERMINAL BLOCKS**

- a. Dowels.
- b. Jainson.
- c. Sharma Electrical
- d. Punitam
- e. Yamuna Powers
- f. Rapid Manufacturer
- g. Varun Controls.

**11.0 CABLE – TRAY**

- a. Ercon Composites.
- b. Yamuna Power & Infrastructure Ltd.
- c. MEM
- d. Bharti
- e. Profab.
- f. Ratan.
- g. Slotco.

**12.0 CABLE TERMINATION AND JOINTING KIT**

- a. CCI.
- b. Raychem.
- c. M-Seal.

**13.0 CEILING/EXHAUST/PEDESTAL FANS & CIRCULATORS**

- a. Bajaj Electricals Ltd.
- b. Crompton Greaves Ltd.
- c. Khaitan Electricals Ltd.



- d. Havell's.
- e. Philips
- f. Usha
- g. Orient

#### **14.0 CONTRACTORS – AC POWER**

- a. Andrew Yule.
- b. ABB.
- c. BHEL.
- d. C&S.
- e. Havell's.
- f. L&T.
- g. Schneider.
- h. Siemens Ltd.
- i. Telemecanique.
- j. GE India Industrial

#### **15.0 CONTROL TRANSFORMER**

- a. AE.
- b. Indushree.
- c. Intra Vidyut.
- d. Kalpa Electricals.
- e. Transpower Industries Ltd.
- f. Siemens.
- g. PROSTARM INFO SYSTEMS LTD.

#### **16.0 GAS GENERATOR/DIESEL GENERATOR SET**

- a. Sterling and Wilson.
- b. Jackson Limited.
- c. Sudhir Gensets.
- d. Power Engineering (India) Pvt Ltd.
- e. Prasha Technologies Limited.
- f. Kumar Generator house.
- g. Ashok Leyland Ltd.



- h. Powerica Limited.
- i. Supernova Engineers Limited.
- j. Bhaskar Power Products (P) Ltd.
- k. Caterpillar India (P) Ltd.
- l. Cummins India Ltd.
- m. Escorts Ltd.
- n. Greaves Cotton Ltd.
- o. Kirloskar Ltd.
- p. Mahindra & Mahindra Ltd.
- q. Honda.
- r. Perkins.
- s. Eicher.
- t. Tata Motors.
- u. Ashok Leyland.

## **17.0 FLAME PROOF LDB'S/ JB'S/CONTROL STATION/ SWITCHES**

- a. FCG.
- b. Sudhir switchgears.
- c. Prompt Engineering Works
- d. Flame Proof equipments pvt. Ltd.
- e. Baliga Lighting Equipments Pvt. Ltd.
- f. Flexpro Electricals Pvt. Ltd.
- g. Exprotecta, Beroda.
- h. FFLP Control Gears.
- i. Sterling.
- j. Kaysons Techno Equipment
- k. Bajaj
- l. Phoenix Contact
- m. RAY Flameproof Pvt Ltd

## **18.0 HIGH MAST**

- a. Bajaj Electricals Limited.
- b. Crompton Greaves Limited.
- c. Philips India Limited.



- d. Surya Roshani.
- e. Transrail

## **19.0 HIGH VOLTAGE PCC/ MCC PANELS**

- a. BHEL.
- b. Control and Switchgear.
- c. Siemens.
- d. Tricolite Electrical Industries.
- e. Schneider.
- f. CGL.
- g. L&T.
- h. ABB.

## **20.0 INDICATING LAMPS**

- a. Alstom Ltd.
- b. BCH.
- c. L&T Ltd.
- d. Siemens Ltd.
- e. Vaishno Electricals.
- f. Tecknik
- g. ABB

## **21.0 INDICATING METERS**

- a. L&T
- b. ABB.
- c. AMCO.
- d. AE
- e. Alstom Ltd. (EE).
- f. Conzerv/Schneider
- g. Elecon Measurement Pvt. Ltd.
- h. HPL Electric & Power Pvt. Ltd.
- i. MECO Instruments Ltd.
- j. Minilec.





- k. Rishabh Instruments Pvt. Ltd.
- l. Trinity energy system.
- m. Kaycee.
- n. Salzer.
- o. Trinity
- p. Secure Meters Limited

**22.0 LIGHTING FIXTURES**

- a. GE Lighting Pvt. Ltd.
- b. Bajaj Electricals Ltd.
- c. Crompton Greaves Ltd.
- d. Philips India Ltd.
- e. Havells
- f. Wipro
- g. Osram
- h. Siska
- i. Halonix
- j. Surya
- k. Polycab
- l. Kawlity Photonix

**23.0 LIGHTING FIXTURES – FLAMEPROOF**

- a. Bajaj Electricals Ltd.
- b. Baliga Lighting Equipment Pvt. Ltd.
- c. Crompton Greaves Ltd.
- d. CEAG Flameproof Controlgear Pvt. Ltd.
- e. Flexpro Electricals Pvt. Ltd.
- f. Philips India Ltd.
- g. Sudhir Switchgears Pvt. Ltd.
- h. FCG.

**24.0 MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB**

- a. ABB.
- b. Hagger.
- c. Havell's India Ltd.



- d. Indo Asian Fusegear Ltd.
- e. Legrand.
- f. MDS Switchgear Ltd.
- g. Schneider.
- h. Siemens Ltd..
- i. HPL.
- j. L & T
- k. Siemens

**25.0 MOULDED CASE CIRCUIT BREAKER (MCCBS)**

- l. ABB.
- m. Andrew Yule.
- n. Larsen & Toubro.
- o. Schneider.
- p. Siemens.
- q. Control and Switchgear.
- r. Indo Asian,
- s. Hager.
- t. Merlin Gerin.
- u. Havell's India Ltd
- v. General Electric

**26.0 PROTECTION RELAYS**

- a. BCH.
- b. L&T Ltd.
- c. Siemens Ltd.
- d. Tele-mechanique & Controls (India) Ltd.
- e. Eaton
- f. Alsthom
- g. ABB
- h. Ashida
- i. Novatek Electronics
- j. Cantronics
- k. Control & Switchgear
- l. Frick Electronics



- m. Indian Technologies
- n. Rao Electromechanical
- o. Kudam Corporation

## **27.0 LOW/MEDIUM VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB**

- a. ABB.
- b. BCH.
- c. BHEL.
- d. C & S.
- e. Elecmech Switchgear & Instrumentation.
- f. KMG ATOZ.
- g. L&T.
- h. Pyrotech Electronics Pvt. Ltd.
- i. Risha Control Engineers Pvt. Ltd.
- j. UDKAM PROCESS EQUIPMENT INDIA PVT. LTD
- k. Tricolite Electrical Industries.
- l. Unilec Engineers Ltd.
- m. Vidyut Control India Pvt. Ltd.
- n. Control and Schematic.
- o. Zenith Engineering.
- p. Schneider Electric,
- q. AEG,
- r. HAVELL'S,
- s. MDS
- t. Synergy System
- u. Expert Engineers
- v. R K Engineering & Infrastructure

## **28.0 PUSH BUTTONS**

- a. BCH.
- b. Alstom Ltd.
- c. L&T.
- d. Siemens Ltd.
- e. Tele-Menchanique & Controls (India) Ltd.



- f. Vaishno Electricals.

## **29.0 SWITCHES-CONTROL**

- a. BCH.
- b. Easum Reyrolle Relays & Devices Ltd.
- c. Alstom.
- d. Kaycee Industries Ltd..
- e. L&T.
- f. Siemens Ltd.

## **30.0 SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET**

- a. Anchor Electronics & Electricals Pvt. Ltd.
- b. Kingal Electricals Pvt. Ltd.
- c. North-West Switchgear Ltd.
- d. Schneider
- e. Havells
- f. Cona
- g. Orient
- h. Panasonic

## **31.0 SWITCH SOCKET OUTLETS (INDUSTRIAL)**

- a. Alstom Ltd.
- b. Best & Crompton Engineering Ltd.
- c. BCH.
- d. Crompton Greaves Ltd.
- e. Essen Engineering Company Pvt. Ltd.

## **32.0 SOLAR POWER SYSTEM MODULES**

- a. Tata Power Solar Systems Ltd
- b. REIL,
- c. CEIL,
- d. HBL Power.
- e. Vikram Solar.
- f. Waaree Solar.
- g. Solar Semiconductor.



- h. Sonali.
- i. Mundra Solar
- j. Vikram Solar
- k. Bharat Electronics Limited
- l. Waaree
- m. Lumipex
- n. Independent Qualitative Accessories
- o. Statcon Energy
- p. Volks Energy
- q. Green Engineering

### **33.0 SOLAR PCU/CHARGE CONTROLLER**

- a. Statcon Energy
- b. Enertech UPS Pvt Ltd
- c. Consul Nowatt
- d. OPS India
- e. Schneider
- f. Delta Electronics
- g. ABB Ltd
- h. KACO
- i. SMA
- j. HBP Power
- k. Universal Instrument

### **34.0 TERMINALS BLOCKS**

- a. Connectwell.
- b. Controls & Switchgear Co. Ltd.
- c. Elmex Controls Pvt. Ltd.
- d. Essen Engineering Co. Pvt. Ltd.
- e. Phoenix Contact

### **35.0 DISTRIBUTION TRANSFORMERS**

- a. ABB.
- b. Andrew Yule.
- c. Areva.



- d. BHEL.
- e. Bharat Bijlee
- f. Crompton Greaves.
- g. EMCO Ltd.
- h. Intra Vidyut.
- i. Indushree.
- j. Indcoil
- k. Kirloskar.
- l. Skippers Electricals.
- m. Transformers & Rectifiers (I) Ltd.
- n. Voltamp.

**36.0 UPS SYSTEM AND INVERTER**

- a. DB Power.
- b. Keltron.
- c. Hi-Rel/HITACHI.
- d. Dubas.
- e. Toshiba Corporation.
- f. Fuzi Electric Co Ltd.
- g. Emerson.
- h. Synergy System.
- i. Eaton.
- j. Enertech
- k. PROSTARM INFO SYSTEMS LTD.

**37.0 GI-OCTAGONAL POLE**

- a. Bajaj.
- b. Transrail.
- c. Wipro.
- d. K.L. Industries.

**38.0 ELECTRICAL MOTORS**

- a. Siemens.
- b. Crompton Greaves.
- c. Kirloskar.
- d. BHEL.



- e. Bharat Bijlee.
- f. Hindustan motors.
- g. Alstom.
- h. Texmo.
- i. GE India.
- j. National Motors.
- k. ABB.

**39.0 ELECTRICAL PROCESS HEATER**

- a. Escorts Limited, Faridabad, Haryana.
- b. Spherehot / Kanti Lal Chuni Lal & Sons Appliances Pvt Ltd.Surat.
- c. Kerone, Bhayander(E), Thane – 401105.
- d. Excel Heaters, Andheri (West), Mumbai - 400 053, India.
- e. Nirmal Industrial Controls Pvt. Ltd., Mulund(W), Mumbai - 400 080.

**40.0 CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS**

- a. CALTECH Engineering Service.
- b. Universal Corrosion Prevention India.
- c. Cathodic Technology Limited.
- d. Cathodic Control Company Pvt. Ltd.
- e. CORRTECH International Pvt Ltd.
- f. MITCORR Cathodic Protection Pvt Ltd.
- g. Underground Pipeline & NDTs Pvt. Ltd.
- h. JG Corrosion Solution.
- i. Mercury Cathodic Protection Service.
- j. UNDTs Corrosion Service.
- k. SARK EPC Projects Pvt. Ltd.

**41.0 BACKUP AGENCY FOR INTERFERENCE SURVEY & MITIGATION**

- a. PLE Germany
- b. Vendor Velde
- c. Nippon Japan
- d. SSS India CIPL / interference survey.
- e. Balslev Denmark, .
- f. SSS Germany



- g. Jef Techno Slutions Pvt. Ltd.
- h. SARK EPC Projects Pvt. Ltd.

#### **42.0 PERMANENT REFERENCE CELL**

- a. PERMACELL/ HARCO (USA)
- b. CORRTECH (ZULU), INDIA
- c. TINKER RASOR, USA
- d. SILVION, UK

#### **43.0 CP CABLES**

- a. Brooks Cables.
- b. Nicco Corporation Ltd.
- c. CCI Ltd.
- d. Delton Cables Ltd.
- e. KEI Industries.
- f. Torrent Cables.
- g. Universal cables.
- h. Victor Cables.
- i. Associated Flexible & Wires Pvt Ltd.
- j. Asain Cables (RPG Cables).
- k. Fort Gloster (Gloster Cables Ltd).
- l. Finolex Cable.
- m. Rediant Cables.
- n. NETCO Cables Pvt Ltd.
- o. Havells Ltd.

#### **44.0 CP SACRIFICIAL ANODES**

- a. Scientific Metals Engineers Pvt. Ltd., Karaikudi
- b. PSL Holding Pvt. Ltd., Mumbai.
- c. Cathodic Controls, Bangalore.
- d. BHEL, Bhopal.
- e. Nippon Corrosion, Japan.
- f. AFIC, KSA.
- g. Platt Bros. and Company, USA





- h. Wilson Walton International.
- i. Impalloy International.
- j. Corrpro International.
- k. HOCKWAY, UK
- l. NAKABOHITEC, Japan .
- m. Cortech International
- n. Titanor Component
- o. Shakti Metals, Ahmedabad
- p. Shaktianodes Private Limited, Ahmedabad

**45.0 CP PORTABLE /PERMANENT REFERENCE CELL**

- a. M/S PERMACELL/HARCO, USA
- b. M/S BORIN MANUFACTURER, USA
- c. M/S M.C.MILLER, USA
- d. M/S TINKER RASOR

**46.0 CPTR (AC OPERATED)**

- a. Canara Electric
- b. CATHODIC CONTROL COMPANY PVT LTD.
- c. Kriston Systems

**47.0 PIN BRAZING / THERMITWELD**

- a. SAFETRACK, SWEDEN
- b. CadWeld
- c. BAC, UK
- d. ERICO, USA
- e. THERMOWELD, USA
- f. ERICO, EUROPE

**48.0 CP SURGE DIVERTER/SPARK GAP ARRESTOR (EX-D)**

- a. Dhen,
- b. OBO
- c. Corrpro system
- d. Sohne
- e. Dairyland

**49.0 CP SOLID STATE POLARISATION CELL.**

- a. Dairyland



- b. Metricorr
- c. Rustol
- d. Dhen
- e. Kriston Systems

**50.0 PETROLEUM COKE BREEZE:**

- a. M/S LORESCO, USA
- b. M/S ASBURY, USA
- c. M/S GOA CARBON, GOA
- d. M/S INDIA CARBON, CALCUTTA
- e. M/S PETROCARBON & CHEMICAL COMPANY, HALDIA

**51.0 CP ANODE (MMO TYPE):**

- a. Corrttech
- b. Scientific Metal Engineers Karaikudi
- c. Titanor Component Ltd., Goa, India.
- d. Denora Permelic S.P.A (Italy).
- e. Oronzio De Nora S.A. Ingano Switzerland
- f. CER Anode Technologies International USA
- g. ACTEL, UK
- h. ELTECH System Corporation, Texas
- i. MAGNETO-CHEMIE, Netherlands
- j. MATCOR (USA)

**52.0 HEAT SHRINK CAP FOR CP ANODE**

- a. MATCOR (USA) To Cable Joint
- b. Seal For Life

**53.0 ER- PROBE (EXTERNAL CORROSION) ER- PROBE & CORROSION  
COUPON ASSEMBLY**

- a. Rose Corrosion Services UK
- b. Metal Samples, USA.
- c. Roharbak Cosasco USA
- d. Caproco UK
- e. Emetricorr, Denmark

**54.0 HEAT SHRINK CAP FOR ANODE TO CABLE JOINT**



- a. Raychem, USA
- b. Matcor (USA)

**55.0 MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)**

- a. Matcor (USA)
- b. Covalence (USA)
- c. Berry Plastics (USA) – (Seal for Life Industries)

**56.0 MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)**

- a. GROUPPO DENORA, GOA, INDIA
- b. CERANODE TECHNOLOGIES, USA
- c. TELPRO, USA

**57.0 MMO TUBULAR/ STRIP/ RIBBON ANODES**

- a. GROUPPO DENORA, GOA, INDIA
- b. ORANZIO DE NORA, ITALY
- c. MAGNETOCHEMIE, HOLLAND
- d. ACTEL LTD., U.K.
- e. ELTECH SYSTEMS CORPORATION, USA
- f. CERANODE TECHNOLOGIES, USA
- g. MATCOR (USA)

**Note: -**

For any other brought out item(s) for which the vendor list is not provided in the tender , bidders can supply those item(s) from vendors/ suppliers who have earlier supplied similar item(s) for the intended services in earlier Oil and Gas projects and the item(s) offered is in their regular manufacturing/ supply range.

- 1) The vendor/supplier should not be in the Holiday list of OWNER/ CONSULTANT/other PSU
- 2) The bidder is not required to enclose documentary evidences (PO copies, Inspection & Completion with satisfactory working certificates etc.) along with their offer, however in case of successful bidder, these documents shall required to be submitted by them within 30 days from date of Placement of Order for approval to OWNER / CONSULTANT.

## **D. INSTRUMENTATION**

### **LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT- OUT ITEMS**

#### **1.0 PRESSURE GAUGES**

- a. AN Instruments Pvt Ltd
- b. Badotherm Process Instruments B.V.
- c. Baumer Bourdon Haenni S.A.S
- d. British Rototherm Co Ltd
- e. Budenberg Gauge Co Ltd
- f. Dresser Inc
- g. Forbes Marshall (Hyd) Pvt Ltd
- h. General Instrument Consortium
- i. H. Guru Instruments (South India) Pvt Ltd
- j. Manometer (India) Pvt Ltd
- k. Nagano Keiki Seisakusho Ltd
- l. Hirlekar Precision, India
- m. Waaree Instruments Ltd
- n. Walchandnagar Industries Ltd (Tiwac Divn)
- o. Wika Alexander Wiegand & Co GmbH
- p. Wika Instruments India Pvt Ltd
- q. Ashcroft India Pvt Ltd.
- r. ITEC Measures Pvt Ltd

#### **2.0 TEMPERATURE GAUGES**

- a. AN Instruments Pvt Ltd.
- b. Badotherm Process Instruments B.V.
- c. Bourdon Haenni S.A.
- d. Dresser Inc.



- e. General Instruments Consortium
- f. H. Guru Instruments (South India) Pvt Ltd
- g. Nagano Keiki Seisakusho Ltd
- h. Solartron ISA
- i. Walchandnagar Industries Ltd (Tiwac Divn)
- j. Wika Alexander Wiegand & Co GmbH
- k. Wika Instruments India Pvt Ltd
- l. Pyro Electric, Goa
- m. Ashcroft India Pvt Ltd.
- n. ITEC Measures Pvt Ltd

### **3.0 TEMPERATURE ELEMENTS INCLUDING SKIN TYPE**

- a. ABB Automation Ltd
- b. Altop Industries Ltd
- c. Bourdon Haenni S.A.
- d. Detriv Instrumentation & Electronics Ltd
- e. General Instruments Consortium
- f. Japan Thermowell Co Ltd
- g. Tecnomatic S.P.A
- h. Tempsen Instrument India Ltd
- i. Thermo Electric Co. Inc.
- j. Thermo-Couple Products Co
- k. Thermo-Electra B.V.
- l. Wika Alexander Wiegand & Co GmbH
- m. Altop Industries Ltd., Baroda
- n. Nagman Sensors (Pvt.) Ltd.
- o. Pyro Electric, Goa
- p. ITEC Measures Pvt Ltd

### **4.0 POSITIVE DISPLACEMENT FLOW METERS**

- a. RMG (Germany)
- b. Elster Instromet
- c. Romet
- d. Dresser
- e. Itron



- f. FMG
- g. Common
- h. Metreg
- i. Raychem RPG
- j. Vemmtec

## **5.0 TURBINE FLOW METER**

- a. Daniel
- b. Elster Instromet
- c. Itron
- d. RMG
- e. Rockwin

## **6.0 ELECTRONIC VOLUME CORRECTOR**

- a. Elgas
- b. Itron
- c. Plum
- d. Pietro Fiorentini

## **7.0 ORIFICES (METER RUN, FLOW CONDITIONER, ORIFICE PLATE AND ASSEMBLY)**

- a. Emerson
- b. FMC, USA
- c. Pietro Fiorentini S.P.A (Italy)
- d. Canalta Controls, Canada

## **8.0 ULTRASONIC FLOW METERS**

- a. Daniel (USA)
- b. RMG (Germany)
- c. Instromet International (Belgium)
- d. Sick Maihak, Germany
- e. FMC, Germany

## **9.0 MASS FLOW METERS**



- a. Daniel Measurement & Control Asia Pacific
- b. Endress + Hauser Instruments International
- c. FMC Measurements Solutions
- d. Heinrichs Messtechnik GMBH
- e. Rheonik MessGerate GMBH

**10.0 FIELD INSTRUMENTS (P, DP, F, L, T)**

- a. ABB Ltd
- b. Honeywell
- c. Fuji Electric Instruments Co Ltd
- d. Yokogawa
- e. Invensys India Pvt.Ltd

**11.0 LEVEL GAUGES/ LEVEL INSTRUMENTS**

- a. Bliss Anand
- b. Chemtrols
- c. V-Automat
- d. Levcon
- e. Nivo Controls
- f. Sbeletro Mechanicals
- g. TRAC

**12.0 PRESSURE REGULATOR AND SLAM SHUT VALVE**

- a. Pietro Fiorentini S.P.A. (Italy)
- b. Emerson
- c. RMG-Regel Messtechnik (Germany)
- d. Mokveld Valves BV (Netherlands)
- e. Schlumberger (USA)
- f. Gortter Controls B V (Netherlands)
- g. Instromet International NV



- h. Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
- i. ESME Valves Ltd
- j. Kaye & Macdonald Inc.
- k. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
- l. Richards Industries (Formerly Treloar)
- m. Samson AG Mess-und Regeltechnik
- n. Tormene Gas Technology
- o. Dresser Inc, USA (upto 8" size, 300# class only)

**13.0 PRESSURE SAFETY VALVES**

- a. Keystone Valves (India) Pvt. Ltd.
- b. Larson & Toubro Ltd.
- c. Lesser GmbH & Co KG
- d. Mekaster Engg Ltd..
- e. Tyco Sanmar Ltd. (New Delhi)
- f. Anderson Greenwood Crosby
- g. BHEL (Trichy)
- h. Curtiss Wright Flow Control Corporation
- i. Dresser Inc.
- j. Fukui Seisakusho Co. Ltd
- k. Nakakita Seisakusho Co Ltd
- l. Nuovo Pignone S.P.A (Italy) (GE Oil co)
- m. Parcol S.P.A
- n. Safety Systems UK Ltd
- o. Tai Milano S.P.A
- p. Weir Valves & Controls France
- q. Bliss Anand Pvt Ltd.

**14.0 CONTROL PANEL & ACCESSORIES**

- a. Keltron Controls Ltd., Kerala
- b. Elechmec Corporation Ltd., Mumbai
- c. Industrial Controls & Appliances Pvt. Ltd.,
- d. Alstom System Ltd., Noida
- e. Emerson Process Management (I) Pvt. Ltd.
- f. ABB Instruments Ltd., New Delhi
- g. Larsen & Toubro Ltd.





- h. Control & Automation, New Delhi
- i. GE Fanuc Systems Pvt. Ltd., New Delhi
- j. Rockwell Automation (I) Ltd., Ghaziabad
- k. Honeywell Automation Ltd.
- l. Rittal
- m. Pyrotech Elcronics Pvt Ltd.
- n. Positronics Pvt Ltd.
- o. Electronics Corporation of India Ltd.
- p. Phoenix Contact (I) Pvt. Ltd

**15.0 JUNCTION BOXES AND CABLES GLANDS**

- a. Ex-Protecta
- b. Flameproof Control Gears
- c. Baliga
- d. Flexpro Electricals
- e. RAY Flameproof Pvt Ltd (Flameproof Weatherproof)

**16.0 CONTROL AND SIGNAL CABLES**

- a. Associated Cables
- b. Brook
- c. Associated Flexibles & Wires (Pvt) Ltd
- d. Universal Cables Ltd, India
- e. Delton Cables Ltd, India
- f. KEI Industries Ltd INDIA
- g. CMI Limited
- h. Cords Cable Industries Ltd, India
- i. Elkay Telelinks (P) Ltd., India
- j. Udey Pyrocables Pvt Ltd, India
- k. Goyolene Fibres (I) Pvt Ltd, India
- l. Netco Cable Industries Pvt Ltd, India
- m. Nicco Corporation Ltd, India
- n. Paramount Communications Ltd, India
- o. Polycab Wires Pvt Ltd, India
- p. Radiant Cables Pvt Ltd, India
- q. Reliance Engineers Ltd., India
- r. Suyog Electricals Ltd, India



- s. Thermo Cables Ltd

## **17.0 GAS DETECTION SYSTEM**

- a. Crowcon Detection Instruments Ltd
- b. Detection Instruments (I) Pvt Ltd
- c. Detector Electronics Corporation
- d. Drager Safety AG & Co. KGAA
- e. General Monitors Ireland Ltd
- f. Mine Safety Appliances Company
- g. MSA – Mines Safety Appliances(India) Ltd
- h. Industrial Scientific Oldham France S.A.
- i. Riken Keiki Co Ltd
- j. Simrad Optronics Icare
- k. Honeywell Analytics
- l. Net Safety Monitoring Inc.
- m. Simtronics SAS
- n. Pollution Protection Systems Mumbai Pvt Ltd

## **18.0 MOV ACTUATOR:**

- a. Rotork- UK, USA & INDIA
- b. Limitorque
- c. Auma- India
- d. Biffi- Italy
- e. DelVal Flow Controls Pvt. Ltd

## **19.0 PNEUMATIC ACTUATOR (SOLENOID OPERATED ON-OFF TYPE)**

- a. Metso Automation
- b. Tyco
- c. Samson Controls
- d. L&T
- e. Emerson
- f. Fisher
- g. Masoneilan Process Control
- h. Instrumentation Limited (IL)-Palghat



- i. Micro Finish
- j. Rotex

**20.0 SOLENOID VALVES**

- a. Avcon
- b. Festo
- c. DelVal Flow Controls Pvt. Ltd

**21.0 ELECTRO – HYDRAULIC ACTUATOR**

- a. Avcon Rotork controls (Deutschland Gmbh)
- b. Biffi Italia Srl
- c. Ledeen (Italy)
- d. Virgo Valves and Controls Ltd.-India
- e. Limittorque
- f. Reineke
- g. Voith
- h. Bettis
- i. Rotork- UK, USA & INDIA
- j. Rotex
- k. Schuck Group
- l. DelVal Flow Controls Pvt. Ltd

**22.0 GAS OVER OIL ACTUATOR**

- a. Biffi Italia Srl,
- b. Ledeen(Italy)
- c. Virgo Valves & Control Ltd.-India,
- d. Voith,
- e. Bettis,
- f. Rotork-UK, USA, India,
- g. Rotex,
- h. Schuck Group,
- i. Valve Italia.

**23.0 OFC**

Manufacture/ Procurement, Testing and supply of suitable OFC Joint closures including all necessary accessories of any of the following make:



- a. Raychem
- b. 3M
- c. Siemens
- d. Any other make from the approved vendor list of client with supporting paper.

**24.0 FLOW CONTROL VALVES**

- a. Fouress Engg. (New Delhi)
- b. Fisher Xomox (New Delhi)
- c. MIL Control Ltd. (Noida)
- d. KOSO India Pvt Ltd
- e. Samson Control (Thane)
- f. Dresser Valves India Pvt Ltd.
- g. Fisher Controls
- h. Valvitalia Italy
- i. CCI Valve technology
- j. Flowserve Pvt Ltd.
- k. Metso Singapore Pvt Ltd.
- l. Instrumentation Ltd Palghat
- m. Dresser Inc. USA

**25.0 FLOW COMPUTERS**

- a. Emerson
- b. Instromet International (Belgium)
- c. FMC Measurement Solutions (UK)
- d. RMG (Germany)
- e. OMNI Flow Computers Inc.
- f. Thermo Fisher, USA

**26.0 INDICATORS & CONTROLLERS**

- a. Yokogawa
- b. Eurotherm Chessel
- c. Honeywell
- d. Emerson

**27.0 BARRIERS**

- a. MTL
- b. STHAL



- c. P&F
- d. Phoenix Contact (I) Pvt. Ltd.

**28.0 GAS CHROMATOGRAPH**

- a. ABB
- b. Emerson
- c. Instromet International, NV
- d. RMG Regal+Messtechnik GmbH
- e. Yokogawa

**29.0 I/P CONVERTERS**

- a. ABB
- b. Emerson
- c. IMI Watson Smith Ltd.
- d. Moore Controls Ltd
- e. Shreyas Instruments Pvt Ltd, India
- f. Thermo Brandt Instruments

**30.0 SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS****30.1 FOR CNG WORK:**

- a. DK-LOK
- b. Swagelok Co.
- c. Parker
- d. Dawsons Tech Components LLP
- e. ASTEC Valves & Fittings Pvt Ltd
- f. Thomas & Brian Mfg. Pvt. Ltd

**30.2 EXCEPT CNG WORK:**

- a. Swagelok Co.
- b. Parker
- c. Aura INC.
- d. HOKE
- e. Excelsior Engineering works
- f. Swastik Engineering works India
- g. Comfit and valves pvt ltd
- h. Arya craft and engineering Pvt ltd
- i. DK lok



- j. ASTEC Valves & Fittings Pvt Ltd
- k. Dawsons Tech Components LLP
- l. DelVal Flow Controls Pvt. Ltd**

### **31.0 SS TUBES**

#### **31.1 FOR CNG WORK:**

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Jindal Saw
- e. Tubacex Tubes and Pipes Private Ltd
- f. Krystal Global Engineering Ltd.
- g. Maxim Tubes Company Pvt. Ltd.
- h. VENUS PIPES & TUBES LIMITED**

#### **31.2 EXCEPT CNG WORK:**

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Heavy metal and tube limited
- e. Nuclear fuel complex India
- f. Scorodite
- g. Ratnamani Metals and Tubes
- h. Jindal Saw

**E. SHOP & FIELD PAINTING****LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-  
OUT ITEMS****1.0 INDIAN VENDORS**

- a. Asian Paints (I) Ltd.
- b. Berger Paints Ltd.
- c. Goodlass Nerlolac Paints Ltd.
- d. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
- e. Shalimar Paints Ltd.
- f. Sigma Coating, Mumabai
- g. CDC Carboline Ltd.
- h. Premier Products Ltd.
- i. Coromandel Paints & Chemicals Ltd.
- j. Anupam Enterprises
- k. Grand Polycoats
- l. Bombay Paints Ltd.
- m. Vanaprabha Esters & Glycer, Mumbai
- n. Sunil Paints and Varnishes Pvt. Ltd.
- o. Courtaulds Coating & Sealants India (Pvt.) Ltd.
- p. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
- q. VCM Polyurethane Paint (for polyurethane Paint only)

**2.0 FOREIGN VENDORS FOR OVERSEAS PRODUCTS**

- a. Sigma Coating, Singapore
- b. Ameron, USA
- c. Kansai Paint, Japan
- d. Hempel Paint, USA
- e. Valspar Corporation, USA
- f. Courtaulds Coating, UK.

**Notes:**

1. Bidder can select equipment of two different makes, selected from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).
2. Vendors who have already supplied above equipment in other terminals of client, shall also be considered qualified for this tender provided the supplied equipment are commissioned and running successfully and they have not been put on holiday.
3. Equipment / Instruments of any make which is offered by one bidder and acceptable to client shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.



**F. FOR PE & LMC WORK (GI/CU)****1.0 MDPE PIPE**

- a. Mukand Poly Products,
- b. Dewa Polymers Pvt. Ltd.

**2.0 MDPE FITTINGS & MDPE VALVES**

- c. Aliaxis,
- d. George Fischer,
- e. Al-Aziz,
- f. Kimplas,
- g. Banides,
- h. Agru,
- i. Friatech,
- j. Plasson

**3.0 GI PIPE**

- a. Swastik Pipe Ltd.
- b. Jindal Industries Ltd.
- c. Vishal Pipes Ltd.
- d. Indus Tubes Ltd
- e. Advance steel Tubes Ltd.
- f. Good Luck Tubes Ltd.
- g. Surya Roshni Limited
- h. APL Apollo Tubes Limited
- i. Jindal Pipes Limited
- j. RK Steel Manufacturing Company Private Limited
- k. PSL Tubes Limited

**4.0 CASTING GI FITTINGS**

- a. Sarin Industries Ltd.
- b. Jupiter Metal Industries Ltd.
- c. Jainsons Industries Ltd.
- d. Jinan Meide Casting Co. Ltd.
- e. Green Malleable Pvt. Ltd.
- f. Chandan Enterprises
- g. Unique Pipe Fitting Co

**5.0 FORGED GI FITTING (FOR HIGH RISE SEGMENT)**

- a. Jainsons Industries
- b. B.M. Meters Pvt. Ltd.

**6.0 COPPER TUBES & FITTINGS**

- a. Jay Banas Mehta Tubes Limited- Trade Mark "MEXFLOW"
- b. Rajco metal (Tubes & Fittings)
- c. Paras Industries
- d. MERCURE METAL & ALLOYS PVT LTD
- e. Chandan Enterprises (Fittings only)

**7.0 BRASS VALVES**

- a. Universal srl, Italy
- b. Tiemme Raccorderie Sede, Italy
- c. Enolgas Bonimu s.a.s., Italy
- d. Fratelli Fortis s.r.l, Italy
- e. Giacomo Climbrio, Italy
- f. Parker Hannifin S.P.A., USA
- g. Singapore Valve & Amp; Fittings Pte Limited, Singapore /Bengaluru
- h. Rubinetterie Utensilerie Bonomi (RUB), Italy
- i. Zhegiang Valogin Technology Co. Ltd., China,
- j. Ningbo Zhiqing Industrial Co. Ltd., China,
- k. Zhegiang Dunan Valve Co. Ltd.,
- l. Ningbo Huaping, China.
- m. Chandan Enterprises

**8.0 Isolation & Appliance valves**

- a. Chandan Enterprises

**9.0 BRASS FITTINGS**

- a. Chandan Enterprises
- b. Paras Industries Ltd.
- c. Chokhawala Distributors – Brass Adaptor.

**10.0 STEEL RE-INFORCED RUBBER HOSE (TYPE-4)**

- a. Super Seal Flexible Hose Ltd.



- b. Suraksha Products Pvt. Ltd.
- c. Vansh Industries
- d. T & L Gases

**11.0 CORRUGATED FLEXIBLE METAL HOSES (ANACONDA)**

- a. KPC Flex Tubes
- b. Vestas Hose Division
- c. Alpha Flexi Tubes
- d. Chandan Enterprises

**Note:**

1. Vendor may procure material from any of approved vendors listed.
2. For equipment/components other than the above, vendor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / Consultant before placing order.
3. In case of exigencies like long delivery periods from approved vendors, the contractor shall list down the proposed suppliers/vendors for such items and submit the same for owner review/approval along with necessary documents/PTR.
4. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication. If equipment is sourced from outside India, vendor shall obtain prior approval for make of equipment before placement of order.

**Above mentioned vendor list is tentative and further addition/deletion may be done as per discretion of Owner/VCS.**



Energising Quality

**LIST OF AUTHORIZED THIRD-PARTY INSPECTION AGENCY (TPIA)**

**DOC. NO.- VCS-C&P-TPIA-001**

**Rev No : 16**

| SL. NO. | NAME OF TPIA                                                                  |
|---------|-------------------------------------------------------------------------------|
| 1       | Det Norske Veritas (DNV)                                                      |
| 2       | Germanischer Lloyd Industrial Services GmbH                                   |
| 3       | Bureau Veritas (India) Pvt. Ltd.                                              |
| 4       | Moody International (India) Pvt. Ltd. (Industry Services Division)            |
| 5       | SGS India Pvt. Ltd.                                                           |
| 6       | Certification Engineer International Limited (CEIL)                           |
| 7       | TÜV SÜD South Asia Pvt. Ltd.                                                  |
| 8       | ABS Industrial Verification (India) Pvt. Ltd.                                 |
| 9       | Lloyd Register of Industrial Services                                         |
| 10      | IRCLASS Systems and Solutions Private Limited                                 |
| 11      | Tata Projects Limited                                                         |
| 12      | International Certification Services Pvt. Ltd.                                |
| 13      | TUV India Pvt. Ltd., Industrial Services Division                             |
| 14      | Intertek India Pvt. Ltd. (Industry Services Division)                         |
| 15      | Quality Austria Central Asia Pvt. Ltd.                                        |
| 16      | Edlipse Engineering Global Pvt. Ltd.                                          |
| 17      | TUV-Rheinland                                                                 |
| 18      | Hertz Inspection & Services Pvt Ltd                                           |
| 19      | Alfred H Knight India Pvt Ltd (Formely known as Dr. Amin Controllers Pvt Ltd) |

**TCP**



Energising Quality

**CITY GAS DISTRIBUTION PROJECT  
OF  
NAGALAND GEOGRAPHICAL AREA**



HPOIL GAS

**TCP DESIGN BASIS**

Total Sheets

7

DOCUMENT NO.

C261162

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CP

DB

4001

**HP OIL GAS PRIVATE LIMITED**

**CITY GAS DISTRIBUTION PROJECT**

**TEMPORARY CATHODIC PROTECTION DESIGN BASIS**

**FOR**

**NAGALAND GEOGRAPHICAL AREA**

|     |            |                   |      |      |      |
|-----|------------|-------------------|------|------|------|
|     |            |                   |      |      |      |
| C1  | 24.12.2025 | ISSUED FOR REVIEW | FJ   | AA   | AA   |
| REV | DATE       | DESCRIPTION       | PREP | CHKD | APPR |

**CITY GAS DISTRIBUTION PROJECT  
OF  
NAGALAND GEOGRAPHICAL AREA**

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# CITY GAS DISTRIBUTION PROJECT OF NAGALAND GEOGRAPHICAL AREA

## 1. GENERAL

This design basis defines the design requirements for this project in addition to the applicable specifications for:-

- Temporary cathodic protection (TCP)
- Sacrificial anode cathodic protection system
- Impressed current cathodic protection system.
- NACE requirements
- OISD requirements and
- PNGRB regulations

In case of conflict the requirements mentioned in the stringent requirements mentioned in this document **or stringent** shall prevail.

## 2. Temporary Cathodic protection

|                                                                   |                                                                                                                                                        |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.1. Type                                                         | <u>Sacrificial Magnesium anode</u>                                                                                                                     |
| 2.2. Design life                                                  | 2 Year or till commissioning of PCP whichever is later                                                                                                 |
| 2.3. Pipeline coating                                             | Three Layer Polyethylene                                                                                                                               |
| 2.4. Casing for carrier pipe                                      | HDD is the preferred obstacle crossing method. Bare casing will be used where required.                                                                |
| 2.5. Protective current density at 30° C                          | As per standard specification                                                                                                                          |
| 2.6. Current drainage and coating resistance measurement survey   | Shall be carried out                                                                                                                                   |
| 2.7. Corrosion Survey                                             | Shall be carried out                                                                                                                                   |
| 2.8. Anode material (for sacrificial CP System)                   | Magnesium (1.55 V )                                                                                                                                    |
| 2.9. Minimum number of anodes (TCP)                               | At least 1 anode must be provided for each km of pipeline even if calculations show a lower requirement.                                               |
| 2.10. Polarization coupons (Factory manufactured)                 | Shall be provided at every 10 kms and additional coupons as required as per specification for TCP                                                      |
| 2.11. Size of exposed area of coupon                              | 10mm x 10mm                                                                                                                                            |
| 2.12. No. & Location of coupons                                   | To be decided during detail engineering subject to 1.7 above                                                                                           |
| 2.13. No. of magnet devices for operation of magnetic reed switch | As per SOR/SOW                                                                                                                                         |
| 2.14. Electrical resistance probes                                | Shall be provided. Location to be decided during detail engineering.                                                                                   |
| 2.15. Polarization cell                                           | Solid state type shall be provided at every HT Line Crossings of 66 KV & Above.                                                                        |
| 2.16. Surge Diverters                                             | Solid state type surge diverter shall be provided at every insulating joint. <i>Lightning impulse current (10/350 <math>\mu</math>s) (Iimp) 150 kA</i> |

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|                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.17. Additional tests to evaluate the coating defects | Shall be conducted after connecting to PCP system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2.18. Test Stations                                    | Test stations shall be provided at an average spacing of 1 km along the pipeline ROW                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2.19. Test station locations                           | <ul style="list-style-type: none"> <li>At places where TCP anodes are installed</li> <li>Both sides of cased crossings (Road or railway)</li> <li>One side of the crossing if it is not cased</li> <li>All insulating joints</li> <li>At location of reference cells, surge diverters, polarization coupons, polarization cells, ER Probes</li> <li>Both sides of canal crossings of width &gt;50 m</li> <li>Both sides of major river crossings</li> <li>At EHV/ HV AC/ HV DC overhead line crossings and where these overhead lines are in parallel.</li> <li>Near DC networks or grounding systems and HV DC grounding systems</li> <li>Where interference problems are suspected</li> <li>At crossings of pipelines and other structures</li> <li>At SV/IP/DT/RT stations</li> <li>At any other location considered necessary by the owner/consultant.</li> </ul> |
| 2.20. Cable type                                       | <ul style="list-style-type: none"> <li>High conductivity, annealed Tinned copper conductor, 650/1100 volt grade, HMWPE insulated, aluminum backed by Mylar tape/polyester tape shielded, armoured/unarmoured and HMWPE sheathed cables shall be used.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2.21. Cable sizes                                      | <ul style="list-style-type: none"> <li>Ref Cell 1x10mm<sup>2</sup></li> <li>Potential measurement 1x6mm<sup>2</sup></li> <li>Polarization coupon 1x6 mm<sup>2</sup> &amp; 1x10 mm<sup>2</sup></li> <li>Current measurement 1x10mm<sup>2</sup></li> <li>Pipe bonding 25mm<sup>2</sup></li> <li>Cathode connection 35 mm<sup>2</sup></li> <li>Anode Header connection 35 mm<sup>2</sup></li> <li>Surge diverter 25 mm<sup>2</sup></li> <li>Anode connection (HT Crossing) 25 mm<sup>2</sup></li> <li>Anode connection Cased crossing 10 mm<sup>2</sup></li> <li>Anode connection TCP 06 mm<sup>2</sup></li> </ul>                                                                                                                                                                                                                                                       |
| 2.22. Bonding with foreign pipelines                   | <ul style="list-style-type: none"> <li>Will be done.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## NOTE:

Withing 60 days of lowering each continuous segment of pipe it should be protected at a minimum -850 mV potential by Mg anodes as part of the TCP. Where soil

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resistivity is 150 ohm.M or more, achievement of -850 mV potential level should not be mandatory. However minimum acceptable shift of potential at such locations (where soil resistivity is 150 ohm.M or more) shall be decided by the owner/consultant, on a case to case basis.

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**3. Additional requirements:**

- a) For protection of the carrier pipe inside casing pipe, if any, zinc ribbon anode shall be used with below mentioned installation method after consultation with PMC/owner:
- Zinc ribbon anodes to be installed for protection of carrier pipe inside the casing pipe along with Bentonite filling at the annular space between casing and carrier. Discrete Mg anode (quantity as required to achieve - 850mV potential level), shall be connected to casing pipe at the cased crossings in case casing and carrier pipe is shorted (i.e become in mechanical contact with each other) and the short is not cleared after filling of Bentonite.
- b) The pipeline shall be grounded through polarization cell with Zinc galvanic anode/zinc ribbon anode or braided copper mitigator, wherever the pipeline is either crossing or running in parallel with overhead EHV/ HV transmission lines of voltage grade 66 KV and above.
- c) Current measurement test station needs to be installed at all the intermediate CP Station for measurement of the upstream and downstream pipeline current as well as coating resistance.
- d) In case anode ground bed for foreign pipeline is existing within 100m of the proposed pipeline ROW and cause interference to proposed pipeline, CP CONTRACTOR need to relocate the anode bed with the consent of the OWNER of the foreign pipeline without any extra cost to HOGPL.
- e) Necessary measures shall be adopted to mitigate the stray current interference due to crossings of high tension line, electrified railway track, existing pipeline in the close vicinity etc. by providing sacrificial anodes, grounding cells, diodes etc.
- f) Surge diverter across insulation joints shall be solid state type. Unprotected side of Surge diverter shall be grounded with GI Earth Electrode and resistance of Earth electrode should be maintained less than 2 Ohms.

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## 4. Codes and Standards:

|                         |                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1. NACE SP0169          | Control Of External Corrosion On Underground Or Submerged Metallic Piping Systems                                               |
| 2. NACE 10A190          | Measurement Techniques Related To Criteria For Cathodic Protection of Underground Or Submerged Steel Piping Systems             |
| 3. NACE SP0177-2014     | Mitigation Of Alternating Current And Lightning Effects On Metallic Structures And Corrosion Control Systems                    |
| 4. NACE SP0286-2007     | Electrical Isolation Of Cathodically Protected Pipelines                                                                        |
| 5. NACE Pub 54276       | CP Monitoring For Buried Pipelines                                                                                              |
| 6. NACE SP0572          | Standard Recommended Practice - Design, Installation, Operation, And Maintenance Of Impressed Current Deep Anode Beds           |
| 7. IS 8062:2006         | Code Of Practice For Cathodic Protection Of Buried Pipelines/Structure For Transportation Of Oil, Natural Gas And Liquids       |
| 8. BS 7361-1:1991       | Cathodic Protection. Code Of Practice For Land And Marine Applications                                                          |
| 9. VDE 0150             | Protection Against Corrosion Due To Stray Currents Of D.C. Installation                                                         |
| 10.BIS 7098 Part I      | Cross-linked Polyethylene Insulated Thermoplastic Sheathed Cables For Working Voltages Up to And Including 1100 Volts           |
| 11.IS 1554-1            | PVC Insulated (Heavy Duty) Electric Cables, Part 1: For Working Voltages Up To And Including 1 100 V                            |
| 12.NACE Standard SP0207 | Performing Close-Interval Potential Surveys and DC Surface Potential Gradient Surveys on Buried or Submerged Metallic Pipelines |
| 13.IS 8062              | Code of Practice for Cathodic Protection of Buried Pipeline/ Structure for Transportation of Natural Gas, Oil and Liquids       |
| 14.IS 1554, Part I      | PVC Insulated (Heavy Duty) Electric Cables: For Working Voltages up to and Including 1100V                                      |
| 15.IS/ IEC: 60079       | Electrical Apparatus for Explosive Gas Atmosphere                                                                               |
| 16.IS/ IEC: 60529       | Classification of Degree of Protection Provided by Enclosures                                                                   |



Energising Quality

**PROJECT NO. C261162**



**TCP SCOPE OF WORK**

**TOTAL SHEETS**

**11**

**DOCUMENT NO.**

**C261162**

**00**

**CP**

**SOW**

**4002**

**HP OIL GAS PRIVATE LIMITED**

**CITY GAS DISTRIBUTION PROJECT OF NAGALAND GA**

**TCP SCOPE OF WORK**

**FOR**

**NAGALAND GEOGRAPHICAL AREAS**

|            |             |                    |             |             |             |
|------------|-------------|--------------------|-------------|-------------|-------------|
|            |             |                    |             |             |             |
|            |             |                    |             |             |             |
| C1         | 24.12.2025  | ISSUED FOR REVIEW  | FJ          | AA          | AA          |
| <b>REV</b> | <b>DATE</b> | <b>DESCRIPTION</b> | <b>PREP</b> | <b>CHKD</b> | <b>APPR</b> |



# CITY GAS DISTRIBUTION PROJECT OF NAGALAND GEOGRAPHICAL AREA

## ABBREVIATION

|       |                                             |
|-------|---------------------------------------------|
| PNGRB | Petroleum and Natural Gas Regulatory Board  |
| OISD  | Oil Industry Safety Directorate             |
| CEA   | Central Electricity Authority               |
| SEA   | State Electricity Authority                 |
| BS    | British Standards                           |
| ICCP  | Impressed Current Cathodic Protection       |
| TCP   | Temporary Cathodic Protection               |
| MEDB  | Main Electrical Distribution Board          |
| HDD   | Horizontal directional drilling             |
| MLV   | Main Line valve                             |
| CPPSM | Cathodic Protection Power Supply Module     |
| 3LPE  | 3-Layer Polyethylene                        |
| NACE  | National Association of Corrosion Engineers |
| ASTM  | American Society for Testing and Materials  |
| CIPL  | Close Interval Potential Logging            |
| CPTRU | Cathodic Protection Transformer Unit        |
| DCVG  | Direct Current Voltage Gradient             |
| IJ    | Insulation Joint                            |

|                                                                                                           |                          |                        |            |
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## 1.0 SCOPE OF WORK

Corrosion survey, design, detail engineering, fabrication, supply, installation, testing and commissioning of the temporary cathodic protection system using Mg galvanic anodes to protect the external surface of 3LPE coated pipeline in Nagaland GA against corrosion for design life of minimum 2 years.

| GA          | Dia(inch) | Length(in KM) |
|-------------|-----------|---------------|
| NAGALAND GA | 12        | 1.50          |
|             | 8         | 10.22         |
|             | 6"        | 21.45         |

Maintaining and keeping of PSP value as specified and monitoring at monthly basis of PSP voltage & AC voltage of the temporary cathodic protection system till the handover of the pipeline to the owner as per Annexure-A. All work shall be carried out conforming to the Scope of work, Design Basis, Data Sheets, national & international standard & as per standard specification No.- VCS-SS-EL-4018A for temporary Cathodic Protection system. Scope shall also include but not limited to the following for completion of jobs:-

- (i) Measurement of soil resistivity along the ROW (At 1000mtr. Interval) & collection of soil & water samples along ROW at depth of 1M, 2M & 3M at every 10km interval (Min 03 sample at each location) for its chemical & microbial analysis as per specification for corrosion survey **VCS-SS-EL-4017 & NACE Standard TM0106-2006** for detection of SRB, ARB, TDS, pH, Rx, Moisture & total dissolved H<sub>2</sub>S etc.

Collection of additional data elements along the ROW of pipeline related to AC, DC interference including details of all like foreign pipeline, overhead power transmission lines crossings & parallelism, power cables, river crossing, road crossing locations, railway traction (electrified/non-electrified), Substations (HVAC/HVDC), existing CP facilities (such as transformer rectifiers, anode ground beds, test facilities etc.) along with GPS coordinates. Site survey report submitted in design document shall have all these details included.

- (ii) Design, Detailed Engineering, Preparation of Design Document, Preparation of Test station schedule & Bill of Material as per the corrosion survey & Chemical analysis of Soil/Water samples for Temporary Cathodic Protection system. Catalogues, vendor drawings, installation procedures, operation and maintenance manuals etc. for all equipment/materials shall be the part of

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design document.

- (iii) Total number of anode shall be calculated as per total anode weight requirement & total protection current required. Localized soil resistivity at 1 Mtr. depth shall be considered for calculation of number of Anodes. However, minimum one anode shall be installed at every 1 KM with test station.
- (iv) Supply, installation, testing & commissioning of Mg (7.6 Kg) galvanic anodes with backfill as per the standard specification- **VCS-SS-EL-4018A**. The weight of the Mg Anode & the total nos. of anodes shall be calculated as per the corrosion survey, soil chemical analysis, total weight and current requirement of the pipeline section.
- (v) Supply, Installation, Testing & commissioning of Test stations (Big Size & Normal Size) weatherproof (IP-55) including cement concrete foundation as per specification & enclosed drawings. Selection of TLP size will be as per the nos. of cables terminating at the station. TLP shall be sealed at both ends by means of foam sealing/solid sealing. Termination plate inside the TLP should have high insulation level (FRP or higher grade) to avoid drainage of CP current due to insulation leakage. All the test-stations and junction boxes shall be provided with shrouded Allen screws to avoid vandalism. Connection scheme shall be permanently fixed inside the TLP.
- (vi) Cable laying and Cable to pipe connection by Thermit welding for 35 mm<sup>2</sup>, 25 mm<sup>2</sup>, 10 mm<sup>2</sup>, 6 mm<sup>2</sup> copper cable including excavation and exposing piping, recoating with epoxy, testing etc. Colour code identification for the various CP System cables used in the system shall be included in design document.
- (vii) Contractor to note that the exact cable routing and exact cable quantities shall be decided at site based on actual site conditions. Contractor shall ensure that there is no surplus or shortage of cables at site and procure cables accordingly.
- (viii) GI Earthing of aboveground cathodically unprotected pipeline at all locations. The earth electrode shall be per IS 3043. Earth electrode resistance shall be limited to 2Ω max.
- (ix) Supply, installation, testing & commissioning of one set of Explosion proof type spark gap arrestor (10/350μS rating shall be 150 kA) across each insulating joint as per P&ID/specification. Surge diverter cable needs to be terminated without any joints across the IJ.
- (x) For CP at cased crossings, **Bare Casing shall be considered** as far as

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possible. At cased crossing, if the casing pipe is coated then it shall be protected additionally by (Independent from carrier pipe protection system) sacrificial Zn anodes installation. Carrier pipeline at cased crossings shall be protected by providing Sacrificial Ribbon anodes. The TCP contractor shall check and confirm the isolation between carrier pipe and casing after installation and before welding the section with mainline. Any re-work requires for establishing isolation shall be in the scope of pipeline Contractor without any extra time and cost to OWNER.

- (xi) Supply, installation, testing & commissioning of solid state polarization cells and Grounding through zinc anodes at HT line crossings/ running parallel (66 KV and above). Rating of polarization cell shall be 3.7 KA @ 30 Cycle & number of 20 kg net weight zinc anode shall not be less than two. The resistance of grounding shall be limited to 2Ω max.

If any proposed additional line of voltage rating 66kV & above is envisaged during construction, the same shall also be considered in the design document. Contractor shall supply polarization cell along with necessary grounding system for the same.

If it is observed during the monthly monitoring that the source of the AC interference is due to the power lines less than 66kV, Contractor shall provide grounding of the pipeline through SSD to mitigate AC interference on the pipeline.

- (xii) Supply, installation, testing & commissioning of external electrical resistance Probe along the pipeline at marshy/vulnerable locations to monitor the external corrosion activity on the pipeline. Location of external ER probe shall be decided during detail engineering.

- (xiii) Supply, installation, testing & commissioning of Polarization coupons having total exposed area of 10mm x 10mm on one side. The coupon shall be installed along the pipeline at additional vulnerable locations (River crossings, Marshy locations, Interference prone area, stray current source locations, foreign pipeline crossings/parallel). Location of external Polarization coupons & magnetic reed switch shall be decided during detail engineering in consultation with HOGPL/VCS.

Exposed side of polarization coupon shall be opposite to pipe & polarization coupon shall not be installed between TLP & Pipeline.

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The works related to collection of approximately 2-5 m of pipeline material (In pieces of 300 to 1000 mm length) for fabrication of polarization coupons is in the scope of the Contractor and shall be supplied by the Owner.

- (xiv) Bonding in between pipelines running parallel or crossing as required including taking of permission from the owner of the foreign pipeline (Permission shall be taken by the Pipeline Owner and any fee required for the same shall be paid by the Owner, however contractor shall assist in all respect to get such permissions from foreign pipeline owner).
- (xv) PSP Monitoring on monthly basis of the TCP system till commissioning of the permanent cathodic protection system including the coupon OFF PSP. Till the construction of the pipeline is in progress and or till handover of the pipeline system to the owner.
- (xvi) All civil/ structural & other miscellaneous works related to TCP system including supply of bricks, cement etc. required for completion of the system.
- (xvii) Coating Integrity test of HDD section of the pipeline shall be conducted immediately after the completion of the HDD of each HDD section by separate temporary power source and anode bed. Bidder shall submit the procedure as per the NACE requirements for approval along with the design document.
- (xviii) Temporary CP system shall be installed immediately of the any lowered section but not later than 15 days from the time of lowering of pipeline segments. To achieve this the TCP design document must be submitted and approved before the construction of the pipeline begins.
- (xix) All civil work related to the CP works like Preparation of buried cable trenches, excavation, back filling, compacting, providing of brick protection by second-class bricks, spreading of fine river sand including supply of bricks, cements steel etc. The job includes repairing of all civil works damaged during installation of electrical and other facilities.
- (xx) The scope of work under this contract shall be inclusive of breaking of walls and floors, and chipping of concrete foundations necessary for the installation of equipment, materials. Minor modifications wherever required to be done in the owner free supplied equipment or devices to enable cable entry, termination, etc.
- (xxi) Supply and installation of all other accessories not specifically mentioned herein but necessary for completion of job.

|                                                                                                             |                          |                        |            |
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(xxii) Co-ordination with other Contractors/Pipeline contractor.

## 2.0 SCOPE OF SUPPLY

2.1 **Owner's scope of Supply: NIL**

2.2 **Bidder's scope of Supply:**

Supply, testing, Packing, Forwarding, Delivery, Installation and commissioning of all items required to accomplish all jobs/activities listed under clause "scope of work" are included in the scope of the contractor. **No equipment will be free issued by the owner.**

(i) All commissioning & start up spares are in bidder's scope (Included in this package). Any commissioning & startup spare consumed during the startup & commissioning is included in the supply of this package, for which no extra payment is made.

(ii) All The necessary permissions required for the bonding, interference mitigation (from SEB's, water works departments/ boards, railways & other pipeline owners) are in the scope of contractor and shall be obtained before taking mitigation measures.

## 3.0 INSPECTION AND TESTING

All the equipment supplied by the contractor shall be inspected by the approved inspection agency (TPI) at the manufacturer's works prior to dispatch. Contractor shall furnish necessary certificates, test reports etc. for Review /Approval to Owner/ Inspection agency. Contractor to get DCN prior to supply of equipment/ material from VCS. The TPI shall be from approved TPI list attached with the tender. TPI shall be arranged by the CP contractor for the testing of the material/equipment at the vendor works.

The issue of DCN for any equipment or component thereof does not absolve the contractor from his contractual obligations towards subsequent satisfactory performance of the equipment at site. If any equipment be found defective, in whole or part thereof after receipt at site or during erection/commissioning and testing, the same shall be Rectified/Changed by contractor free of cost.

|                                                                                                           |                   |                        |     |
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## 4.0 TESTING & COMMISSIONING

The successful tenderer shall provide adequate supervisory/ skilled personnel and all tools and tackles, testing equipment and instruments required for complete checking of installations and testing and commissioning of all equipment and accessories. The testing and commissioning of all equipment is in the scope of bidder & shall be carried out in accordance with the latest edition of relevant Indian / International Standard and NACE standards.

Any defects noticed during the testing and commissioning relating to the equipment supplied and work carried out by the Contractor, will be rectified by the contractor at his own cost. Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carry out the rectification at his own cost.

## 5.0 DRAWINGS, STANDARD SPECIFICATION AND INSTALLATION STANDARDS

5.1 The equipment/ materials to be supplied and their installation by the contractor shall conform to the requirements of the applicable standard specifications. Also of various material/ equipment shall also conform to the standard specification.

Construction shall be as per drawings/ specifications issued/ approved by the Owner/ Consultant during the course of execution of work.

|           |                                                                  |                 |
|-----------|------------------------------------------------------------------|-----------------|
| <b>A)</b> | <b>SPECIFICATION</b>                                             |                 |
|           | Specification for TCP system                                     | VCS-SS-EL-4018A |
|           | Specification for Corrosion Survey                               | VCS-SS-EL-4017  |
| <b>B)</b> | <b>DATASHEETS &amp; QAP</b>                                      |                 |
|           | Quality Assurance Plan                                           | VCS/QAP/TCP/001 |
| <b>C)</b> | <b>STANDARD DRAWINGS</b>                                         |                 |
| 1.0       | Prepacked Zinc Anode                                             | VCS-STD-EL-4511 |
| 2.0       | Prepacked Mg Anode                                               | VCS-STD-EL-4510 |
| 3.0       | Details of Test Station for TCP                                  | VCS-STD-EL-4510 |
| 4.0       | Test Station Connection Schemes                                  | VCS-STD-EL-4514 |
| 5.0       | Galvanic Anode Installation                                      | VCS-STD-EL-4502 |
| 6.0       | Zinc Ribbon Anode for Cased Crossings with Coated Casings        | VCS-STD-EL-4506 |
| 7.0       | Pipeline Grounding Through Polarisation Cell and Galvanic Anodes | VCS-STD-EL-4507 |
| 8.0       | Details of Zinc Grounding Cell                                   | VCS-STD-EL-4508 |

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| 9.0  | Permanent Copper – Copper Sulphate Reference Cell & Installation Details | VCS-STD-EL-4509 |
| 10.0 | Details of thermit weld for cable to pipe joint                          | VCS-STD-EL-4504 |

**Note:**

Pipeline Schematic Route Diagram attached with tender is indicative of the nature of work and issued for tendering purposes only. The bidders, however, shall visit the site before bidding for proper information of site conditions.

**6.0** In case of an irreconcilable conflict between Indian or other applicable standards, general conditions of contract, special conditions of contract, specifications, drawings or schedule of rates, the following shall prevail to the extent of such irreconcilable conflict in order of precedence:

1. Contract Agreement
2. Detailed Letter of Acceptance along with Statement of Agreed Variations.
3. Fax / Letter of Intent / Fax of Acceptance.
4. Schedule of Rates as enclosures to Letter of Acceptance.
5. Job / Particular Specifications.
6. Drawings
7. Technical / Material Specifications.
8. Special Conditions of Contract.
9. Instruction to Bidders
10. General Conditions of Contract.
11. Indian Standards
12. Other applicable Standards

- 6.1 It will be the contractor's responsibility to bring to the notice of engineer-in-charge any irreconcilable conflict in the contract documents before starting the work (s) or making the supply with reference which the conflict exists.
- 6.2 In the absence of any specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with standard engineering practice as per the instructions / directions of the engineer-in-charge, which will be binding on the contractor.
- 6.3 In case of any conflict in technical requirements among PJS, TS, SCC, SOR etc. of tender document and international / national codes / standards, more stringent requirement shall govern or as per the decision of EIC.

|                                                                                                             |                          |                        |            |
|-------------------------------------------------------------------------------------------------------------|--------------------------|------------------------|------------|
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# CITY GAS DISTRIBUTION PROJECT OF NAGALAND GEOGRAPHICAL AREA

## Annexure-A

### Format for TCP system Commissioning

| Sr. No | TS No | Chainage | TS Type | Natural PSP | Instant PSP | Polarised PSP (24 Hrs.) | Anode Voltage (V) | Anode Current (mA) | AC Voltage (V) | Other Readings (If Any) | Remarks |
|--------|-------|----------|---------|-------------|-------------|-------------------------|-------------------|--------------------|----------------|-------------------------|---------|
|        |       |          |         |             |             |                         |                   |                    |                |                         |         |
|        |       |          |         |             |             |                         |                   |                    |                |                         |         |
|        |       |          |         |             |             |                         |                   |                    |                |                         |         |

### Format for Monthly Monitoring Report of TCP system

| Sr. No | TS No | Chainage | TS Type | PSP (-) Voltage |         |                       | Anode Voltage (V) | Anode current (mA) | AC Voltage (mV) | Other Readings (If Any) | Remarks |
|--------|-------|----------|---------|-----------------|---------|-----------------------|-------------------|--------------------|-----------------|-------------------------|---------|
|        |       |          |         | Carrier         |         | Casing (If Protected) |                   |                    |                 |                         |         |
|        |       |          |         | Without Bonding | Bonding |                       |                   |                    |                 |                         |         |
|        |       |          |         |                 |         |                       |                   |                    |                 |                         |         |
|        |       |          |         |                 |         |                       |                   |                    |                 |                         |         |

|                        |                          |                        |            |
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ENERGISING QUALITY

**VCS QUALITY SERVICES PVT. LTD.**

**STANDARD SPECIFICATION  
FOR  
SACRIFICIAL ANODE CATHODIC PROTECTION SYSTEM FOR  
PIPELINES**

**VCS – SS – EL – 018A**

|         |            |                    |                                                                                     |                                                                                       |                                                                                       |                                                                                       |
|---------|------------|--------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
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| 00      | 06.11.2017 | ISSUED AS STANDARD |  |  |  |  |
| Rev. No | Date       | Purpose            | Prepared By                                                                         | Checked By                                                                            | Approved By                                                                           | Approved By                                                                           |





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## **ANNEXURE-I : TCP MATERIALS DATASHEET**



## ABBREVIATION

|                          |                                              |
|--------------------------|----------------------------------------------|
| LPE                      | Three Layer Polyethylene                     |
| AC                       | Alternating Current                          |
| Ag / AgCl                | Silver / Silver chloride reference electrode |
| CSE/Cu/CuSO <sub>4</sub> | Copper Sulphate Electrode                    |
| DC                       | Direct Current                               |
| HDD                      | Horizontal Directional Drilling              |
| HT                       | High Tension Line                            |
| ICCP                     | Impressed current Cathodic Protection        |
| MIJ                      | Monolithic Insulation Joint                  |
| PCP                      | Permanent Cathodic Protection                |
| PSP                      | Pipe to Soil Potential                       |
| ROU                      | Right of Use                                 |
| ROW                      | Right of Way                                 |
| SV Station               | Sectionalized Valve Station                  |
| TCP                      | Temporary Cathodic Protection                |
| TLP                      | Test Lead Point                              |



## 1.0 SCOPE

This specification defines the requirements of design, engineering, installation, testing and commissioning of sacrificial anode cathodic protection system (SACP) for external surface of city gas distribution buried 3LPE coated pipelines with associated high build liquid epoxy valves/fitting. The SACP system shall be used for protecting city gas distribution pipelines during the TCP construction phase.

This specification defines the basic guidelines to develop a suitable sacrificial cathodic protection system for city gas distribution pipelines.

All data required in this regard shall be taken into consideration to develop an acceptable design and for proper engineering of the system.

Compliance with this specification and/or approval of any of the contractor's documents shall in no case relieve the contractor of his contractual obligations.

## 2.0 LATEST CODES & STANDARDS

|                      |                                                                                                                  |
|----------------------|------------------------------------------------------------------------------------------------------------------|
| ISO 15589-1: 2015    | Petroleum and natural gas industries-CP of pipe line transportation systems- on land pipelines                   |
| NACE SP-0169-2013    | Recommended practice control of external corrosion on underground or submerged metallic piping system            |
| IS 8062 part-2: 2006 | Code of Practice for Cathodic Protection of Steel Structures, Part II: Underground Pipelines                     |
| OISD-RP-226- 2013    | Natural gas transmission pipelines and city gas distribution networks                                            |
| NACE SP-0286-2007    | Recommended Practice- the electrical isolation of cathodically protected pipe lines                              |
| NACE SP-0200-2014    | Cathodic Protection for metallic cased crossings                                                                 |
| BS EN 50162:2004     | Protection against corrosion by stray current from direct current systems                                        |
| BS EN 15280:2013     | Evaluation of AC corrosion likelihood of buried pipelines applicable to cathodically protected pipelines         |
| NACE SP-0177-2014    | Recommended Practice- Mitigation of AC and lighting effects on metallic structures and corrosion control systems |
| NACE-SP-21424-2018   | Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation, and Monitoring   |
| NACE SP0104-2014     | The Use of Coupons for Cathodic Protection Monitoring Applications                                               |
| NACE TM0497-2012     | Measurement techniques related to criteria for cathodic protection on submerged metallic piping system           |
| ASTM G57-2012        | Field measurement of soil resistivity using Wenner four pin electrode method                                     |
| ASTM B418-2016       | Cast and Wrought Galvanic Zinc Anodes                                                                            |
| ASTM B843-2018       | Magnesium Alloy anodes for cathodic protection                                                                   |
| API 1102             | Recommended practice for Steel Pipelines Crossing Railroads and Highways                                         |
| IS 1554 PART-1       | PVC Insulated heavy duty cables                                                                                  |
| IS 3043: 2007        | Code of practice for Earthing                                                                                    |
| ISO 13847:2013       | Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines                    |



|                                          |                                                                                                                  |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| OISD RP-113-2013                         | Classification of area for electrical installations at hydrocarbon processing and handling facilities            |
| OISD-RP-188-2019                         | Corrosion monitoring of offshore and onshore pipelines                                                           |
| PNGRB-G.S.R. Infra/ T4S/ P&PPPL/01 /2014 | Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Products Pipelines |
| PESO Petroleum rules 2002                | CHAPTER III: PART V- Transport by Pipelines                                                                      |

The equipment shall also confirm to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

In case of any contradiction between various referred standards/ specifications /data sheet and statutory regulations the following order of priority shall govern:

- a. Statutory regulations
- b. Material datasheet
- c. Particular specification (if applicable)
- d. This specification (standard specification)
- e. Codes and standards

### **3.0 DESIGN**

The design and engineering of the SACP system shall be carried out by the contractor as per procedures and design parameters specified below:

#### **3.1 SYSTEM IMPLEMENTATION**

- a. Corrosion survey of the ROW as per VCS tender specification
- b. Design basis of SACP system
- c. Design and engineering package of SACP (Including calculation for SACP system)
- d. Field testing and commissioning procedure
- e. As built documentation

#### **3.2 CORROSION SURVEY**

- 3.2.1 The details of corrosion survey including soil resistivity data along ROW and other data required for CP design if available with the Owner shall be included as part of project specification. However, verification of its veracity and adequacy shall be the entire responsibility of the contractor. Contractor shall also carry out soil resistivity survey at sacrificial anode ground bed locations for proper design of ground. Wenner's 4-pin method or approved equal shall be used for such measurements. Survey instruments shall have maximum AC and DC ground current rejection feature.

Soil/water samples shall be collected along the ROU for analysis. Samples shall be collected on an average at one location for every 05 km along ROU with minimum at two locations. Exact locations shall be decided at site depending on the type of soil, soil resistivity and in consultation with OWNER or his representative. At each location the soil samples shall be collected at 1 M, 2 M depth and at expected depth of pipeline if it is more than 2 m at the location.



- 3.2.2 Care shall be taken to ensure that the resistivity observations are not influenced by the presence of foreign pipelines/structures, and earth currents in the vicinity of HT lines and installations using earth return in their power system etc.

### **3.3 ADDITIONAL DATA TO BE COLLECTED**

The following data shall be collected to generate design data for evaluation of interaction/interference possibilities due to presence of other services in ROW/in vicinity. Owner shall provide assistance for liaison work to the extent possible.

- Route and types of foreign service/pipeline in and around or crossing the right of way (including those existing and those which are likely to come up during contract execution)
- Diameter, wall thickness, pressure, soil-cover, and type of external coating, type of cathodic protection system provided, if any and year of laying/commissioning in case of foreign pipelines.
- Details of the existing cathodic protection systems protecting the services i.e., type of protection, location, rating of anode beds, test station locations and their connection schemes. Present output current and voltage readings of the CP power supply units.
- Remedial measures existing on foreign pipelines/services to prevent interaction.
- Graphical representation of existing structure/ pipe to soil potential records.
- Possibility of integration/isolation of CP systems, which may involve negotiations with owners of other services
- Information on existing and proposed DC/AC power sources and systems using earth return path such as HVDC substations/ earthing stations, fabrication yards with electric welding etc. in the vicinity of the entire pipeline route.
- Crossing and parallel running of electrified and non-electrified traction (along with information regarding operating voltage; AC/DC type etc.) as well as abandoned tracks near ROW having electrical continuity with the tracks in use.
- Crossing or parallel running of any existing or proposed 11 kV and above AC/DC overhead power lines along with details of voltage, AC/DC type etc.
- Voltage rating phases sheathing details of underground power cables running along ROW or in its vicinity.
- Any other relevant information that may be needed in designing and implementing proper protection.
- Contractor shall conduct necessary potential gradient surveys for any existing anode ground beds that may interfere with the CP system of the pipelines covered under this project.

### **3.4 REPORT**

- On completion of all field work, a report incorporating all the results generated from surveys and details of additional data, collected shall be prepared.



- The report shall also contain detailed interpretation of:
  - Survey results and resistivity data
  - List of Foreign pipeline crossings and other DC interference prone areas
  - List of HT line ( $\geq 66\text{kV}$ ) crossings and other AC interference prone areas
  - Various drawings prepared in connection with the above work.
  - Soil resistivity values plotted on semi-log graph sheets.

### 3.5 CATHODIC PROTECTION DESIGN PARAMETERS

Unless otherwise specified, following parameters shall be used for design of cathodic protection system.

Where the cathodic protection system is specified for temporary protection, those parts of sacrificial anode cathodic protection system, which will be integrated, with the permanent CP system shall be designed based on permanent CP parameters.

#### 3.5.1 DESIGN LIFE

- TCP shall be designed for 2 years

#### 3.5.2 PROTECTION CURRENT DENSITY

Pipelines directly buried and having three-layer polyethylene (3LPE) coating

| Pipeline surrounding                   | Temporary CP<br>( $\mu\text{ A/m}^2$ ) |
|----------------------------------------|----------------------------------------|
| Soil resistivity more than 100 ohm-m   | 10                                     |
| Soil resistivity 10 ohm-m to 100 ohm-m | 25                                     |
| Soil resistivity less than 10 ohm-m    | 50                                     |

Pipelines laid through HDD and having three-layer polyethylene (3LPE) coating

| Pipeline surrounding     | Temporary CP<br>( $\mu\text{ A/m}^2$ ) |
|--------------------------|----------------------------------------|
| Soil resistivity for HDD | 50                                     |

**Note:**

- I. Safety factor for current density: 1.3
- II. Anode utilization factor: 0.85
- III. Pipeline Natural Potential: (-) 0.45 V w.r.t CSE
- IV. Steel Resistivity:  $2.2 \times 10^{-7}$  ohm-M

The above current density values for temporary CP system are applicable for CP system design life.



Actual current density to be adopted shall be decided based upon soil and other environmental conditions, current drainage survey data (where included in Contractor's scope) at HDD locations, proximity of foreign pipe lines/structures and other interference areas affecting the installation. Where considered necessary for satisfactory protection of pipeline the current density shall be suitably increased by contractor.

The pipe protection current density indicated as above shall be applicable where the temperature of the fluid transported by the pipeline/ the surface temperature of the buried portion of the pipeline does not exceed 30° C, the protection current density shall be increased suitably in consultation with the Owner/Company.

### **3.5.3 CATHODIC PROTECTION DESIGN CRITERIA**

Cathodic protection system shall be designed to meet the following criteria:

The pipe to soil potential measurements shall be between (-) 0.95 V (ON) and (-) 1.5 V (ON) for polyethylene coated pipe lines with respect to a copper/copper sulphate reference electrode.

At locations of polarization coupons, the coupon to soil potential measurement shall be between -0.850 V (Instant OFF) to -1.18 V (Instant OFF) with respect to stable permanent copper / copper sulfate reference electrode installed close to the coupon.

A positive potential swing of 50 milli volts or more shall be considered sufficient to indicate the presence of an interaction/interference situation requiring investigation and incorporation of mitigation measures by the Contractor.

## **4.0 MATERIAL**

The system shall include the following major equipment/sub-systems unless otherwise specified in project specifications.

- a. Sacrificial anodes (Magnesium/Zinc, as per soil resistivity)
- b. Sacrificial (Mg) anodes only at coated cased crossings
- c. Sacrificial (Mg) anodes at HDD locations
- d. Test stations
- e. Surge diverter at MIJ and zinc grounding anode at unprotected side of MIJ
- f. DC decoupling device with earthing system
- g. Interconnecting cables
- h. Cables to pipe connections
- i. Polarization coupons for measurement of "Instant OFF" potentials with permanent reference cell

All equipment shall be new and procured from approved manufacturers. Equipment offered shall be field proven. Equipment requiring specialized maintenance or operation shall be avoided as far as possible. Prototype equipment shall not be accepted.



Equipment shall conform to the relevant specifications enclosed with the tender document. All equipment including test stations shall be located in safe non-hazardous areas.

Where it is essential to install the equipment in hazardous area, such equipment shall be flame-proof type and shall meet the requirement of IS: 2148 or equivalent international Standard and shall be suitable for gas group IIB, temperature class T3 (200°C). Indigenous equipment shall be certified by CMRI or any other recognized testing body and shall be approved by the concerned statutory authority. All flameproof equipment shall carry the BIS license marking as per the requirement of statutory authorities. All imported equipment for hazardous area may be tested and certified by an independent certifying agency of country of equipment origin and shall be approved by the concerned statutory authority in India.

#### **4.1 SACRIFICIAL ANODE GROUND BEDS**

- 4.1.1 Along ROW where soil resistivity predominantly remains low, ranges from 0-10 ohm-m and pH value is within 9, zinc anodes shall be provided. Anodes of type I as per ASTM-B 418 standard shall be used for seawater, brackish water or saline electrolyte application and anode of type II as per ASTM-B 418 standard shall be used for fresh water, back fill and soil applications.
- 4.1.2 Along ROW where soil resistivity is predominantly in the range of 10 ohm-m to 30 ohm-m, low potential (1.55V) magnesium anodes, as per ASTM-B 843 shall be provided.
- 4.1.3 Along ROW where soil resistivity is predominantly in the range of 30 ohm-m to 50 ohm-m high potential (1.75V) magnesium anodes, as per ASTM-B 843 shall be provided.
- 4.1.4 At high resistivity area where resistivity is of the order of 50 ohm-m and above magnesium ribbon anodes may be provided.
- 4.1.5 In case the soil resistivity varies from 5 ohm-m to 50 ohm-m, then low potential (-1.55V<sub>CSE</sub>) magnesium anode shall be used for the entire length of the pipeline.
- 4.1.6 Average separation distance between each consecutive sacrificial anode location along the pipeline route for temporary cathodic protection shall be 1 km.
- 4.1.7 The minimum weight of the sacrificial anode for temporary cathodic protection for design life of 2 years shall be min. 2.5kg net pre-packed or whichever is higher, as per detailed design calculations.
- 4.1.8 Suitability of the selected sacrificial anodes for the soil conditions with particular attention to carbonates, bicarbonates, phosphates and nitrates, shall be checked for proper operation by the Contractor.
- 4.1.9 The anodes shall be laid in proper type of back fill consisting of a 20 % bentonite, 75 % gypsum and 5 % of sodium sulfate to improve the local conductivity around the anodes, such that the effect of soil is minimum on the anode effectiveness and life.
- 4.1.10 The leads of all the anodes shall be brought up to the test station and shall be terminated individually.





- 4.1.11 The number of anodes at each ground bed shall be sufficient for providing the specified pipe protection current density taking into consideration the ground bed resistance, cable resistance, etc. The number of anodes for ground bed, spacing of ground beds based on the applicable soil resistivity, size of pipeline, type of coating for the pipeline shall be chosen from the table after necessary verification by the CP contractor.
- 4.1.12 Any deficiency in the protection system if noticed during commissioning or during monitoring shall be corrected by the CP contractor by suitably augmenting the system with additional anodes without any cost / schedule implications.
- 4.1.13 For the portion of the pipeline for which the CP system has been specified based on the permanent CP system parameters – cased crossing, HDD, HT line locations, the contractor shall ascertain the requirement of the cathodic protection current density indicated above, and the anodes installed at these locations, shall be suitable for PCP system design life.

## **4.2 TEST STATIONS**

- 4.2.1 Test stations shall be provided along the pipeline ROW for monitoring the performance of the cathodic protection system at the following locations. Test stations shall be provided at additional locations, if required, so that distance between any two adjacent test stations does not exceed 1000 meters in inhabited areas and 2000 meters in uninhabited areas like forest/deserts.
- At the location of anode ground beds
  - At one sides of metallised road crossings
  - At all insulating joints
  - At tap-off station
  - At HT ( $\geq 66\text{kV}$ ) AC/DC overhead line crossings and location of HT line parallelism within 50M of the pipeline.
  - At vulnerable location with drastic change in soil resistivity.
  - At both sides of major river crossings and HDD.
  - At location of DC decoupler
  - In the vicinity of DC networks or grounding system where interference problems are suspected.
  - At crossings of other pipelines/structures.
  - At both sides of cased crossings.
  - At any other locations considered vulnerable/locations where AC/DC interference is expected
  - At railway line crossings and at selected location along railway lines running parallel to the pipeline.
  - At the location of Sectionalizing Valve (SV) Station.
  - At any other locations considered necessary by owner/owner's representative



4.2.2 The types of TLP to be used shall be as follow:

- i. Type A- Potential measurement
- ii. Type B- Current measurement
- iii. Type C- At the locations of cased crossing- Bare casing
- iv. Type D- At the locations of cased crossing – coated casing
- v. Type E- At locations of foreign pipeline crossings
- vi. Type F- At MIJ locations
- vii. Type H- At HV locations and SV stations
- viii. Type A+HDD- At HDD crossing locations
- ix. Type A + PC- At locations of polarization coupon installations

4.2.3 Test stations used for sacrificial anodes shall have shunt for measurement of anode current, provision for resistance insertion to limit the anode current output and anode disconnecting link.

4.2.4 Test stations for bonding shall be provided with shunt and resistor as a means to monitor and control current flow between the pipeline and foreign pipelines or structures that may exist in common ROW-

4.2.5 Test station with current measuring facility shall be provided at interference prone areas, on both sides of major river crossings, HDD locations, near marshy areas and minimum one for every 10 km max. along the pipeline.

4.2.6 The test stations shall be installed with the face of the test station facing the pipeline. The nameplate of test stations shall carry the following minimum information

- a. Chainage in km.
- b. Test station connection scheme
- c. Distance from pipeline in meters.
- d. Direction of product flow.

4.2.7 Terminals and different schemes of wiring shall be provided as per the test station connection scheme. Minimum twenty percent spare terminals shall be provided in each test.

4.2.8 Minimum two cables shall be provided from the pipeline at any test station

4.2.9 The location of all the test stations shall be marked with their connection schemes and other relevant information on alignment sheets. A detailed test station schedule shall be prepared.

#### **4.3 SURGE DIVERTER & GROUNDING OF PIPELINE AT UNPROTECTED SIDE OF MIJ**

Explosion proof type spark gap surge diverter shall be connected across each monolithic insulating joint (MIJ) to protect it from high voltage surges.

The surge diverter shall be rated for discharging lightning current (10/350  $\mu$ s) & AC fault currents picked by the pipeline across the MIJ without causing excessive voltage build up which would damage the MIJ or cause an electric arc or flashover across the MIJ.



Surge diverters shall be directly mounted on MIJ to prevent the breakdown of MIJ which is 5 kV. The length of the surge diverter leads connecting across the MIJ shall be suitable to connect to the MIJ cleats without any joint/copper clamp.

The above ground portion of the pipeline at the unprotected side of the MIJ shall be grounded by GI plant earthing or zinc anodes of 20 kg net weight.

#### 4.4 GROUNDING OF PIPELINE

##### 4.4.1 AT LOCATION OF HT TRANSMISSION LINE CROSSING ( $\geq 66$ kV)

In TCP scope at all HT crossings (66 kV and above), H-Type TLP's shall be provided, for grounding 3LPE coated pipeline through a suitably rated DC decoupler and suitably designed grounding system.

- a) DC Decoupler:** The DC Decoupler through which the pipeline shall be grounded shall be solid state type and shall be capable of blocking DC voltages  $\pm 2$  V and provide an effective and continuous conductive path to suitably design the grounding system for AC induced voltages, lightning currents, surge currents and AC fault currents.
- b) Grounding System:** The grounding system resistance shall be less than 5 ohms to meet the following requirement of AC interference mitigation:
- AC induced voltage:  $< 15$  V RMS AC
  - AC current density: a)  $< 30$  A/m<sup>2</sup>, if DC current density exceeds 1 A/m<sup>2</sup>  
b)  $< 100$  A/m<sup>2</sup>, if DC current density is less than 1 A/m<sup>2</sup>

The AC-DC current density to be measured at coupon locations and the current densities mentioned above will be time weighted average of 24 hrs.

To achieve required grounding resistance, following type of grounding system shall be designed and installed:

| Soil resistivity Range<br>(in ohm-cm) | Type of Grounding System                                                                                                                                                                        |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $< 2500$ ohm-cm                       | Minimum two (2) nos. of zinc grounding anodes, in a chemical backfill. Each zinc grounding cell shall have net weight of 20kg.                                                                  |
| $> 2500$ ohm-cm                       | - Zinc ribbon anode of minimum dimension 12/14 mm, with trench backfilled with chemical backfill.<br>- Copper conductor of size 16 mm <sup>2</sup> , with factory pre-packed adequate backfill. |

Note: The length of zinc ribbon anode/copper conductor shall be decided by the contractor after having performed grounding calculations.

##### 4.4.2 AT LOCATION OF HT TRANSMISSION LINE RUNNING PARALLEL

Where transmission lines run parallel within 50 M of either side of the pipeline, the pipeline shall be grounded at a maximum interval of 1 km, at suitable locations, where AC induced voltages are the highest. The grounding shall be done through DC decoupler using grounding system to meet the AC interference criteria as specified above under Clause 4.6.1



#### **4.5 CP AT CASED CROSSING**

- 4.5.1 Casing should be avoided as far as possible. If cased crossing is unavoidable, bare casing to be provided, with selecting higher thickness allowance as per API 1102
- 4.5.2 No sacrificial anodes (ribbon anodes) shall be used inside casing & carrier annular space.

#### **4.6 REFERENCE CELL ACCESS POINTS**

- 4.6.1 Reference cell access points shall be provided at all test station locations, at insulating joint locations, where the ground is paved, for measurement of pipe to soil potentials. A perforated 2" PVC pipe of 1.5- 2-meter length so as to reach the pipeline depth filled with native soil and buried at the location shall be provided for the purpose. The length of the PVC pipe shall be adequate to reach the native soil below the paving.

#### **4.7 CABLES**

- 4.7.1 Cables shall be with annealed high conductivity stranded copper conductor, PVC insulated, 650/1100V grade, PVC sheathed conforming to IS: 1554 Part -I. The size of the copper conductor shall be:
- For anode tail cable to test station: 10 mm<sup>2</sup> unarmored
  - From test station to pipeline: 10 mm<sup>2</sup> armored
  - For bonding, DC decoupler, grounding anodes and surge diverter: 25 mm<sup>2</sup> armored
  - For reference cells and pipeline potential measurements: 6 mm<sup>2</sup> armored

#### **CABLE LAYING**

Cables shall be laid in accordance with the layout drawings to be prepared by the Contractor. No straight through joint shall be permitted. Cable route shall be carefully measured and cables cut to required length. Minimum half meter cable slack shall be provided near anodes, pipeline and test stations to account for any settling

All cables inside station/plant area shall be laid at a depth of 0.75 M Cables outside station/plant area shall be laid at a depth of minimum 1.5 M Cables shall be laid in sand under brick cover and backfilled with normal soil. For cables laid outside the station/plant area, polyethylene warning mats shall be placed at a depth of 0.9 m. from the finished grade to mark the route

PVC pipes of proper size shall be provided for all underground cables for road crossings

Cables shall be neatly arranged in trenches in such a manner that crisscrossing is avoided and final take off to equipment is facilitated.

#### **4.8 POLARIZATION COUPON**

- 4.8.1 Coupon shall have one side exposed area of 1 cm<sup>2</sup>. The coupon shall be made from the material of the pipeline. Minimum one polarization coupon shall be installed every



5 kms for measurement of "Instant OFF" or polarized potential of the 3LPE coated buried pipeline, which otherwise cannot be measured in a TCP based cathodic protection system.

- 4.8.2 The location of polarization coupon TLP shall preferably be between two Types-A TLP's to check the mid-point pipeline polarization.
- 4.8.3 Cable connection of 10mm<sup>2</sup> and 6mm<sup>2</sup> shall be provided to the coupon for connecting it to the pipeline for cathodic protection and potential protection measurements respectively.
- 4.8.4 Polarization coupon TLP will not have any sacrificial anode connected.
- 4.8.5 Polarization coupon shall be provided with a permanent copper / copper sulfate reference electrode installed close to the polarization coupon.
- 4.8.6 Connection of coupon to pipeline shall be through a vacuum sealed magnetic reed switch housed inside the test station. The magnetic reed switch shall be rated to carry and break minimum 10 mA at 50 V DC.
- 4.8.7 Coupons shall be installed at bottom 1/3<sup>rd</sup> portion of the pipeline and 250 mm away from the pipe surface.
- 4.8.8 The bare area of coupon shall be placed opposite to the pipeline.
- 4.8.9 The permanent reference electrode shall be placed 150 mm from the pipeline.
- 4.8.10 Coupons shall be provided as per the requirement of NACE SP104:2014
- 4.8.11 Selection of other locations of Polarization coupons shall be decided by PMC / Engineer-In-Charge

#### **4.9 PERMANENT REFERENCE CELLS**

- 4.9.1 High purity copper-copper sulphate reference cells with proven high reliability shall be provided for stable coupon to soil potential measurement at the locations of polarization coupons.
- 4.9.2 The reference cells shall be of silver/silver chloride type in place of copper/copper sulphate cells, at marshy area locations, where water table is high and chloride ion concentration is more than 300 ppm for marshy area in saline soils high purity zinc may be considered as an alternative to silver/silver chloride.
- 4.9.3 The life of reference cells shall be minimum 10 years under burial-conditions.
- 4.9.4 The test station connection scheme inside the test station shall clearly indicate the type of reference cell (Cu CuSO<sub>4</sub> /Ag AgCl).

#### **4.10 CABLE TO PIPE CONNECTIONS**

- 4.10.1 All cable connections to the new pipeline shall be made by an approved exothermic process or by pin brazing. However, cable connection to charged pipelines shall be made by pin brazing. Exothermic welding shall be adopted for water pipelines. The resistance of the cable to pipe at the connection point shall not exceed 0.1 ohm.



Coating shall be repaired after connection of cable conductor to pipeline. The coating repair material shall be compatible with the original coating and shall prevent ingress of water along the cable, surface and at the interface of coating repair with the original pipe coating

## **5.0 INSPECTION, TESTING AND COMMISSIONING**

### **5.1 SYSTEM TESTING AT SITE**

- 5.1.1 Field tests as per the reviewed field testing and commissioning procedures prepared by the Contractor shall be carried out on the equipment/systems before these are put into service. Acceptance of the complete installation shall be contingent upon inspection and test results
- 5.1.2 Before the CP system facilities are put into operation, necessary tests shall be carried out to establish that all equipment, devices, wiring and connection have been correctly installed, connected and are in good working condition as required for the intended operation. Owner/Owner's representative may witness all tests. Intimation shall be given at least one week before commencing the tests.
- 5.1.3 All tools, equipment and instruments required for testing shall be provided by Contractor. Generally, the following minimum tests must be carried out and recorded.

#### **a. Cables**

- i. Cable No.
- ii. Voltage grade
- iii. Conductor cross section
- iv. Continuity check
- v. Voltage test
- vi. Insulation resistance values between each core & earth, between cores. All cables shall be tested by 500 V megger

#### **b. Insulating Joint**

- i. Location
- ii. Pipe to soil potential of both protected and non-protected sides of the insulating joint before and after energization of CP system

#### **c. Surge Diverter**

- i. Location/Identification number rating
- ii. Type
- iii. Explosion proof enclosure check for healthiness
- iv. Check for proper connection

#### **d. DC Decoupler**

- i. Location/Identification number
- ii. Ratings
- iii. Check for wiring



- iv. Details of grounding provided

**e. Sacrificial Anode**

- I. Location
- II. Type
- III. Open circuit potential

**f. Permanent Reference Cell**

- I. Location
- II. Type of cell
- III. Potential reading
- IV. Installed on near coupon location
- V. Distance and depth from pipeline

**g. Grounding Anodes**

- I. Location
- II. Type of anode
- III. Potential reading
- IV. Grounding Resistance

**h. Coupon**

- I. Location
- II. Exposed area of coupon
- III. Potential reading
- IV. Distance and depth from pipeline
- V. Distance of permanent reference electrode from coupon

## **5.2 COMMISSIONING**

- 5.2.1 Natural potential of pipe to soil for the complete pipeline and casing pipeline at the locations of cased crossings shall be measured at all the test station locations, recorded prior to connecting anodes to pipe line and casing pipeline respectively.
- 5.2.2 The anode shall be connected to pipeline in the test station and the pipe to soil potential observation shall be made after allowing 48 to 72 hours for polarization.
- 5.2.3 The current output of each anode at temporary CP anode ground bed shall also be measured. In case the anode output current exceeds the rated capacity, it shall be controlled by insertion of resistance element in the anode circuit inside test station and the pipe to soil potential shall be rechecked for adequacy of protection.
- 5.2.4 At locations of polarization coupon, the coupon 'Instant OFF' potential shall be measured by switching off the reed switch.
- 5.2.5 Additional anodes shall be provided where required to achieve desired level of protection and to keep the anode output current within the rated value. In case pipe to soil potential exceeds the specified value, suitable resistance shall be inserted in the anode circuit to limit the potential.



- 5.2.6 The PSP of casing and carrier pipe shall be recorded and in case the difference in the ON PSP of casing (with anodes disconnected) and carrier pipe is less than 200 mV, the same shall be reported to the Owner/Owner's representative.
- 5.2.7 AC induced voltage measurements shall also be made on the pipeline at all TLP locations to find out continuous induction of voltage.
- 5.2.8 Potential on the protected and unprotected side of the MIJ to be recorded to confirm the integrity of MIJ.
- 5.2.9 At foreign pipeline locations, potential of both the pipelines- owners and foreign shall be recorded and the locations of foreign pipeline anode bed have to be identified to avoid any anodic interference in future. At locations of foreign pipeline crossing Zinc anodes- 20 kg can also be installed as a mitigation measure shall be sized for the design life specified for permanent CP.
- 5.2.10 Resistance of the grounding anode shall be recorded at MIJ (unprotected side) and HT line crossing (location shall be recorded it should be less than 5 ohm or as per design requirement).
- 5.2.11 After connecting all the anode ground beds to pipe line, measurement of pipe to soil potentials shall be taken at each test station to ensure conformity to protection criteria.
- 5.2.12 In case of insufficient protection as per the CP design criteria on any portion of the pipeline/ casing pipeline (at cased crossings where casing is cathodically protected) Contractor shall carry out necessary additions/modifications to the provided protection in consultation with the Owner/Owner's representative.

## **6.0 SYSTEM MONITORING**

- 6.1** Where the CP provided is temporary, the CP system shall be monitored at all test stations once in a month for healthiness/adequacy of protection of installed TCP system. If any deficiency/interference in protection system is noticed, the same shall be rectified/augmented by providing additional anodes as required. The monitoring report shall be submitted regularly to owner for his review/information.





## **ANNEXURE – I** **TCP MATERIALS DATASHEET**

### **1.1 MAGNESIUM ANODE**

| <b>MAGNESIUM ANODE</b>       |                                                         |                                            |
|------------------------------|---------------------------------------------------------|--------------------------------------------|
| <b>Standard</b>              | <b>ASTM-B-843</b>                                       |                                            |
| <b>Composition</b>           | <b>Weight Content<br/>(Low Potential)</b>               | <b>Weight Content<br/>(High Potential)</b> |
| Manganese                    | 0.15 %                                                  | 0.5 – 1.3%                                 |
| Aluminum                     | 5.3-6.7 % max.                                          | 0.01 % max.                                |
| Copper                       | 0.02 % max.                                             | 0.02 % max.                                |
| Nickel                       | 0.002% max.                                             | 0.001% max.                                |
| Iron                         | 0.003 % max.                                            | 0.03 % max.                                |
| Zinc                         | 2.5-3.5 %                                               | -                                          |
| Silicon                      | 0.1% max.                                               | 0.05% max.                                 |
| Other                        | 0.30 % max. (Total)                                     | 0.30 % max. (Total)                        |
| Magnesium                    | Balance                                                 |                                            |
| Anode Circuit Open Potential | 1.55 volts (CSE)                                        | 1.75 volts (CSE)                           |
| Anode Consumption Rate       | 7.9 Kg/ (A. Yr) max.                                    | 7.9 Kg/ (A. Yr) max.                       |
| Anode tail cable             | 1C X 10 mm <sup>2</sup> (un-armored)                    |                                            |
| Backfill Material            | Gypsum – 75%<br>Bentonite – 20%<br>Sodium Sulphate – 5% |                                            |
| Make                         | As per approved vendor list                             |                                            |

### **1.2 ZINC ANODE**

| <b>ZINC ANODE</b>            |                                                                                                |                                                                                   |
|------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <b>Standard</b>              | <b>ASTM-B-418</b>                                                                              |                                                                                   |
| <b>Composition</b>           | <b>Weight: Type-I</b><br>(Used for seawater, brackish water or saline electrolyte application) | <b>Weight: Type-II</b><br>(Used for fresh water, back fill and soil applications) |
| Aluminum                     | 0.1% to 0.5% max.                                                                              | 0.005 % max.                                                                      |
| Cadmium                      | 0.025% to 0.07%                                                                                | 0.003 % max.                                                                      |
| Copper                       | 0.005 % max.                                                                                   | 0.002 % max.                                                                      |
| Iron                         | 0.005 % max.                                                                                   | 0.0014 % max.                                                                     |
| Lead                         | 0.006 % max.                                                                                   | 0.003 % max.                                                                      |
| Others                       | 0.01% max.                                                                                     | -                                                                                 |
| Zinc                         | Balance                                                                                        | Balance                                                                           |
| Anode Open Circuit Potential | (-) 1.1 Volts w.r.t CSE                                                                        | (-) 1.1 Volts w.r.t CSE                                                           |
| Anode Consumption rate       | 11.24 Kg/(A. Yr) max.                                                                          | 11.24 Kg/ (A. Yr) max.                                                            |



| ZINC ANODE        |                                   |
|-------------------|-----------------------------------|
| Anode tail cable  | 1C X 25 mm <sup>2</sup> (armored) |
| Backfill Material | Gypsum –50%<br>Bentonite – 50%    |
| Make              | As per approved vendor list       |

### 1.3 ZINC RIBBON ANODE

| ZINC RIBBON ANODE            |                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------|
| Standard                     | ASTM-B-418                                                                               |
| Dimension                    | 12/14 mm                                                                                 |
| Length                       | As required                                                                              |
| <u>Composition</u>           | <u>Weight: Type-II</u><br><u>(Used for fresh water, back fill and soil applications)</u> |
| Aluminum                     | 0.005 % max.                                                                             |
| Cadmium                      | 0.003 % max.                                                                             |
| Copper                       | 0.002 % max.                                                                             |
| Iron                         | 0.0014 % max.                                                                            |
| Lead                         | 0.003 % max.                                                                             |
| Others                       | -                                                                                        |
| Zinc                         | Balance                                                                                  |
| Anode Open Circuit Potential | (-) 1.1 Volts w.r.t CSE                                                                  |
| Anode Consumption rate       | 11.24 Kg/ (A. Yr) max.                                                                   |
| Anode tail cable             | 1C X 25 mm <sup>2</sup> (armored)                                                        |
| Backfill Material            | Gypsum –50%<br>Bentonite – 50%                                                           |
| Remarks                      | Trench to be backfilled with chemical backfill                                           |
| Make                         | As per approved vendor list                                                              |

### 1.4 COPPER CONDUCTOR (AC MITIGATOR)

| COPPER CONDUCTOR |                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------|
| Diameter         | 38mm                                                                                              |
| Wire Size        | 6 AWG (16 mm <sup>2</sup> )                                                                       |
| Length           | As required                                                                                       |
| Backfill         | Special backfill with corrosion inhibitors                                                        |
| Fabric           | Integrated woven synthetic acid resistant                                                         |
| Braid            | Tough, porous, protective braid enhancing the abrasion and damage resistance of the fabric jacket |
| Make             | As per approved vendor list                                                                       |

**1.5 SURGE DIVERTER**

| SURGE DIVERTER                             |                                                     |
|--------------------------------------------|-----------------------------------------------------|
| Type                                       | Spark gap, explosion proof Ex d IIC T6, Solid State |
| Lightning Impulse Current (10/350 $\mu$ s) | 50 kA                                               |
| Nominal Discharge Current (8/20 $\mu$ s)   | 100 kA                                              |
| Spark Over AC Voltage (50 Hz)              | $\leq 1.2$ kV                                       |
| Power Frequency Sparkover Voltage (50 z)   | $\leq 0.5$ kV                                       |
| Power Frequency Withstand Voltage (50 z)   | $\leq 250$ V                                        |
| Degree of protection                       | IP-67                                               |
| Make                                       | As per approved vendor list                         |

**1.6 DC DECOUPLER/POLARIZATION CELL**

| DC DECOUPLER                                         |                             |
|------------------------------------------------------|-----------------------------|
| Type                                                 | Solid state type            |
| Blocking DC Voltage                                  | - 2 V DC                    |
| Leakage Current at -1.2V at 20°C                     | < 20 $\mu$ A                |
| Steady state AC discharge current                    | 45 Arms @ 50 Hz             |
| Power fault current (40 milli sec) 2 cycle @ 50 Hz   | 5 kA                        |
| Power fault current (200 milli sec) 10 cycle @ 50 Hz | 3.7 kA                      |
| Power fault current (600 milli sec) 30 cycle @ 50 Hz | 3.7 kA                      |
| Lightning Impulse Current (10/350 $\mu$ s)           | 75 kA                       |
| Lightning Impulse Current (8/20 $\mu$ s)             | 100 kA                      |
| Max. permissible voltage DC                          | - 2 V                       |
| Degree of protection                                 | IP-68                       |
| Make                                                 | As per approved vendor list |



## 1.7 CABLES

All the cables shall be annealed high conductivity, tinned, stranded copper conductor, XLPE insulated, 1100V grade, FRLS, PVC sheathed

| <b>CABLES</b>                            |                                                                              |
|------------------------------------------|------------------------------------------------------------------------------|
| Anode Tail cable for Magnesium anodes    | Conductor Size - 10 Sq mm<br>No of Cores - Single<br>Protection - Un armored |
| Potential Measurement                    | Conductor Size - 6 Sq mm<br>No of Cores - Single<br>Protection - Armored     |
| Current Measurement cable                | Conductor Size - 10 Sq mm<br>No of Cores - Single<br>Protection - Armored    |
| Bonding, Surge Diverter connection Cable | Conductor Size - 25 Sq mm<br>No of Cores - Single<br>Protection - Armored    |
| Make                                     | As per approved vendor list                                                  |

## 1.8 TEST STATION

| <b>TEST STATION</b>                          |                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type                                         | Normal Type / Big Type (to house DC Decoupler)                                                                                                                                                                                                                                                                                                                  |
| Dimension                                    | As per manufacturer's detailed drawings                                                                                                                                                                                                                                                                                                                         |
| Terminal Plate dimension                     | As per manufacturer's detailed drawings                                                                                                                                                                                                                                                                                                                         |
| Height of the Test station from ground level | 1200 mm (min.) Bakelite Sheet with 20% spares.                                                                                                                                                                                                                                                                                                                  |
| No. of Terminals                             | 12 Nos. (min.) M-8 (SS)                                                                                                                                                                                                                                                                                                                                         |
| Test station Material                        | Mild Steel (MS, 3 mm thick)                                                                                                                                                                                                                                                                                                                                     |
| Protection Level                             | IP 55 (Weather Proof), IP - 55 Certificate shall be enclosed with MTC                                                                                                                                                                                                                                                                                           |
| Cable Entry                                  | Bottom entry through pipe bend                                                                                                                                                                                                                                                                                                                                  |
| Support Pipe                                 | M.S. Pipe of 100 mm Dia (4"), SCH -40, 90° Elbow, R=5D                                                                                                                                                                                                                                                                                                          |
| Length of Support Pipe                       | 1000 mm.                                                                                                                                                                                                                                                                                                                                                        |
| Base Plate                                   | As per manufacturer's detailed drawings                                                                                                                                                                                                                                                                                                                         |
| Thickness of pipe                            | 4.5 mm.                                                                                                                                                                                                                                                                                                                                                         |
| Shutter of the test station                  | Hinged type with concealed lock (With castle lock key) + Two Nos. of Allen Key lock                                                                                                                                                                                                                                                                             |
| Test station for Sacrificial anode           | Shall have a shunt (0.10Ohm, 0.5 A, 50 mV) & provision for variable resistance insertion (Rating: 0-0.1 Ohm) at Mg anode locations                                                                                                                                                                                                                              |
| Name plate                                   | As per design document (Anodized aluminum name plate, White letter with black back ground) (0.9 thick x 120 x 160mm)                                                                                                                                                                                                                                            |
| Painting                                     | The sheet steel used for fabrication of test lead point shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surfaces shall be prepared by applying a coat of phosphate paint and a coat of blue/grey zinc chromate primer. The |



| <b>TEST STATION</b>            |                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                | under surfaces shall be free from all imperfections before undertaking the finished coat. After preparation of the under surface, spray painting with two coats of final paint shall be done. The finished panel is dried in oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc. |
| Cable Entry Sealing            | With Foam / Solid Sealing                                                                                                                                                                                                                                                                                                                                 |
| Gas Kit                        | 6 mm – Neoprene                                                                                                                                                                                                                                                                                                                                           |
| PCC Details                    | 1:5:10                                                                                                                                                                                                                                                                                                                                                    |
| RCC Details                    | M20                                                                                                                                                                                                                                                                                                                                                       |
| PCC over foundation base Plate | 150 mm PCC over foundation                                                                                                                                                                                                                                                                                                                                |
| Stencil block letter marking   | 40 mm marking on Test station by black color, showing arrow of direction of flow, Test Station No., Chainage, "Test station connection scheme type with name of the pipeline", Distance from pipeline in meters                                                                                                                                           |
| Make                           | As per approved vendor list                                                                                                                                                                                                                                                                                                                               |

Note: - Variable Power Resistor shall be provided in circuit to limit PSP to -1.5 V (ON).

### 1.9 PIN BRAZING KIT

| <b>PIN BRAZING KIT</b>    |                                   |
|---------------------------|-----------------------------------|
| Pin Brazing Pin + Ferrule | Safe track Make or Equivalent     |
| Insulating Resin Material | Epoxy Dobo fill 60 + Hardener 758 |
| Enclosure                 | Funnel                            |

### 1.10 THERMIT WELD CONNECTION KIT

| <b>THERMIT WELD CONNECTION KIT</b> |                                                               |
|------------------------------------|---------------------------------------------------------------|
| Thermit Cartridge                  | M/s Erico Europa Make or Equivalent                           |
|                                    | CA-15: For 6 to 16 Sq. mm.<br>CA-25: For 25 sq. mm. and above |
| Insulating Resin Material          | Epoxy Dobo fill 60 + Hardener 758                             |
| Enclosure                          | Funnel                                                        |



Energising Quality

## VCS Quality Services Pvt Ltd

### STANDARD SPECIFICATION FOR CORROSION SURVEY

**VCS – SS – EL - 4017**

|         |            |             |            |             |               |
|---------|------------|-------------|------------|-------------|---------------|
| 02      | 05.03.2022 | SP          | RD         | AA          | HK            |
| 01      | 16.10.2019 | MG          | VV         | AD          | SK            |
| 00      | 05.07.2017 | MG          | RD         | AD          | SK            |
| Rev. No | Date       | Prepared By | Checked By | Approved By | Authorized By |

|                   |   |                       |
|-------------------|---|-----------------------|
| UNCONTROLLED COPY | : | If printed            |
| CONTROLLED COPY   | : | If in soft and signed |

| <b>REVISION RECORD</b> |               |             |            |             |               |                             |
|------------------------|---------------|-------------|------------|-------------|---------------|-----------------------------|
| Rev.                   | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description        |
| 00                     | 05.07.2017    | MG          | RD         | AD          | SK            | Issued for use as Standard  |
| 01                     | 16.10.2019    | MG          | VV         | AD          | SK            | New revision system updated |
| 02                     | 05.03.2022    | SP          | RD         | AA          | HK            | New revision system updated |
|                        |               |             |            |             |               |                             |

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### **ABBREVIATION**

|     |                    |
|-----|--------------------|
| ROU | Right of Use       |
| EHC | Extra High Voltage |
| HV  | High Voltage       |



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## **1.0 SCOPE**

- 1.1** The Specification covers the requirements for corrosion survey including measurement of soil resistivity, chemical analysis of soil/water and collection of other cathodic protection related data along ROU of the pipelines.

## **2.0 REFERENCE DOCUMENTS**

- 2.1** Equipment and measurement techniques shall unless otherwise specified, conform to the requirement of latest revisions of following applicable Standards:
- BIS Specifications
  - BS Specifications and codes of practice
  - NACE publications
- 2.2** The work shall be carried out in compliance with all applicable local laws and regulations.
- 2.3** In case of any contradiction between various referred Standards/Specifications/Data Sheet and statutory regulations the following order of priority shall govern:
- Statutory regulations
  - Data Sheets
  - Job Specification
  - This Specification
  - Codes and Standards.

## **3.0 DEFINITION**

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

|                            |                                                                                                                                                                            |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OWNER / COMPANY            | OWNER of the particular Project (Project Specific).                                                                                                                        |
| CONSULTANT                 | The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management. |
| BIDDER / SUPPLIER / VENDOR | The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.          |

## **4.0 GENERAL**

- 4.1** This Specification defines the basic guidelines for carrying out the corrosion survey. Contractor shall be responsible for providing necessary data interpretation based on corrosion survey measurements, which is intended to form a basis for design of cathodic protection system for the pipeline.

## **5.0 SOIL RESISTIVITY SURVEY**

- 5.1** Unless otherwise specified the soil resistivity measurements shall be carried out at intervals of approximately 500 m along the ROU. Where soil resistivity is less than 100 ohm.m and two successive readings differ by more than 2:1 then additional soil resistivity readings in between the two locations shall be taken.
- 5.2** To carry out the soil resistivity measurement Wenner's 4 pin method or approved equal shall be used. The depth of resistivity measurement at each location shall be at around 1 m and at the burial depth of the pipeline accounting for the cuttings /fillings or 2 m approximately whichever is higher. At locations where multi-layer soil with large variation in resistivity/ corrosiveness is expected and /or locations specifically advised by Owner or his representative resistivity measurements at additional depth of up to 3 m (approx.) or more shall be taken. In general the resistivity of soil, which shall be surrounding the pipe, shall be measured. Hence the depth of measurement / electrode spacing may vary depending on topography and strata at the area.
- 5.3** At places where ROU has not yet been cleared, measurements shall be made right over the center line of pipeline route surveyed accounting for the cuttings /fillings also.
- 5.4** Observations shall be made enclosing the soils adjoining the trench wherever pipeline trenching has already been done.
- 5.5** The observations shall be made enclosing the soil immediately surrounding the pipeline route where ROU has been cleared but trenching has not been done.
- 5.6** All measurements shall be taken at right angles to the ROU unless otherwise asked by Owner or his representative at site.
- 5.7** At places in ROU where other pipelines are already existing care shall be taken to precisely locate such pipes line and take such precautions that observations are not adversely affected by presence of such pipelines.
- 5.8** Care shall also be taken that the observations are not influenced by presence of other earth currents in the area especially in the vicinity of EHV/HV lines and plants using earth return in their source of power etc.
- 5.9** Wherever possible / advised by Owner or his representative, depth of water table shall be determined by resistivity observations.
- 5.10** All measurements shall be made and recorded in metric units. While recording the data reference to the nearest intersecting point shall be made. To provide visual representation of variations in the resistivity along ROU, values shall be plotted on semi log graph sheets. The resistivity graph shall also indicate the resistivity at additional depths measured at various locations and depth of water table.

## **6.0 TESTS ON SOIL SAMPLES**

- 6.1** Soil/water samples shall be collected along the ROU for analysis. Samples shall be collected on an average at one location for every 10 km along ROU with minimum at two locations. Exact locations shall be decided at site depending on the type of soil, soil

resistivity and in consultation with Owner or his representative. At each location the soil samples shall be collected at 1 m, 2 m depth and at expected depth of pipeline if it is more than 2 in at the location.

- 6.2** The collected soil/water shall be analyzed to determine presence and percentage of corrosive compounds including carbonates, bicarbonates, nitrates, chlorides, oxygen activity, moisture content and pH value.

## **7.0 ADDITIONAL DATA COLLECTION**

- 7.1** The following data shall be collected with a view to generate design data for evaluation of cathodic protection interaction possibilities due to presence of other services in ROU and its vicinity:

- 7.2** Following information regarding foreign service/pipeline in or around the ROU (for existing and those, which are likely to come up during contract execution).

7.2.1 Types of service / pipelines and year of laying.

7.2.2 Diameter and pipeline coating in case of pipeline.

7.2.3 Parallel running / crossing.

7.2.4 Year of laying / commissioning.

7.2.5 Depth of laying.

7.2.6 Type of existing cathodic protection systems (impressed-current / sacrificial).

7.2.7 Location and type (Deep well / surface) of anode ground bed.

7.2.8 Rating of impressed current type of anode ground bed.

7.2.9 Location of existing CP power supply units and their output voltage, current, pipe to soil potential readings.

7.2.10 Location of existing test stations.

7.2.11 Remedial measures existing on foreign service/pipeline to prevent interactions.

7.2.12 Graphical representation of existing structure / pipe to soil potential records.

7.2.13 Possibility of integration/isolation of CP system of the foreign service/pipeline with that of the proposed pipeline, which may involve negotiations with owners of foreign services.

7.2.14 Where, pipeline is likely to "pass close to any existing ground bed (within 100 m approx.), anode-bed potential gradient survey shall be carried out, to verify possible interference with the CP system of the pipeline covered under this project.,

- 7.3** Voltage rating, phases and sheathing details of cables running parallel or crossing the ROU.

- 
- 7.4** Existing .and proposed DC/AC power sources and systems using earth return path such as HVDC substations/ earthing stations fabrication yards with electric welding etc. in the vicinity of the entire pipeline route
  - 7.5** Crossing and parallel running of electrified and non-electrified traction (along with information regarding, operating voltage, AC/DC type etc.) as well as abandoned tracks near ROU having electrical continuity with the tracks in use.
  - 7.6** Crossing or parallel running of any existing or proposed EHV/HV AC/DC overhead power lines along with details of voltage, AC/DC type etc.
  - 7.7** Voltage rating, phases, sheathing details of underground power cables, along ROU or in its vicinity.
  - 7.8** Any-other relevant information that may be needed in designing and implementing of proper cathodic protection scheme for the proposed pipeline.

## **8.0 REPORT**

- 8.1** On completion of all the field and laboratory work an interim report incorporating results generated from surveys, additional data collected, results of test carried out, etc., shall be submitted for comments / approval. The report shall also highlight any adverse impact on performance of sacrificial anodes due to the percentage of corrosive compounds including carbonates, bicarbonates, nitrates, chlorides present in the soil and pH value of the soil noticed during the survey. The final report incorporating comments/missing data shall be furnished for records. The report along with various drawings, graphs etc. prepared in connection with the work shall be submitted along with six prints by the Contractor.



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VCS QUALITY SERVICES  
PRIVATE LIMITED

TEST STATION WITH FOUNDATION  
DETAILS

STANDARD DRAWING NO.

REV.

SIZE

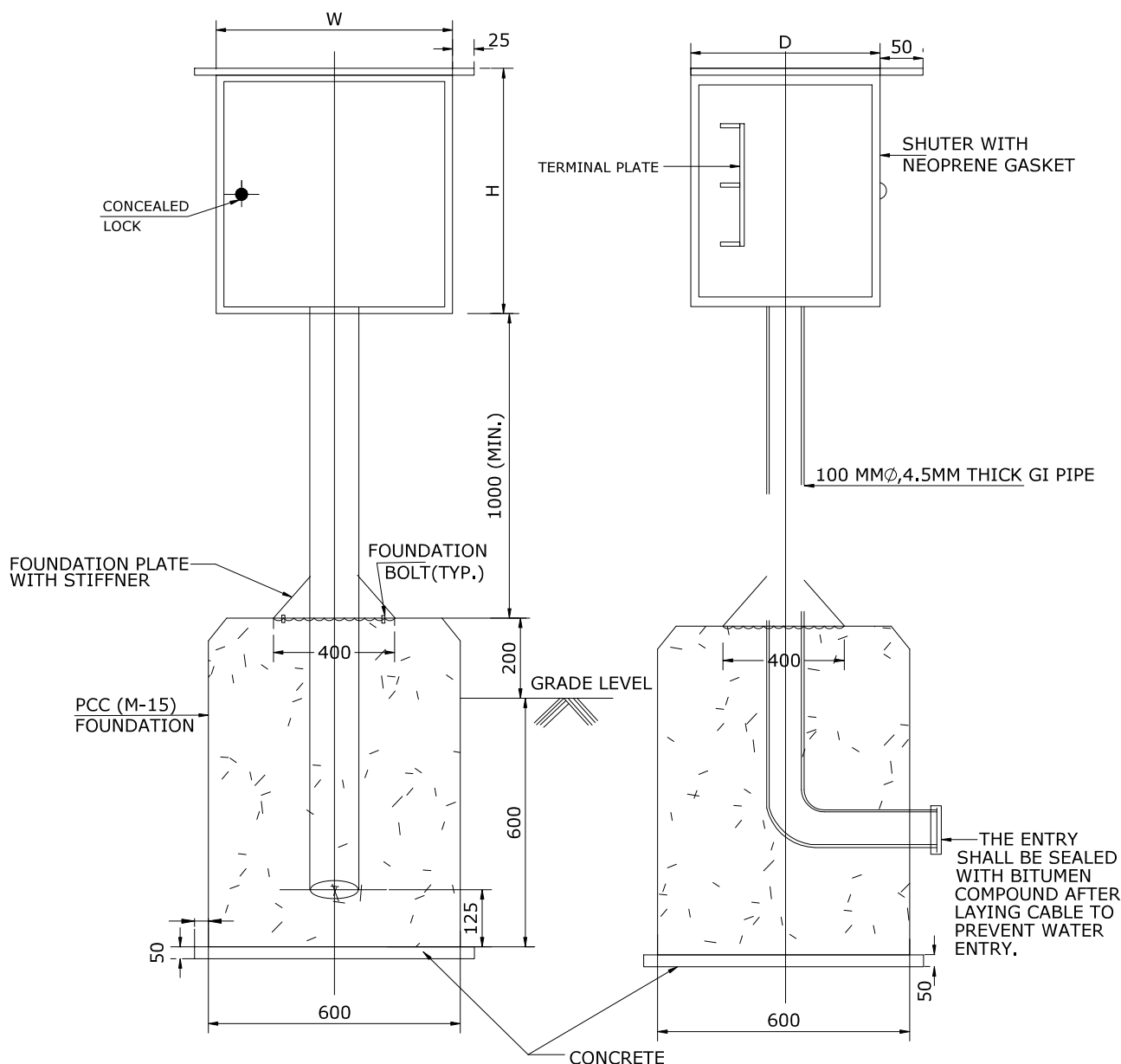
VCS-STD-EL-4501

02

A4

SHEET NO.

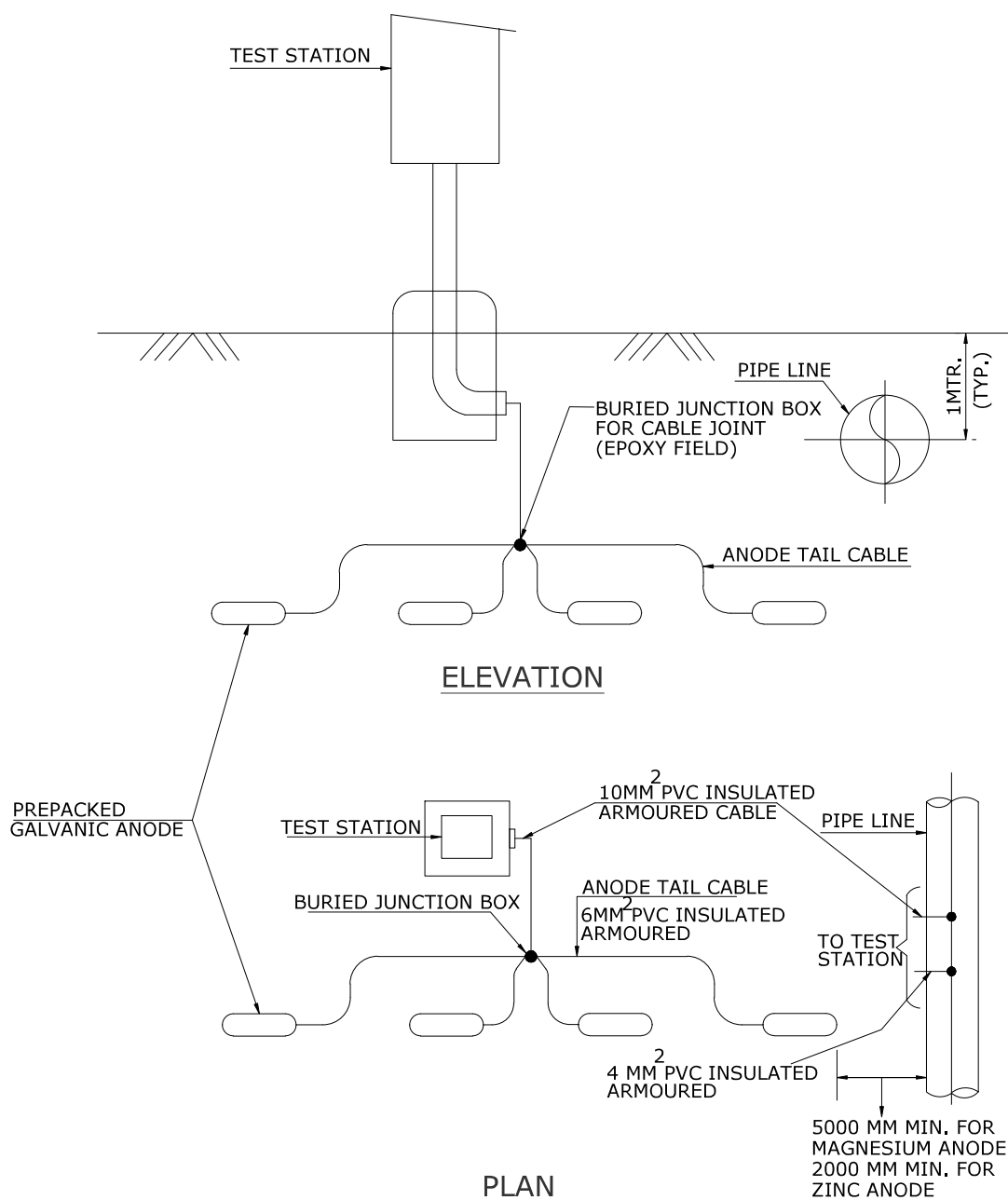
1 OF 1



## NOTES:

1. THE SHUTTER SHALL BE HINGED TYPE WITH CONCEALED LOCK & SHALL HAVE DOOR GASKET TO MAKE THE TEST STATION WEATHER PROOF (IP:55).
2. THE INNER & OUTER SURFACE OF THE TEST STATION SHALL BE EPOXY PAINTED.
3. THE NAME PLATE SHALL BE OF ANODISED ALUMINIUM WITH BLACK BACKGROUND & WHITE LETTERS & SHALL BE FIXED TO THE INNER SIDE OF SHUTTER.
4. TEST STATION SHALL BE ERECTED WITH THEIR SHUTTERS PARALLEL TO THE LINE OF AXIS & FACING THE PIPELINE.
5. THE CHAINAGE OF TEST STATION SHALL BE WRITTEN WITH BLACK PAINT ON THE OUTER SIDE OF THE FRONT SHUTTER.
6. HEIGHT OF THE TEST STATION SHOWN ABOVE GROUND LEVEL IS MINIMUM ONLY. THE ACTUAL HEIGHT SHALL BE DECIDED BASED ON LOCAL FLOOD LEVELS TO BE ASCERTAINED .
7. CONTACTORS SHALL FURNISH ALL THE DIMENSIONS OF THE TEST STATION.
8. ALL DIMENSIONS ARE IN MM.

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| 02      | 05.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
| 01      | 18.12.19 | RE-ISSUED AS STANDARD DRAWING | SY          | VV         | AD          | SK            |
| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
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## GALVANIC ANODE INSTALLATION

NOTES:

1. THE PREPACKED GALVANIC ANODE SHALL BE INSTALLED AT A MINIMUM DEPTH, EQUAL TO BOTTOM LEVEL OF THE PIPELINE.
2. THE ANODES ARE SHOWN HORIZONTALLY LAID. ALTERNATIVELY THE ANODES MAY BE VERTICALLY INSTALLED WITH
3. NUMBER OF TERMINALS FOR TEST STATION FOR GALVANIC ANODES FOR PERMANENT CP SYSTEM SHALL BE DECIDED BASED ON NUMBER OF ANODES.

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SHALLOW ANODE GROUND BED (PCP)

STANDARD DRAWING NO.

VCS-STD-EL-4503

SHEET NO.

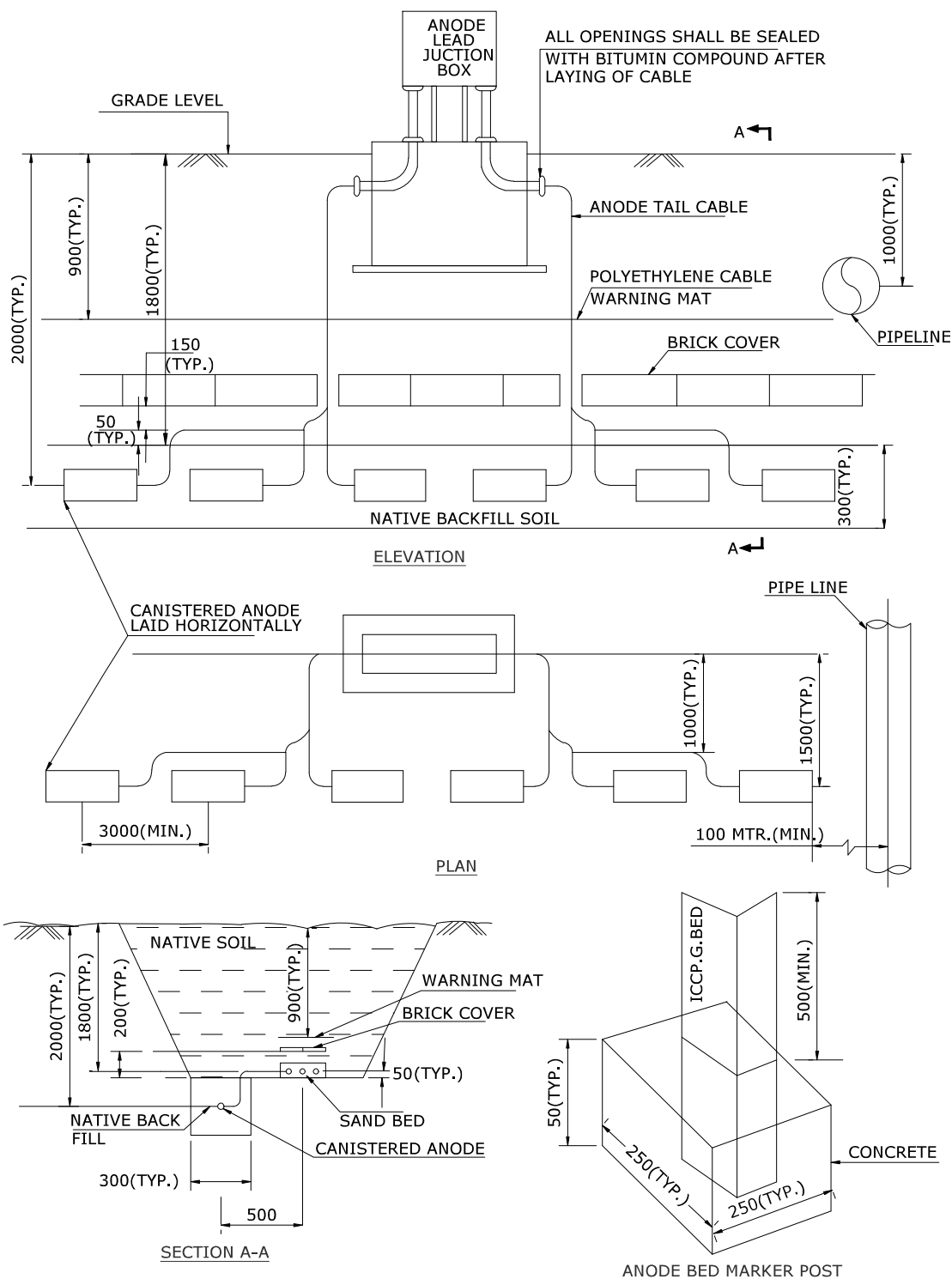
1 OF 1

REV.

02

SIZE

A4



#### NOTES:

1. THE ANODE GROUND BED SHALL BE LOCATED ELECTRICALLY REMOTE FROM THE PIPELINE WITH MINIMUM 100 MTR. AWAY FROM THE NEAREST POINT ON THE PIPELINE.
2. NO. SPLICING SHALL BE ALLOWED FOR THE CABLES.
3. CONTACTOR SHALL FURNISH THE DIMENSIONED DRAWING SHOWING ACTUAL QUANTITY OF ANODES FOR EACH GROUND BED.
4. ALL UNARMoured CABLES SHALL BE RUN THROUGH PE SLEEVES.
5. ANODE BED MARKER SHALL BE RUN THROUGH PE SLEEVES.
6. NATIVE BACKFILL SOIL SHALL BE FREE OF ROCKS, GARBAGE, PAPERS, PLASTICS ETC.
7. ANODES MAY BE LAID VERTICALLY IN CASE OF VERTICALLY SHALLOW ANODE GROUND BED DESIGN.
8. ALL THE DIMENSIONS ARE IN MM.

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Singh  
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THERMITE WELD CONNECTION DETAILS

STANDARD DRAWING NO.

REV.

SIZE

VCS-STD-EL-4504

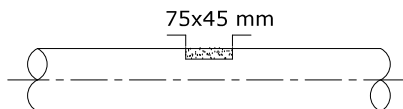
02

A4

SHEET NO.

1 OF 1

REMOVABLE PIPE COATING, FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH



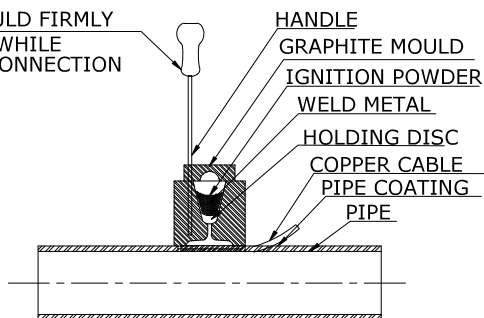
STEP-1

STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD



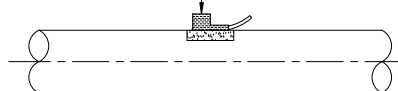
STEP-2

HOLD MOULD FIRMLY IN PLACE WHILE MAKING CONNECTION



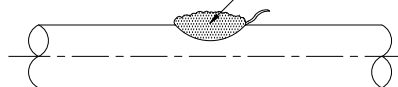
STEP-3

REMOVE SLAG WITH HAMMER/ WIRE BRUSH



STEP-4

EPOXY ENCAPSULATION  
INTERGARD 821(OR EQUIVALENT)



STEP-5

## NOTES: GENERAL THERMITE WELDING PROCEDURE

1. REMOVABLE PIPE COATING FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH.
2. STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD.
3. INSERT THE CONDUCTOR INTO MOULD.
4. INSERT STEEL DISC IN BOTTOM OF MOULD CAVITY INSIDE MOULD \_ DUMP THE METAL INTO MOULD BEING CAREFUL NOT TO UPSET THE STEEL DISC. TAP THE BOTTOM OF THE TUBE TO LOOSEN ALL THE IGNITION POWDER AND SPREAD IT EVENLY OVER THE WELD METAL. PLACE A SMALL MOUNT OF STARTING POWDER ON THE TOP EDGE OF THE MOULD UNDER COVER OPENING FOR EASY IGNITION.
5. CLOSE COVER AND IGNITE WITH THE FLINT GUN MOVE GUN AWAY QUICKLY TO PREVENT FOULING . IF FLINT GUN SHOULD BECOME FOULED , SOAK IT IN HOUSEHOLD AMMONIA.
6. AFTER IGNITION, HOLD THE MOULD IN PLACE FOR 5 SECONDS TO ALLOW THE WELD TO SOLIDIFY, AFTER THE WELD HAS COOLED, REMOVE THE SLAG WITH A CHIPPING HAMMER OR WIRE BRUSH.
7. ENCAPSULATE THE CONNECTION AND ENTIRE PREPARED SURFACE WITH TWO PART EPOXY COMPOUND.
8. REMOVE ALL SLAG'S FROM THE WELDER BEFORE MAKING THE NEXT WELD CLEAN THE COVER EVERY 6 TO 10 WELDS.
9. WET OR DAMP MOULDS WILL PRODUCE POROUS WELDS. MOULDS MUST BE DRIED OUT BEFORE ATTEMPTING TO WELD.
10. CONNECTIONS ARE TO BE PLACED A MINIMUM OF 100mm APART, UNSUCCESSFUL WELDS ARE ABANDONED AND MOVED TO ANOTHER PREPARED SURFACE NOT LESS THAN 100mm AWAY.

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VCS QUALITY SERVICES  
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TYPICAL CONSTRUCTION DETAILS  
OF HIGH SILICON CAST  
IRON ANODE

STANDARD DRAWING NO.

VCS-STD-EL-4505

SHEET NO.

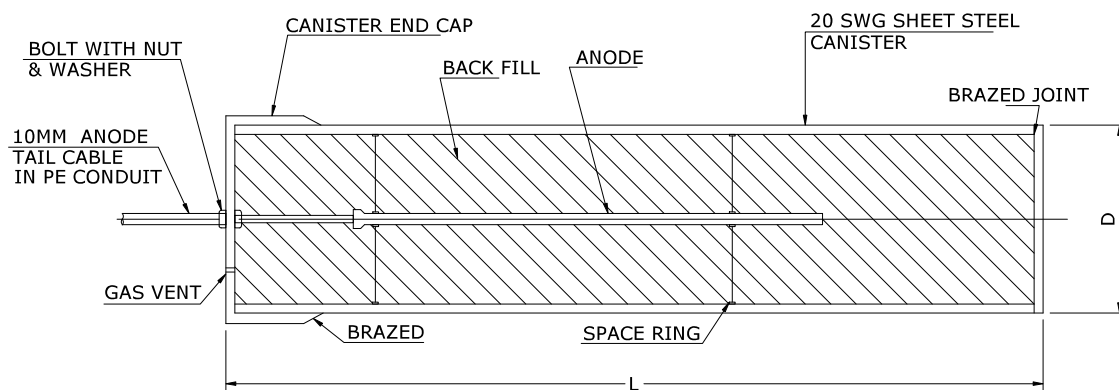
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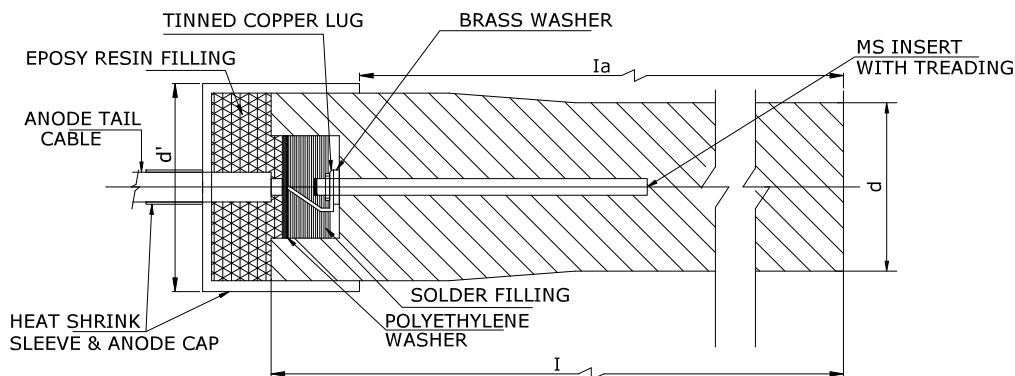
02

SIZE

A4



PREPACKED CANISTERED ANODE



ANODE DETAILS

CHEMICAL COMPOSITION OF ANODE (% WEIGHT):-

CARBON -----: 0.7%-1.1%  
MANGANESE -----: 1.5% max.  
SILICON -----: 14.2%-14.75%  
CHROMIUM -----: 3.25%-5%  
MOLYBDENUM -----: 0.2%max.  
COPPER -----: 0.5% max  
IRON -----: REMAINDER

NOTES:

1. ANODE FOR SURFACE AND DEEP GROUND BED APPLICATION SHALL BE IDENTICAL EXCEPT FOR BACK FILL PREPACKING.
2. SHEET STEEL ANODE CANISTERS SHALL BE FILLED WITH METALLURGICAL GRADE COKE BREEZE.
3. FLUID PETROLEUM COKE BREEZE BACKFILL SHALL BE PROVIDED IN THE WELL, SURROUNDING ANODES IN DEEP WELL GROUND BEDS.
4. ANODE TAIL CABLE SHALL BE 10 Sq.mm HIGH CONDUCTIVITY, STRANDED COPPER CONDUCTOR, 650V GRADE, PE INSULATED, PVC SHEATHED & UNARMoured.
5. ALL THE DIMENSIONS, NET WEIGHT & GROSS WEIGHT OF THE ANODE SHALL BE FURNISHED BY CONTACTOR.
6. THE ACTIVE LENGTH 'Ia' OF ANODE SHALL BE CONSIDERED FOR CALCULATING THE SIZE / WEIGHT.

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ZINC RIBBON ANODE FOR CASED  
CROSSINGS WITH COATED/PAINTED  
CASING

STANDARD DRAWING NO.

VCS-STD-EL-4506

SHEET NO.

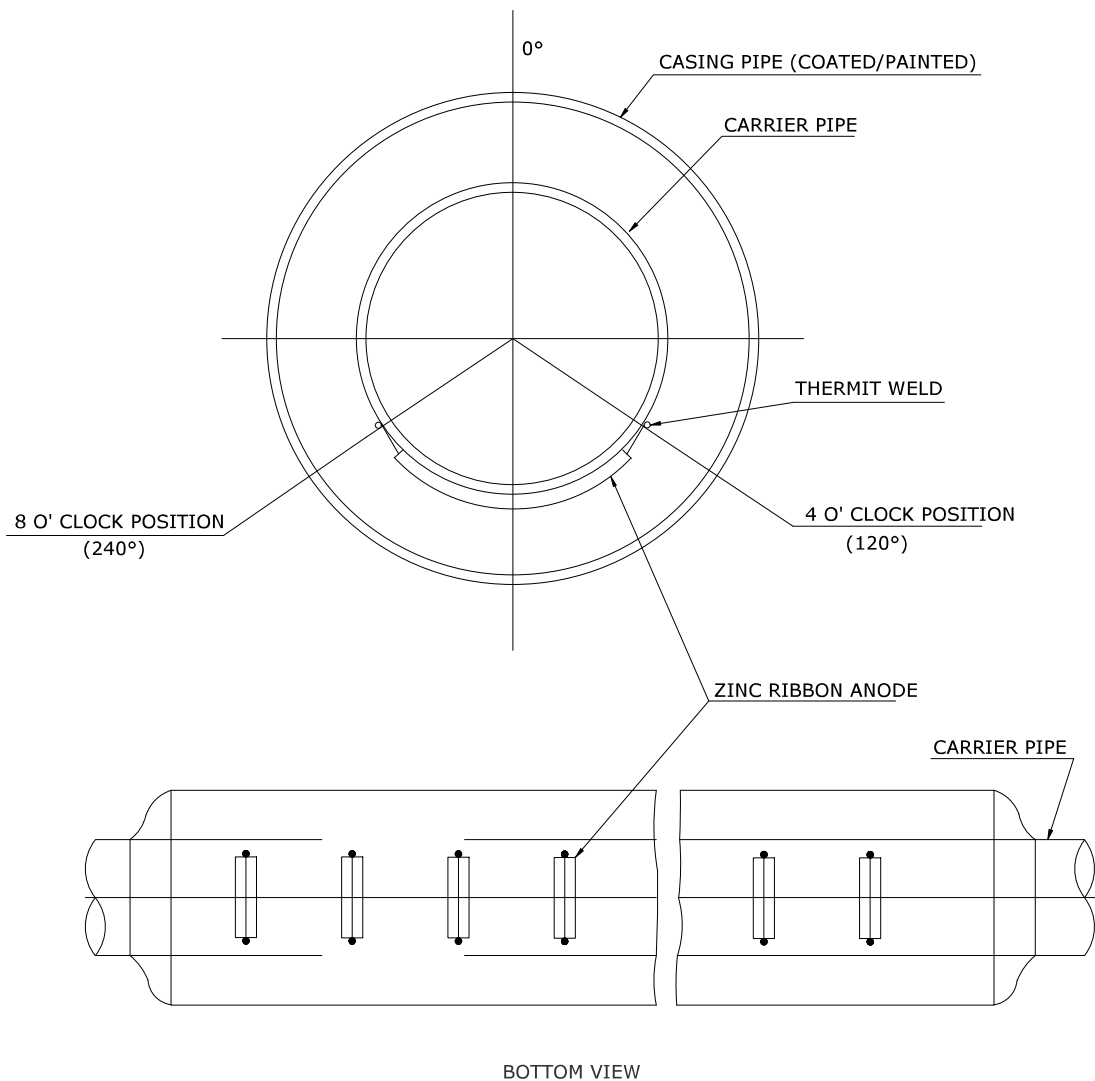
1 OF 1

REV.

02

SIZE

A4



BOTTOM VIEW

CHEMICAL COMPOSITION OF ANODE (% WEIGHT):-

A1 ----- : 0.005% max.  
Cd ----- : 0.003% max.  
Cu ----- : 0.002% max.  
Fe ----- : 0.0014% max.  
Pb ----- : 0.003% max.  
Zn ----- : REMAINDER

NOTES:

1. STEEL CORE TO BE THERMIT WELDED DIRECTLY TO CARRIER PIPE WITHIN CASINGS AT 4 & 8 'O' CLOCK POSITIONS FOR CARRIER PIPE OF LESS THAN 4 INCH DIA. ANODES MAY BE PROVIDED ALONG THE LENGTH OF THE CARRIER PIPE LINE AT THE BOTTOM LEVEL.
2. SIZE OF ANODE & SPACING BETWEEN ANODES SHALL BE DECIDED BASED ON DESIGN CRITERIA. HOWEVER MINIMUM ONE NUMBER ANODE SHALL BE PROVIDED BETWEEN TWO PIPE SPACERS/CENTRALISERS PROVIDED BETWEEN CARRIER AND CASING PIPES.
3. PIPE SPACERS/CENTRALISERS ARE NOT SHOWN.
4. ANODE COMPOSITION, DIMENSION, NET & GROSS WEIGHT PER UNIT LENGTH SHALL BE FURNISHED BY THE CONTACTOR.
5. CASING PIPE WHERE COATED AGAINST CORROSION OF EXTERNAL SURFACE SHALL BE PROTECTED BY GALVANIC ANODES INSTALLED AT BOTH THE ENDS OF THE CASING PIPE.

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PRIVATE LIMITED

PIPELINE GROUNDING THROUGH  
POLARIZATION CELL AND  
GALVANIC ANODE

STANDARD DRAWING NO.

VCS-STD-EL-4507

SHEET NO.

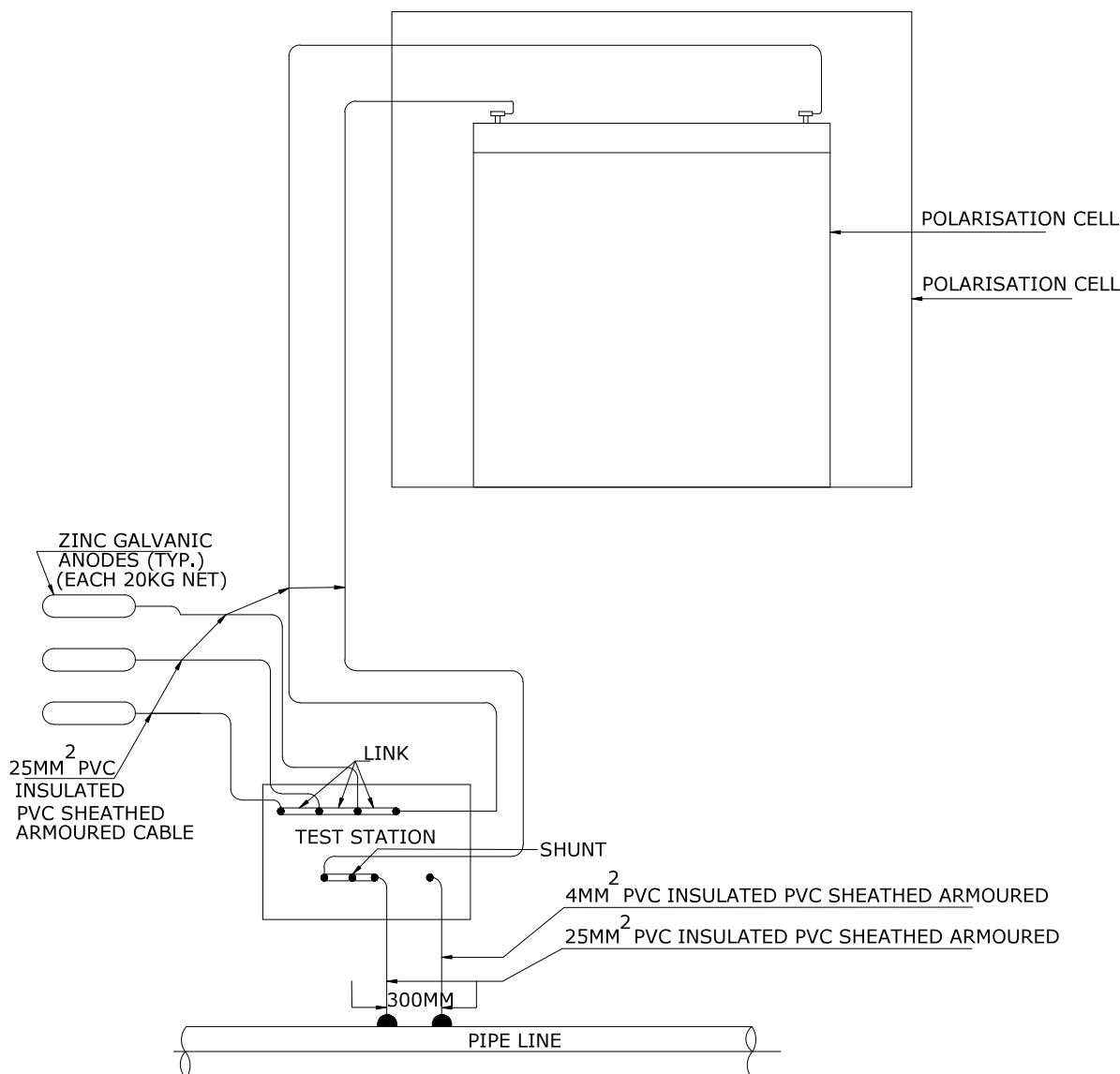
1 OF 1

REV.

02

SIZE

A4



## NOTES:

1. THE POLARISATION CELL, ANODES AND ASSOCIATED CABLES, CABLE JOINT ETC. SHALL BE MINIMUM BE RATED FOR THE EXPECTED FAULT CURRENT AT THE LOCATION OF THE INSTALLATION & SIZED FOR DESIGN LIFE OF PERMANENT C.P SYSTEM.
2. THE POLARISATION CELL SHALL BE HOUSED IN A VANDALLISM PROOF HOUSING.
3. CELL SHALL HAVE GOOD VENTILATION TO ATMOSPHERE & SHALL BE PROTECTED AGANIST DIRECT SUN LIGHT & RAIN / WATER.
4. ANODE TAIL CABLES OF EACH ANODE SHALL BE TERMINATED INDIVIDUALLY IN TESTSTATION.
5. CONTACTOR SHALL FURNISH DRAWING WITH ACTUAL DIMENSIONS & RATINGS.
6. EASY ACCESS TO POLARISATION CELL SHALL BE AS PER STANDARD 7-51-0601 (PREPACKED ZINC ANODE).

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PRIVATE LIMITED

ZINC GROUNDING CELL  
TWO PLATE TYPE

STANDARD DRAWING NO.

REV.

SIZE

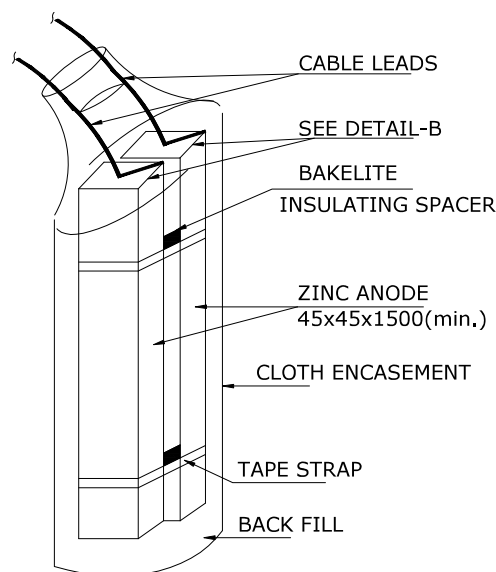
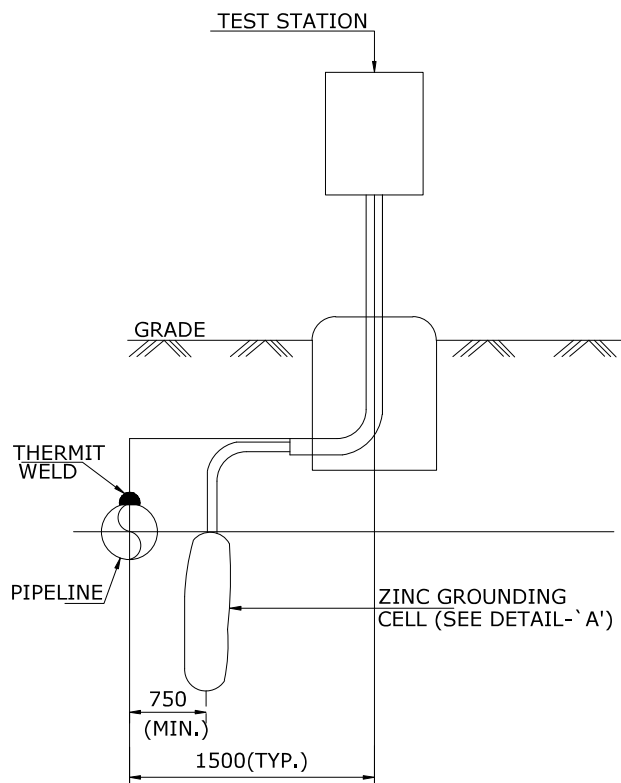
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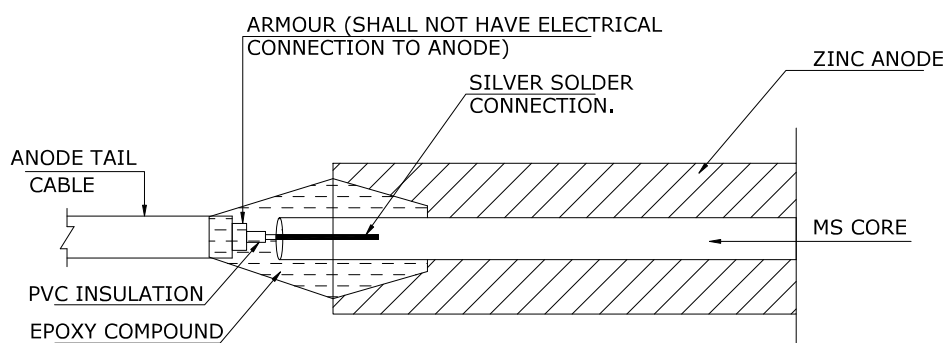
A4

SHEET NO.

1 OF 1



DETAIL-A



DETAIL-B

## NOTES:

1. CONTACTOR SHALL FURNISH ANODE COMPOSITION, NET WEIGHT, GROSS WEIGHT AND ALL THE DIMENSIONS OF THE GROUNDING CELL.
2. ZINC GROUNDING CELLS SHALL BE INSTALLED VERTICALLY SUCH THAT THE TOP OF THE CELL IS APPROXIMATELY AT THE SAME ELEVATION AS PIPE CENTRE LINE.
3. NET WEIGHT OF ZINC FOR EACH PLATE OF THE GROUNDING CELL SHALL BE MINIMUM 20KG.
4. ALL CABLE LEADS FOR ZINC GROUNDING CELL SHALL BE KEPT AS SHORT & DIRECT AS POSSIBLE.
5. GROUNDING CELL CABLE LEAD SHALL BE 25 Sqmm HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR 650V GRADE, PVC INSULTED, ARMOURED & PVC SHEATHED.
6. CABLE JOINT TO ANODE CORE SHALL BE SUITABLE TO DISCHARGE MINIMUM 10 KA FAULT CURRENT.
7. ALL DIMENSIONS ARE IN MM.

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PERMANENT COPPER-COPPER SULPHATE  
REFERENCE CELL AND  
INSTALLATION DETAILS

STANDARD DRAWING NO.

VCS-STD-EL-4509

SHEET NO.

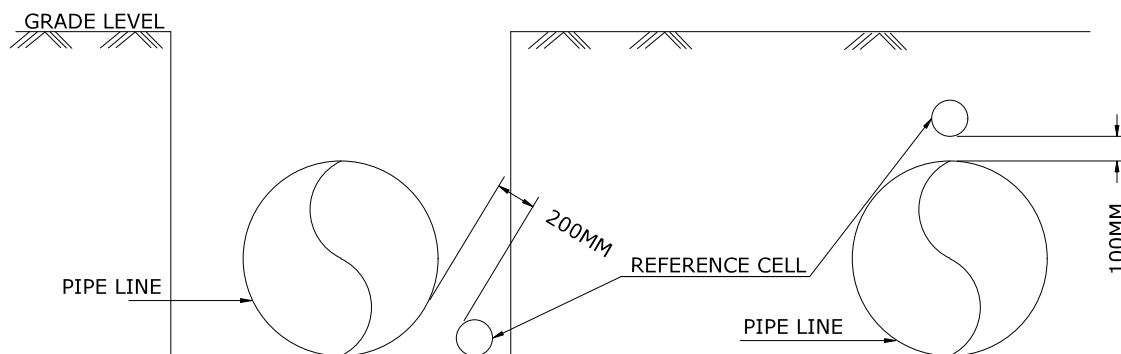
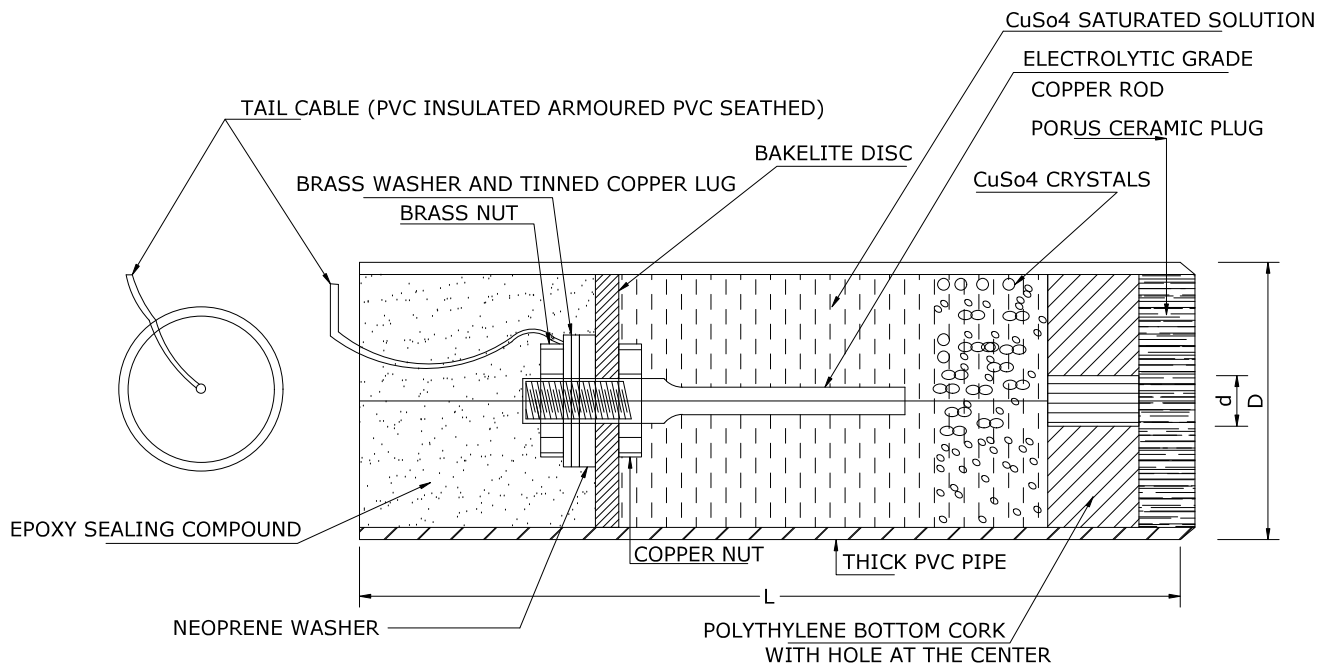
1 OF 1

REV.

02

SIZE

A4



REFERENCE CELL INSTALLATION

#### NOTES:

1. REFERENCE CELL SHALL BE BACK FILLED WITH CARBONACEOUS BACK FILL MATERIAL SPECIFIED.
2. FOR NEW PIPELINES REFERENCE ELECTRODE SHALL BE INSTALLED APPROXIMATELY AT THE BOTTOM LEVEL OF THE PIPE LINE, 200MM AWAY FROM SURFACE OF THE PIPELINE.
3. REFERENCE ELECTRODES MAY BE INSTALLED AT THE TOP OF THE PIPELINE, APPROXIMATELY 100MM ABOVE THE PIPELINE WHERE THE PIPELINE HAS ALREADY BEEN LAID.
4. REFERENCE CELL CABLE SHALL BE ROUTED ALONG THE BOTTOM LEVEL OF THE PIPELINE, AND 250MM APPROX. AWAY FROM THE SURFACE OF THE PIPE.
5. BACKFILLED REFERENCE ELECTRODES SHALL BE SOAKED IN 20 LTRS. OF CLEAN FRESH WATER FOR 24 HOURS IMMEDIATELY PRIOR TO INSTALLATION.
6. CONTACTOR SHALL FURNISH REFERENCE CELL DRAWING WITH ALL DIMENSIONS.

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PREPACKED MAGNESIUM ANODE

STANDARD DRAWING NO.

REV.

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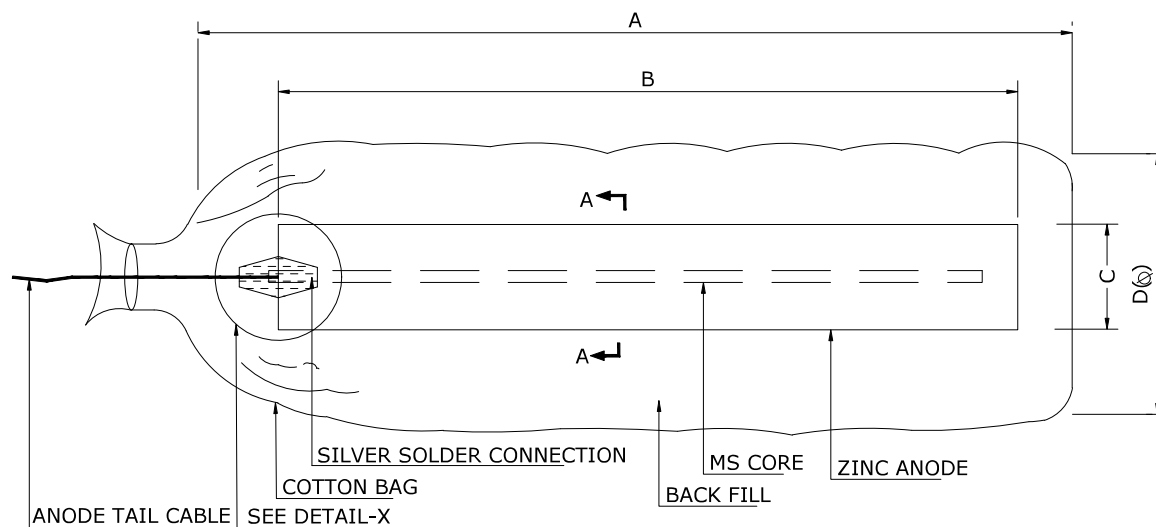
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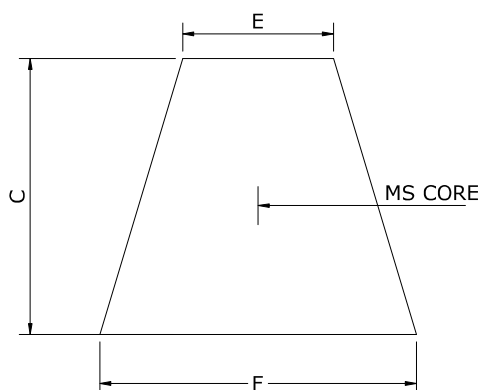
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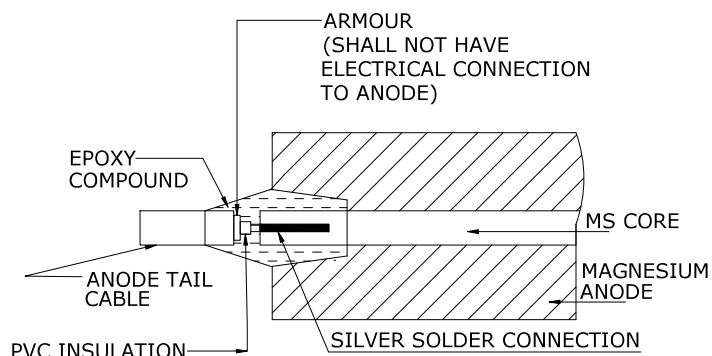
1 OF 1



ELEVATION



SECTION-AA



DETAIL-X

## NOTES:

1. ANODE COMPOSTION, NET WEIGHT, GROSS WEIGHT AND DIMENSIONS SHALL BE FURNISHED BY CONTACTOR.
2. ANODE TAIL CABLE SHALL BE HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR, 650V GRADE, PVC INSULATED, PVC SHEATHED & ARMOURED.

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Singh  
Date: 2026.04.01 11:29:21 IST

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PRIVATE LIMITED

PREPACKED ZINC ANODE

STANDARD DRAWING NO.

REV.

SIZE

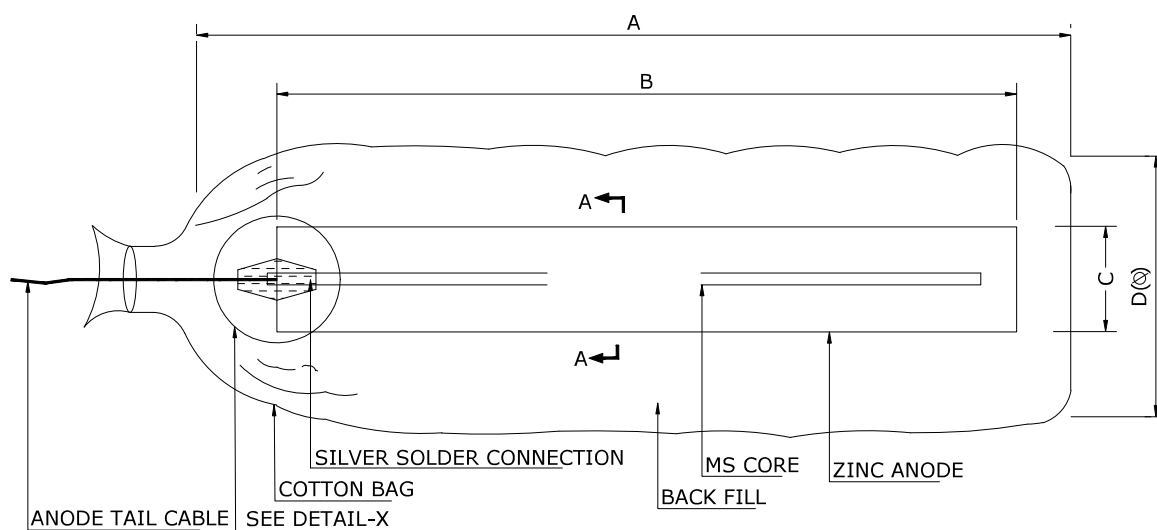
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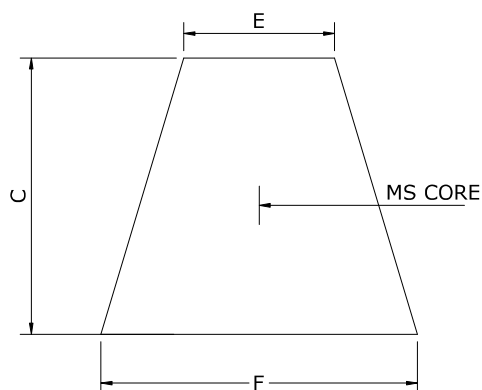
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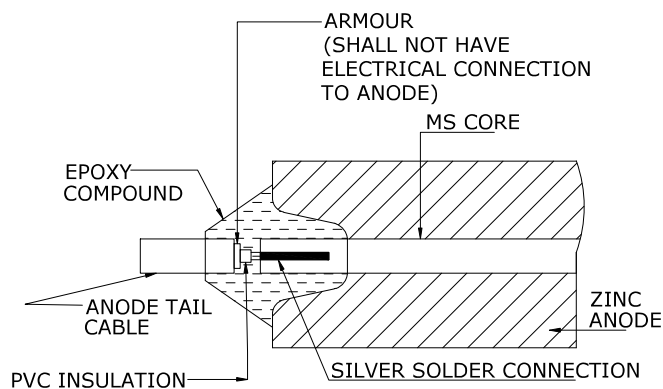
1 OF 1



ELEVATION



SECTION-AA



DETAIL-X

## NOTES:

1. ANODE COMPOSITION, NET WEIGHT, GROSS WEIGHT AND DIMENSIONS (A,B,C,D,E & F) SHALL BE FURNISHED BY CONTACTOR.
2. ANODE TAIL CABLE SHALL BE HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR, 650V GRADE, PVC INSULATED, PVC SHEATHED & ARMoured.
3. ANODE TYPE-I SHALL BE USED FOR SEA WATER, BRACKISH WATER OR SALINE ELECTROLYTE AND ANODE-II SHALL BE USED FOR WATER, BACK FILLS & SOIL APPLICATION.

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Singh  
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PRIVATE LIMITED

CATHODIC PROTECTION SYSTEM  
TEST POST INSTALLATION AT  
ROAD CROSSING (RX)

STANDARD DRAWING NO.

VCS-STD-EL-4512

SHEET NO.

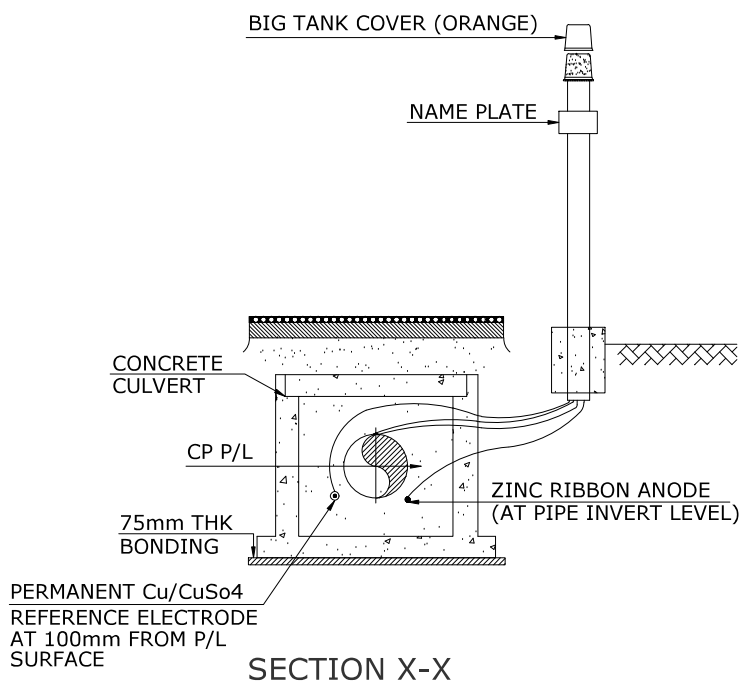
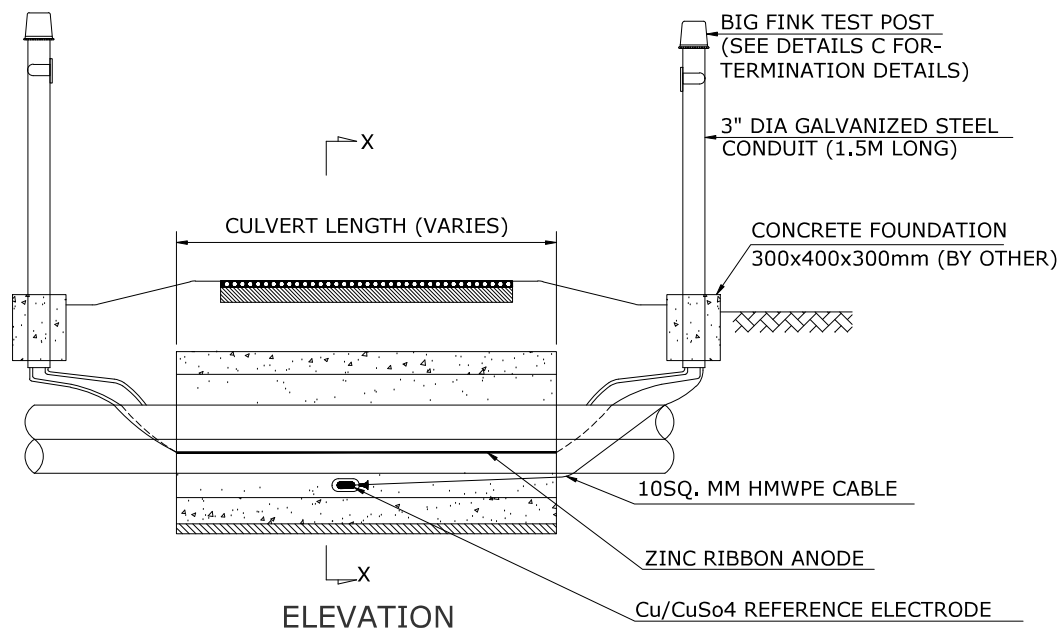
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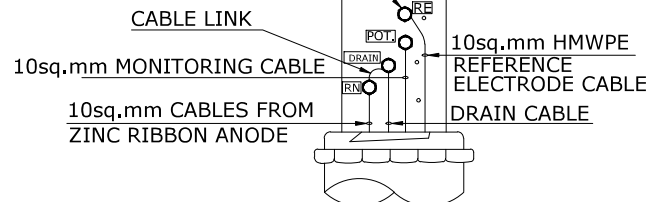
02

SIZE

A4



NICKEL PLATED BRASS NUT  
AND SCREW FOR TERMINAL  
LEAD CONNECTION



## TEST POST INSTALLATION DETAILS AT ROAD CROSSING WITH CONCRETE CULVERT

### NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. ANODE RIBBONS SHALL BE INSTALLED AT ROAD CROSSING WHERE THE PIPE IS CASED IN CONCRETE CULVERT.
3. EACH TEST POST SHALL BE HAVE ONE MONITORING AND ONE DRAIN CABLE CONNECTED TO THE PIPE PIPE STRUCTURE.

| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
| 01      | 19.12.19 | RE-ISSUED AS STANDARD DRAWING | SY          | VV         | AD          | SK            |
| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |



Energising Quality

VCS QUALITY SERVICES  
PRIVATE LIMITED

CATHODIC PROTECTION SYSTEM HIGH  
TENSION LINE  
CROSSING JUNCTION BOX  
(HTB) INSTALLATION DETAILS

STANDARD DRAWING NO.

VCS-STD-EL-4513

SHEET NO.

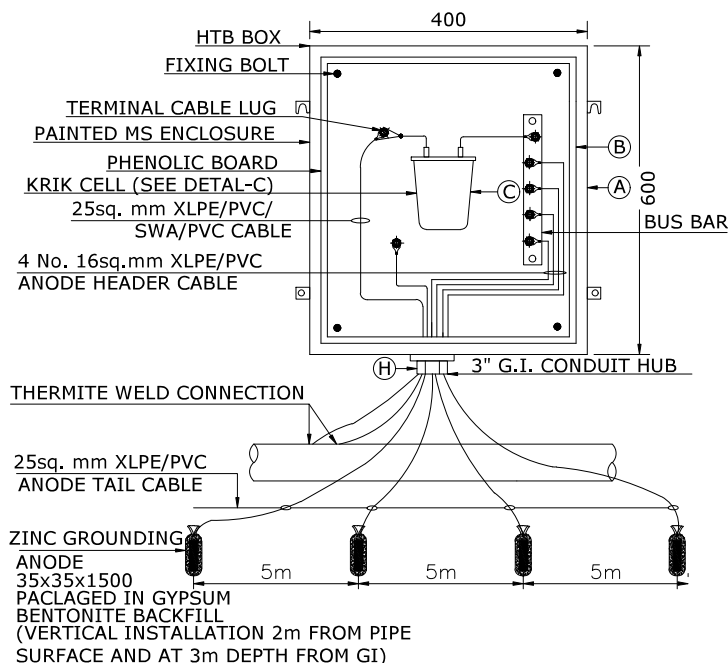
1 OF 1

REV.

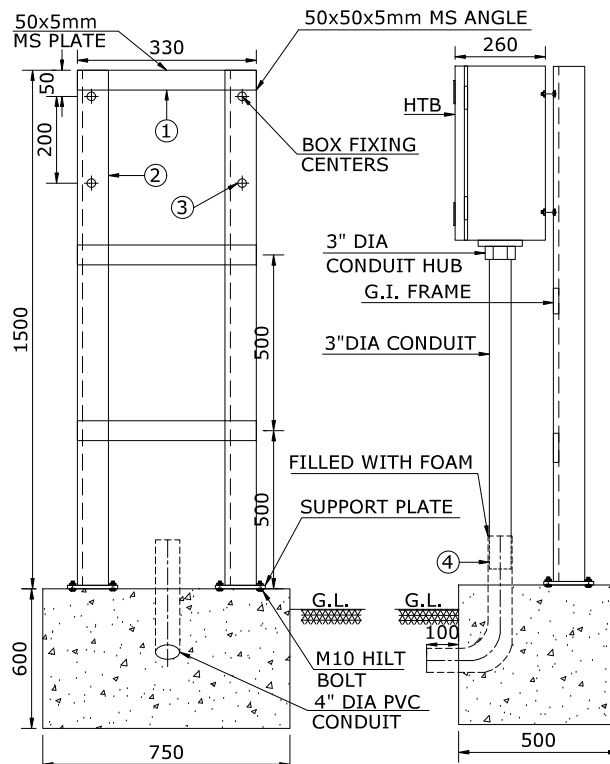
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SIZE

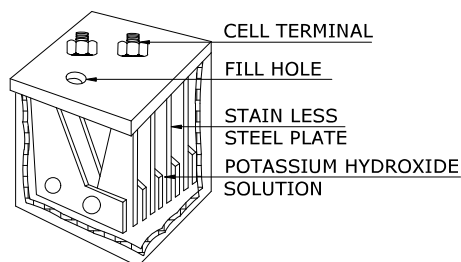
A4



ZINC GROUNDING CELL



HTB MOUNTING DETAILS (BY OTHERS)



DETAIL-C  
KRIK CELL (5ka RATING) DETAILS

### MATERIALS SCHEDULE

| ITEM NO. | DESCRIPTION                                                                        | QTY.    |
|----------|------------------------------------------------------------------------------------|---------|
| A.       | PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK. | 1 No.   |
| B.       | PHENOLIC BOARD-6mm THICK                                                           | 1 No.   |
| C.       | TINNED CUPPER BUS BAR 25x5mm PLATE                                                 | 1 No.   |
| D.       | SHUNT 10A, 100mV                                                                   | 2 No.   |
| E.       | VARIABLE RESISTOR 1.29 OHM 60 WATTS.                                               | 2 No.   |
| F.       | BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS                                      | AS REQ. |
| G.       | CRIMPED CABLE LUG                                                                  | AS REQ. |
| H.       | 2" DIA G.I. CONDUIT HUB                                                            | 1 No.   |

### MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

| ITEM NO. | DESCRIPTION                                                                                | UNIT | QTY. |
|----------|--------------------------------------------------------------------------------------------|------|------|
| 1.       | MS FLAT SIZE 50x5mm, LENGTH TO SUIT                                                        | NO   | 3    |
| 2.       | MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm                                            | NO   | 2    |
| 3.       | FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS | NO   | 4    |
| 4.       | CONDUIT LENGTH TO SUIT.                                                                    | NO   | 1    |
| 5.       | 2" DIA PVC CONDUIT LENGTH TO SUIT.                                                         | NO   | 1    |

### NOTES:

- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
- THE ZINC GROUNDING ANODE INSTALLATION CAN BE DONE ON ANY ONE SIDE OF THE OVERHEAD POWER LINE CROSSING TO SUIT THE DRILLING AUGERING MACHINE ACCESSIBILITY AT SITE.

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Singh  
Date: 2026.04.01 11:29:21 IST

|         |          |                               |             |            |             |               |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
| 01      | 19.12.19 | RE-ISSUED AS STANDARD DRAWING | SY          | VV         | AD          | SK            |
| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |



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TEST STATION CONNECTION  
SCHEMES

STANDARD DRAWING NO.

VCS-STD-EL-4514

SHEET NO.

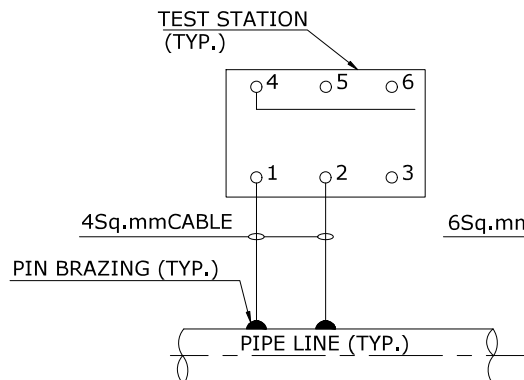
1 OF 3

REV.

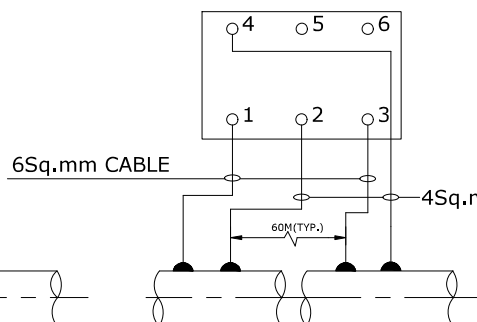
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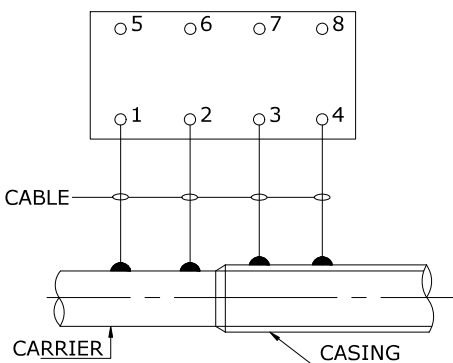
A4



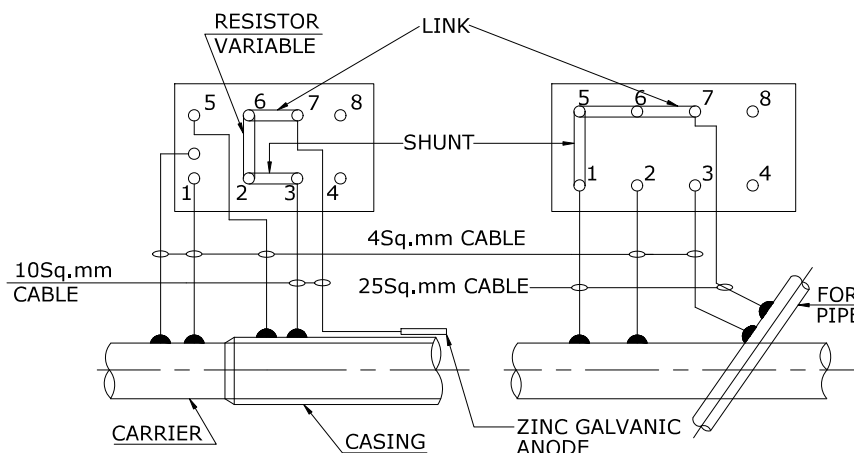
POTENTIAL MEASUREMENT  
CONNECTION SCHEME-A



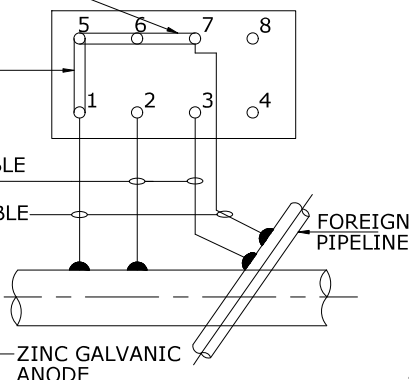
CURRENT MEASUREMENT  
CONNECTION SCHEME-B



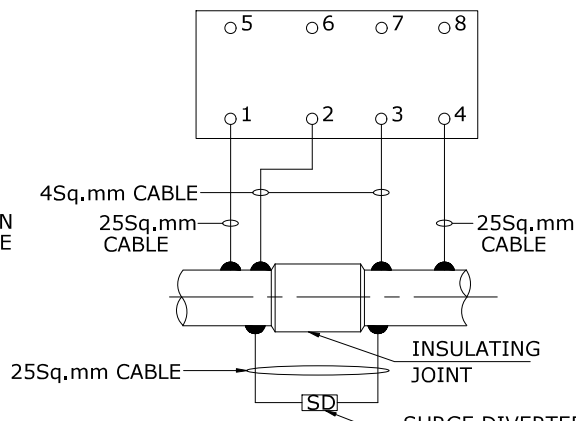
CASED CROSSING WITH  
UNCOATED/UNPAINTED CASIN  
CONNECTION SCHEME-C



CASED CROSSING WITH  
COATED/PAINTED CASING  
(CONNECTION SCHEME-D)



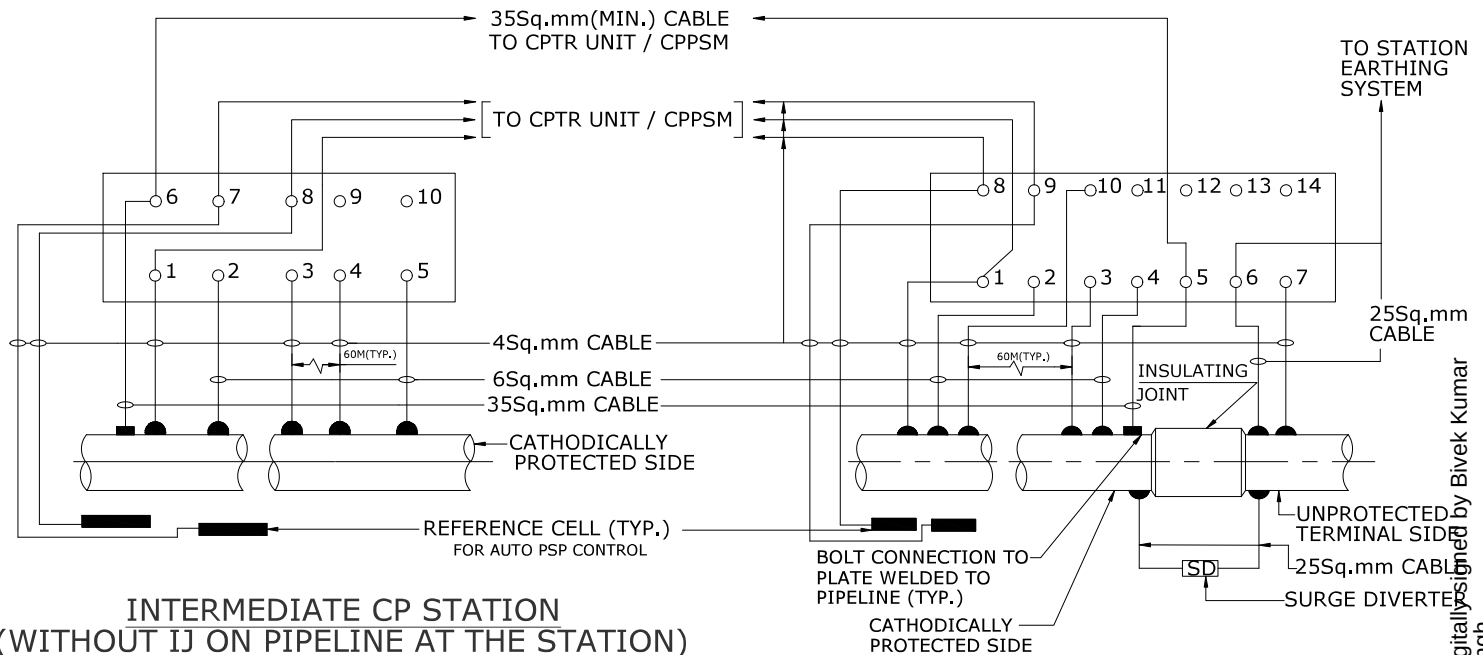
FOREIGN PIPELINE CROSSING  
(CONNECTION SCHEME-E)



INSULATING JOINT CONNECTION  
(CONNECTION SCHEME-F)

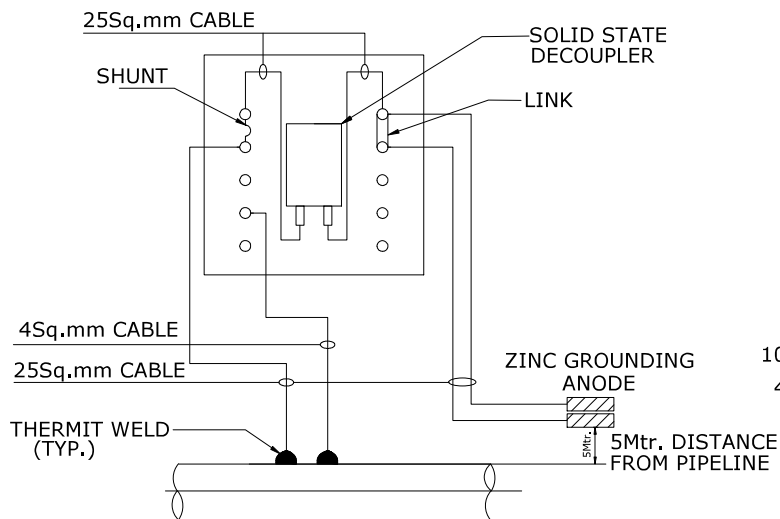
Digitally signed by Bivek Kumar  
Singh  
Date: 2026.04.01 11:29:21 IST

|         |          |                               |             |            |             |               |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
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| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |

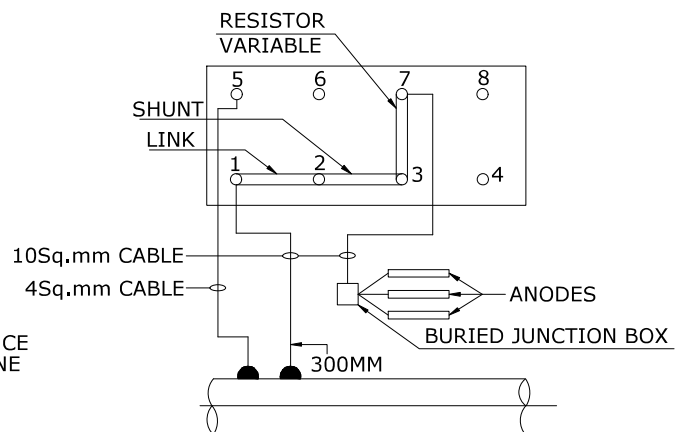


INTERMEDIATE CP STATION  
(WITHOUT IJ ON PIPELINE AT THE STATION)  
IMPRESSED CURRENT DRAINAGE POINT  
(CONNECTION SCHEME-G)

TERMINAL STATION IMPRESSED  
CURRENT DRAINAGE POINT  
(CONNECTION SCHEME-H)



PIPELINE GROUNDING THROUGH  
POLARIZATION CELL AND GALVANIC ANODE  
(CONNECTION SCHEME-M)



TCP GALVANIC ANODE INSTALLATION  
(CONNECTION SCHEME-L)

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Date: 2026.04.01 11:29:21 IST

|         |          |                               |             |            |             |               |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
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| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |



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VCS QUALITY SERVICES  
PRIVATE LIMITED

TEST STATION CONNECTION  
SCHEMES

STANDARD DRAWING NO.

VCS-STD-EL-4514

SHEET NO.

3 OF 3

REV.

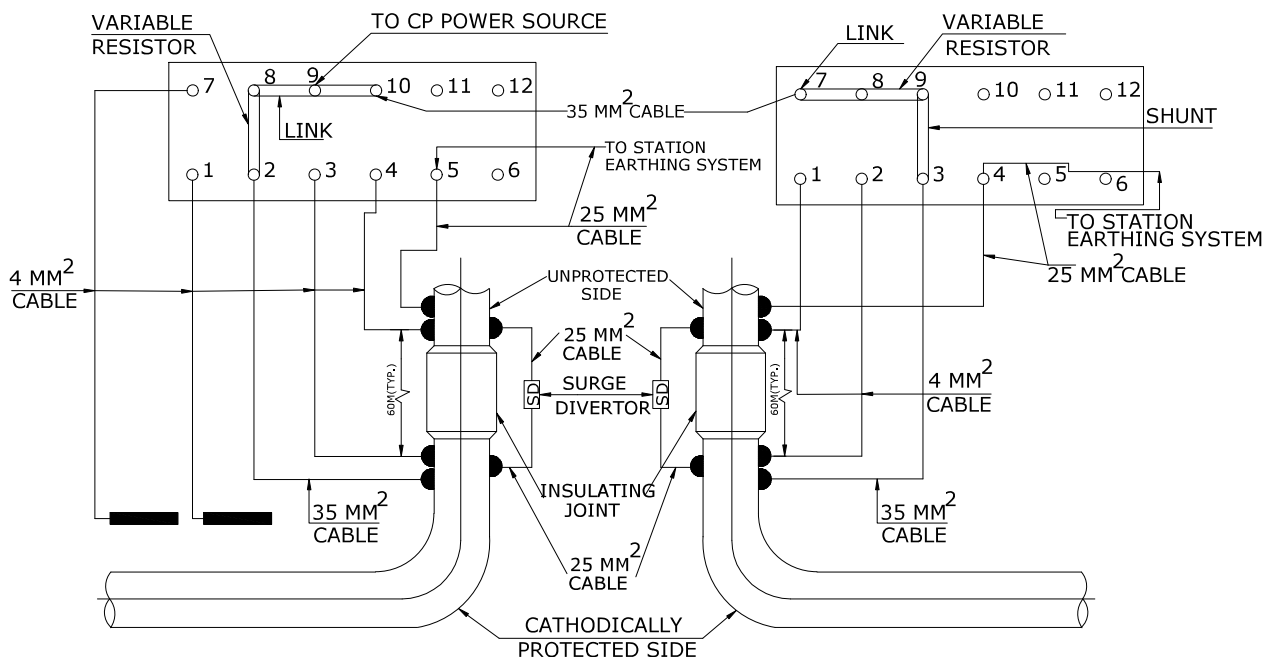
02

SIZE

A4

### TEST STATION I-1

### TEST STATION I-2



### INTERMEDIATE PIGGING STATION IMPRESSED CURRENT DRAINAGE POINT CONNECTION SCHEME -I

#### NOTES:

1. NUMBER OF TERMINALS FOR TEST STATION OF DIFFERENT CONNECTION SCHEME SHALL BE AS SHOWN ON THE RESPECTIVE SCHEME DRAWING, TEST STATION FOR ANY OTHER SCHEME DRAWING, TEST STATION FOR ANY OTHER SCHEME SHALL PREFERABLY BE SIMILAR TO ANY OF THE ABOVE TYPES.
2. ELECTRICAL CONNECTIONS SHALL BE CLEANED TO BRIGHT SURFACE & TIGHTENED WITH NON-OXIDE GREASE APPLIED ON MECHANICALLY MATED SURFACE.
3. NUMBER OF TERMINALS FOR TEST STATION FOR GALVANIC ANODES FOR PERMANENT CP SYSTEM SHALL BE DECIDED BASED ON NUMBER OF ANODES.

|         |          |                               |             |            |             |               |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
| 01      | 18.12.19 | RE-ISSUED AS STANDARD DRAWING | SY          | VV         | AD          | SK            |
| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |



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CATHODIC PROTECTION SCHEMATIC  
DIAGRAM

STANDARD DRAWING NO.

VCS-STD-EL-4515

SHEET NO.

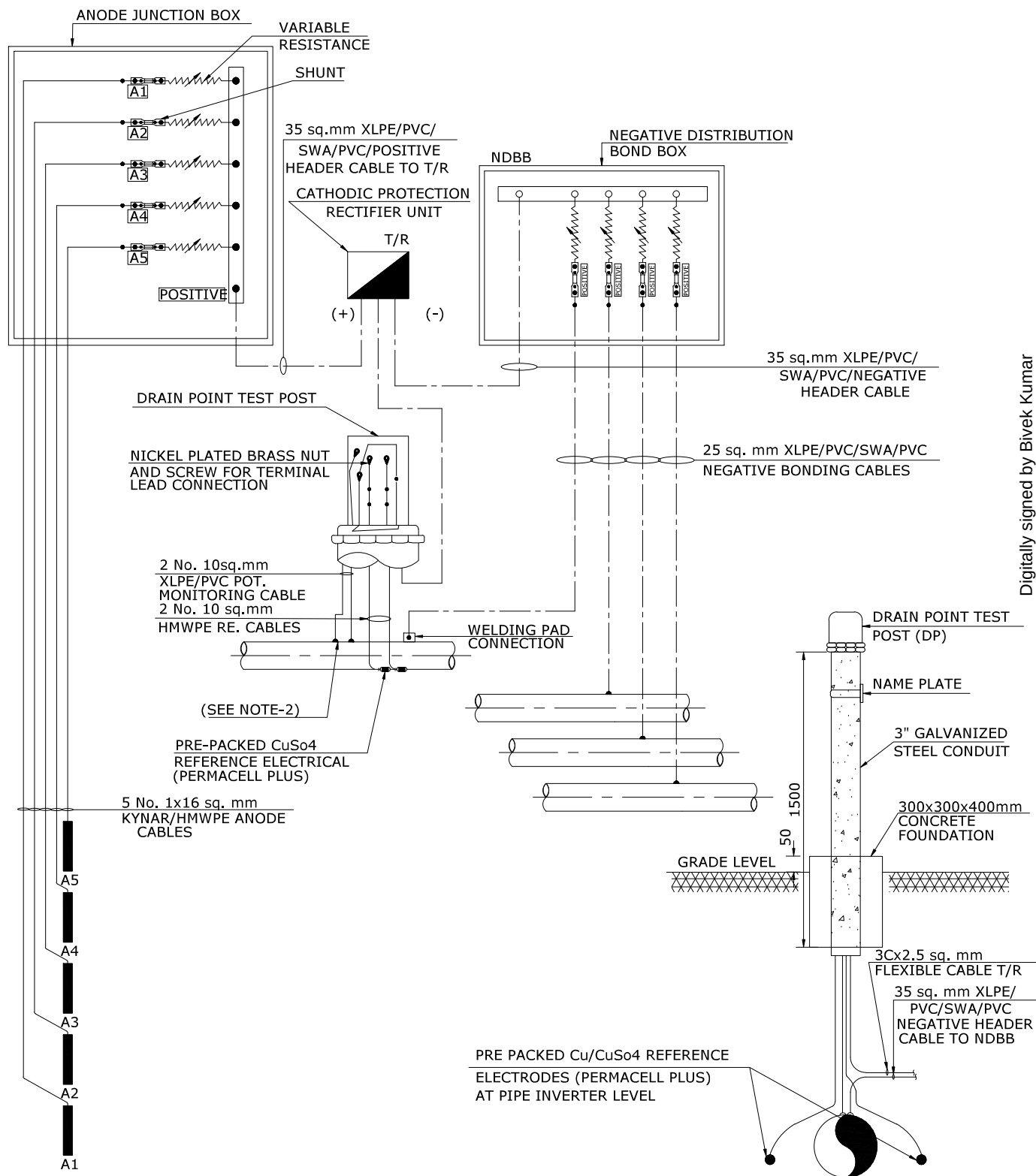
1 OF 1

REV.

02

SIZE

A4



### MMO ANODES GROUNDED

#### NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. ALL CABLES-TO-PIPE CONNECTIONS (EXCEPT DRAIN CONNECTION ON RMETP) FOR UNDERGROUND PIPELINE SHALL BE MADE VIA THERMITE WELDING AS PER DWG. STD.

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Singh  
Date: 2026.04.01 11:29:21 IST

|         |          |                               |             |            |             |               |
|---------|----------|-------------------------------|-------------|------------|-------------|---------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA          | HK            |
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| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD          | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED BY | AUTHORIZED BY |



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Date: 2026.04.01 11:29:21 IST





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PRIVATE LIMITED

CATHODIC PROTECTION SYSTEM FOREIGN  
BOND BOX (FBB)  
DETAILS (2CIRCUITS)

STANDARD DRAWING NO.

REV. SIZE

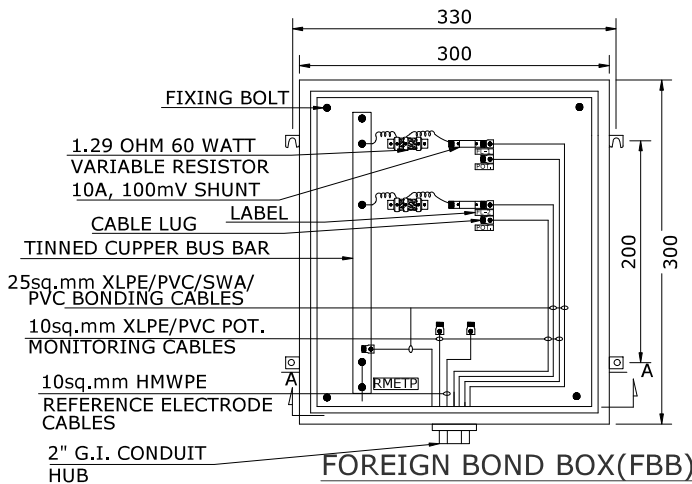
VCS-STD-EL-4517

02

A4

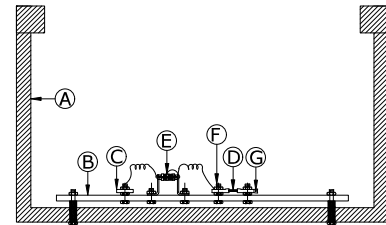
SHEET NO.

1 OF 1

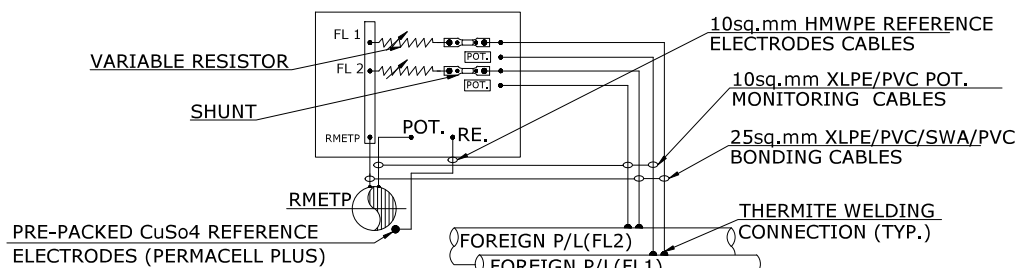


SIDE VIEW

DETAIL-1  
NAME PLATE DETAILS



SECTION A-A



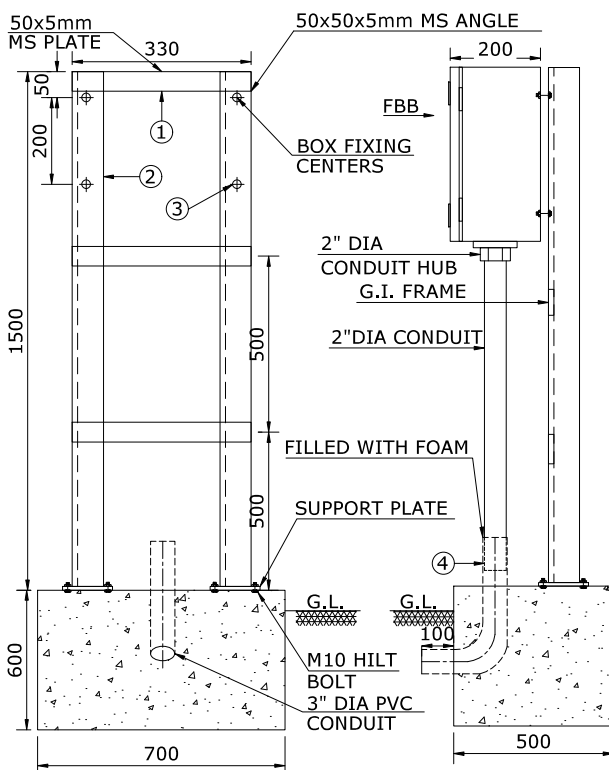
TERMINATION DETAILS

MATERIALS SCHEDULE

| ITEM NO. | DESCRIPTION                                                                        | QTY.    |
|----------|------------------------------------------------------------------------------------|---------|
| A.       | PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK. | 1 No.   |
| B.       | PHENOLIC BOARD-6mm THICK                                                           | 1 No.   |
| C.       | TINNED CUPPER BUS BAR 25x5mm PLATE                                                 | 1 No.   |
| D.       | SHUNT 10A, 100mV                                                                   | 2 No.   |
| E.       | VARIABLE RESISTOR 1.29 OHM 60 WATTS.                                               | 2 No.   |
| F.       | BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS                                      | AS REQ. |
| G.       | CRIMPED CABLE LUG                                                                  | AS REQ. |
| H.       | 2" DIA G.I. CONDUIT HUB                                                            | 1 No.   |

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

| ITEM NO. | DESCRIPTION                                                                                | UNIT | QTY. |
|----------|--------------------------------------------------------------------------------------------|------|------|
| 1.       | MS FLAT SIZE 50x5mm, LENGTH TO SUIT                                                        | NO   | 3    |
| 2.       | MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm                                            | NO   | 2    |
| 3.       | FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS | NO   | 4    |
| 4.       | CONDUIT LENGTH TO SUIT.                                                                    | NO   | 1    |
| 5.       | 2" DIA PVC CONDUIT LENGTH TO SUIT.                                                         | NO   | 1    |



FOREIGN BOND BOX (FBB) MOUNTING  
DETAILS (BY OTHERS)

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

|         |          |                               |             |            |                                                    |               |
|---------|----------|-------------------------------|-------------|------------|----------------------------------------------------|---------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA                                                 | HK            |
| 01      | 19.12.19 | RE-ISSUED AS STANDARD DRAWING | SY          | VV         | AD                                                 | SK            |
| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD                                                 | SK            |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED<br>Digitally signed by Bikash Kumar Singh | AUTHORIZED BY |





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NEGATIVE DISTRIBUTION BOND  
BOX (NDBB) DETAILS

STANDARD DRAWING NO.

VCS-STD-EL-4518

SHEET NO.

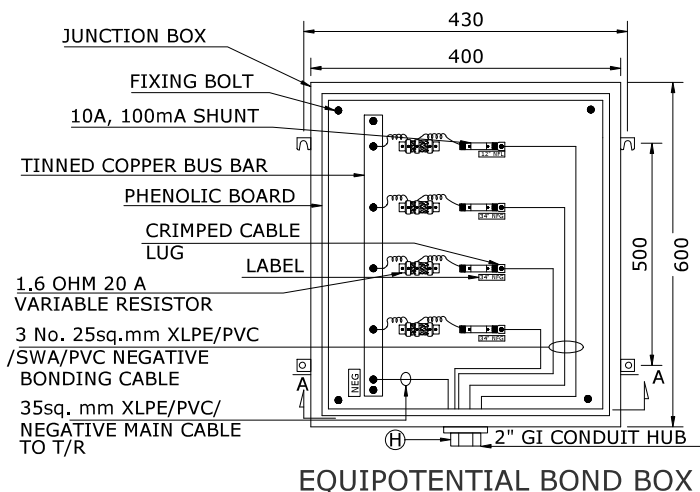
1 OF 1

REV.

02

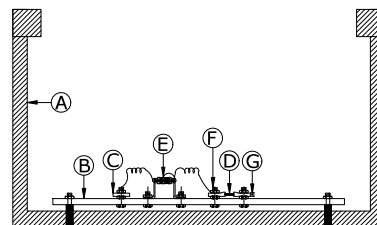
SIZE

A4

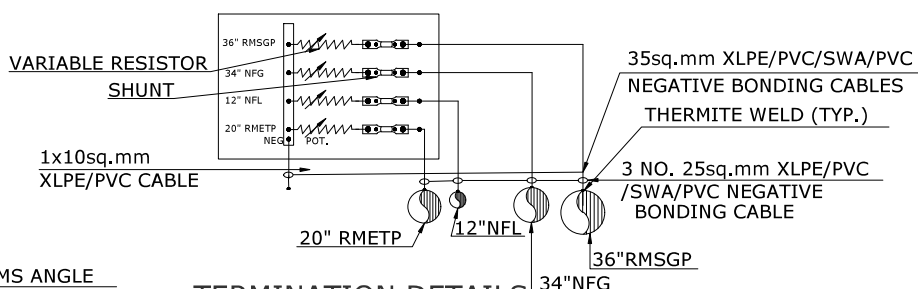


EQUIPOTENTIAL BOND BOX

DETAIL-1  
NAME PLATE DETAILS



SECTION A-A



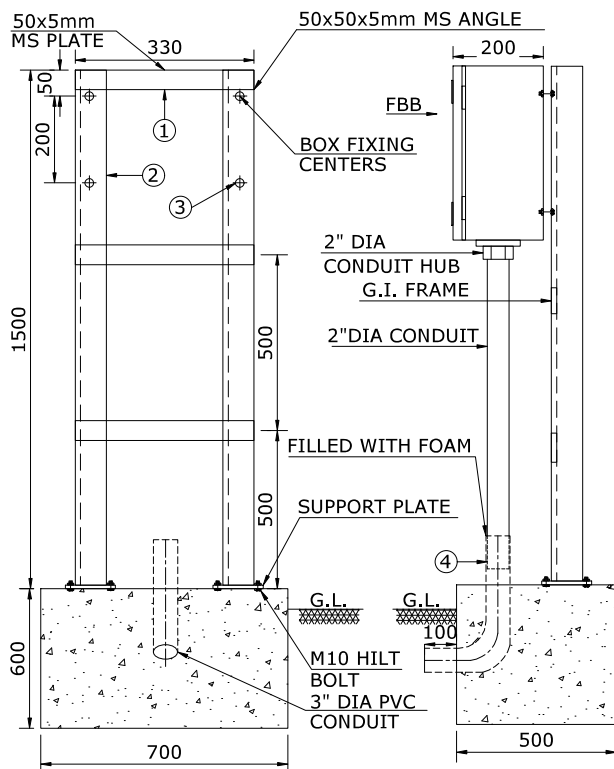
TERMINATION DETAILS

MATERIALS SCHEDULE

| ITEM NO. | DESCRIPTION                                                                        | QTY.    |
|----------|------------------------------------------------------------------------------------|---------|
| A.       | PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK. | 1 No.   |
| B.       | PHENOLIC BOARD-6mm THICK                                                           | 1 No.   |
| C.       | TINNED CUPPER BUS BAR 25x5mm PLATE                                                 | 1 No.   |
| D.       | SHUNT 10A, 100mV                                                                   | 4 No.   |
| E.       | VARIABLE RESISTOR 1.29 OHM 60 WATTS.                                               | 4 No.   |
| F.       | BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS                                      | AS REQ. |
| G.       | CRIMPED CABLE LUG                                                                  | AS REQ. |
| H.       | 2" DIA G.I. CONDUIT HUB                                                            | 1 No.   |

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

| ITEM NO. | DESCRIPTION                                                                                | UNIT | QTY. |
|----------|--------------------------------------------------------------------------------------------|------|------|
| 1.       | MS FLAT SIZE 50x5mm, LENGTH TO SUIT                                                        | NO   | 3    |
| 2.       | MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm                                            | NO   | 2    |
| 3.       | FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS | NO   | 4    |
| 4.       | 3" PVC CONDUIT LENGTH TO SUIT.                                                             | NO   | 1    |
| 5.       | 2" G.I. CONDUIT LENGTH TO SUIT.                                                            | NO   | 1    |

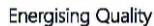


NEGATIVE DISTRIBUTION BOND BOX  
MOUNTING DETAILS (BY OTHERS)

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

|         |          |                               |             |            |          |            |
|---------|----------|-------------------------------|-------------|------------|----------|------------|
| 02      | 06.05.22 | RE-ISSUED AS STANDARD DRAWING | SY          | RD         | AA       | HK         |
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| 0       | 15.05.17 | ISSUED AS STANDARD            | SY          | RD         | AD       | SK         |
| REV NO. | DATE     | PURPOSE                       | PREPARED BY | CHECKED BY | APPROVED | AUTHORIZED |







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PRIVATE LIMITED**

**TYPICAL DRAWING FOR OVERHEAD  
POWER LINE FOR PIPE LINES**

**STANDARD DRAWING NO.**

**VCS-STD-EL-4521**

**SHEET NO.**

**1 OF 1**

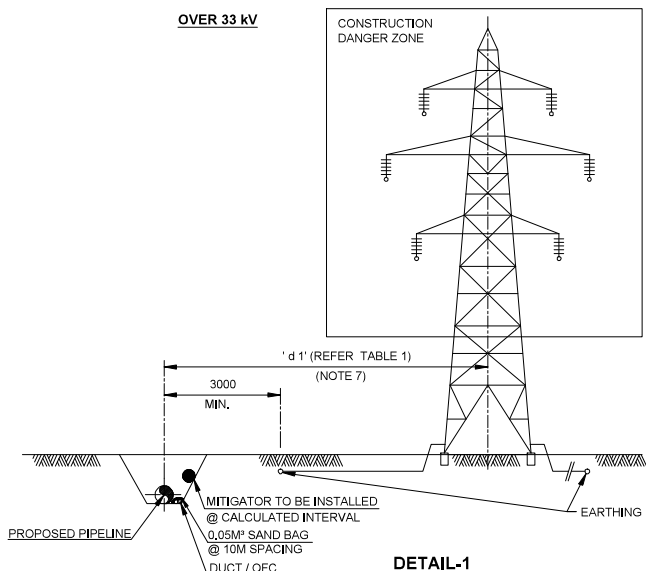
**REV. SIZE**

**02**

**A4**

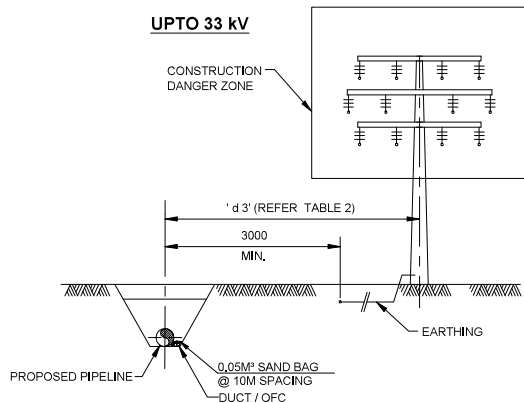
# **PARALLELISM TO HIGH VOLTAGE TRANSMISSION LINES**

**OVER 33 kV**



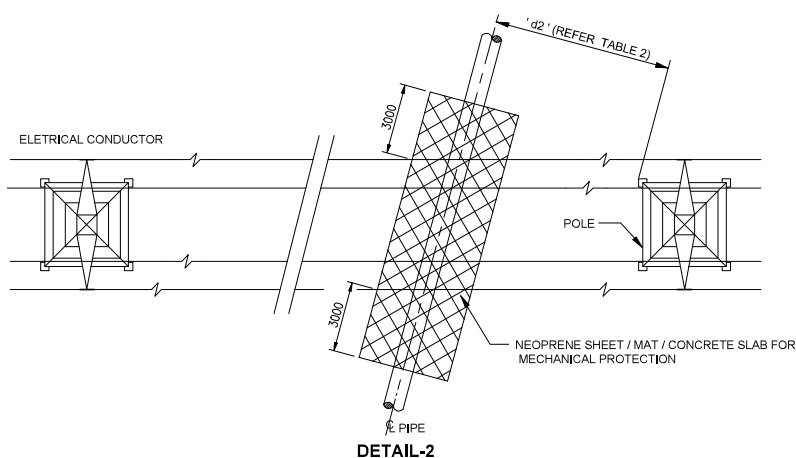
**DETAIL-1**

**UPTO 33 kV**

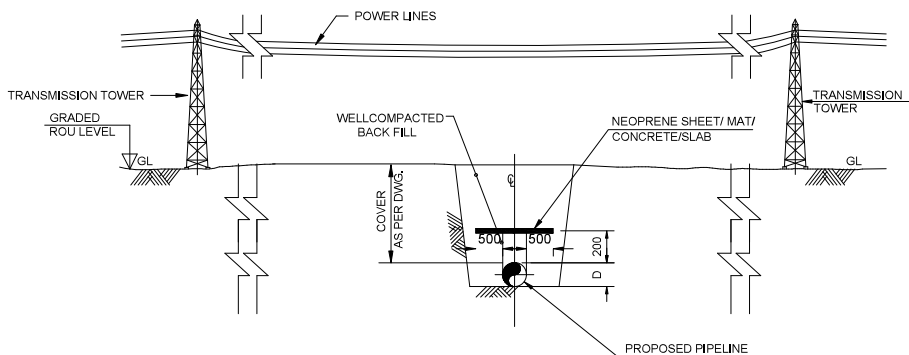


**DETAIL-3**

## **CROSSING OF HIGH VOLTAGE TRANSMISSION LINES**



**DETAIL-2**



**DETAIL-4**

### **NOTES:**

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. IN CASE THE MINIMUM DISTANCE IS NOT MET, THE LOCAL ELECTRICAL COMPANY HAS TO BE CONTACTED FOR APPROVAL.
3. CONSIDERATION SHOULD BE GIVEN TO LIGHTNING FAULT, CURRENT PROTECTION OF PIPELINE & SAFETY OF PERSONNEL.
4. IN CASE OF CROSSING OF HIGH VOLTAGE TRANSMISSION LINES, MIN. DISTANCE SHALL BE MAINTAINED AS PER TABLE-1.
5. SUITABLE MEASURE SHALL BE TAKEN FOR THE PROTECTION OF THE LINE AS PER TABLE-2.
6. CONCRETE SLAB/ NEOPRENE / MAT SHALL BE PROVIDED FOR OHL CROSSINGS FOR 11 KV AND ABOVE AS PER REQUIREMENTS.
7. AS PER NOTE-4 MIN. DISTANCE IS NOT FEASIBLE THEN PLEASE REFER THE DETAILS-A

**TABLE 1**

IF THE OHL IS RUNNING PARALLEL TO THE PIPE LINE MORE THEN 100mtrs. MAINTAIN THE MINIMUM DISTANCE FROM CENTERLINE OF PIPELINE TO POWER TRANSMISSION STRUCTURES / LINE

Right of Way Clearance (As per Standard)

| KV     | Min. ROW                  |
|--------|---------------------------|
| 66 KV  | 18 Meter                  |
| 132 KV | 27 Meter                  |
| 220 KV | 35 Meter                  |
| 400KV  | 52 Meter (Single Circuit) |
| 400 KV | 48 Meter (Double Circuit) |

**TABLE 2**

Minimum Clearance Between Power Lines to other metal / human safety distance at Nominal System Voltage of line.

| KV    | METER      |
|-------|------------|
| 11 KV | 2,44 Meter |
| 33 KV | 2,44 Meter |
| 66 KV | 2,44 Meter |
| 132KV | 3,05 Meter |
| 220KV | 4,58 Meter |
| 400KV | 6,10 Meter |

**02**

**06.05.22**

**RE-ISSUED AS STANDARD DRAWING**

**SY**

**RD**

**AA**

**HK**

**01**

**18.12.19**

**RE-ISSUED AS STANDARD DRAWING**

**SY**

**VV**

**AD**

**SK**

**0**

**15.05.17**

**ISSUED AS STANDARD**

**SY**

**RD**

**AD**

**SK**

**REV NO.**

**DATE**

**PURPOSE**

**PREPARED  
BY**

**CHECKED  
BY**

**APPROVED**

**AUTHORIZED**

Digitally signed by Brij Kumar Singh

| <br>Energising Quality                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CONTRACTOR                                                                   |                    | <b>QUALITY ASSURANCE</b><br><br><b>PLAN FOR TCP WORKS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| <b>INSTRUCTIONS FOR FILLING UP :</b><br>1. QAP shall be submitted for each of the equipment separately with breakup of assembly/sub-assembly & part/component or for group of equipment having same specification.<br>2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment<br>3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.<br>4. Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available. |                                                                              |                    | <b>CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES &amp; DOCUMENTS:</b><br><table border="0"> <tr> <td>Code</td> <td>Description</td> <td>Code</td> <td>Description</td> <td>Code</td> <td>Description</td> <td>DOCUMENTS:</td> </tr> <tr> <td>1.</td> <td>Visual</td> <td>12.</td> <td>Routine test as per relevant IS other standard</td> <td>23.</td> <td>Short time rating</td> <td>D1. Approved GA drawings</td> </tr> <tr> <td>2.</td> <td>Dimensional</td> <td>13.</td> <td>Type test as per relevant IS/ other standard</td> <td>24.</td> <td>Operational &amp; functional check</td> <td>D2. Approved single line/ schematic diagram</td> </tr> <tr> <td>3.</td> <td>Fitment &amp; Alignment</td> <td></td> <td></td> <td>25.</td> <td>Over Speed Test</td> <td>D3. Approved</td> </tr> <tr> <td>4.</td> <td>Physical Test (Sample)</td> <td></td> <td></td> <td>26.</td> <td>Flame Proof Test</td> <td>data sheet</td> </tr> <tr> <td>5.</td> <td>Chemical Test (Sample) (Review of test report only)</td> <td>14.</td> <td>Impulse Test</td> <td>27.</td> <td>Clearance and creepage Distance</td> <td>D4. Approved bill of materials</td> </tr> <tr> <td>6.</td> <td>Ultrasonic Test</td> <td>15.</td> <td>Partial Discharge Test</td> <td>28.</td> <td>Acceptance Test</td> <td>D5. Unpriced P.O. copy</td> </tr> <tr> <td>7.</td> <td>Magnetic Particle Test (MPT)</td> <td>16.</td> <td>Heat run risc test\tempr.</td> <td>29.</td> <td>Material test</td> <td>D6. Calibration Certificate of all measuring instruments and gauges</td> </tr> <tr> <td>8.</td> <td>Radiography Test</td> <td>17.</td> <td>Enclosure Protection Test</td> <td>30.</td> <td>Coating Thickness (MMO Anode), Resistivity (MMO Anode) &amp; consumption rate (For Mg, Zn &amp; Zn Ribbon Anode only review of Test report)</td> <td></td> </tr> <tr> <td>9.</td> <td>Dye Penetration Test</td> <td>18.</td> <td>Calibration</td> <td>31.</td> <td>Contact Resistance anode to cable Joint</td> <td></td> </tr> <tr> <td>10.</td> <td>Measurement of IR Value</td> <td>19.</td> <td>Noise &amp; Vibration</td> <td>32.</td> <td>Destructive testing</td> <td></td> </tr> <tr> <td>a) Before HV Test</td> <td></td> <td>20.</td> <td>Test certificates for bought out components</td> <td>33.</td> <td>Test Station Connection Scheme check, Name plate and terminal check</td> <td></td> </tr> <tr> <td>b) After HV Test</td> <td></td> <td>22.</td> <td>Paint shade verification &amp; Thickness check</td> <td>34.</td> <td>Chemical Composition &amp; Open Circuit Potential (For Zn Ribbon Anode, Review of Test report only)</td> <td></td> </tr> <tr> <td>11.</td> <td>High Voltage test/Dielectric test</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> |      |                                                                                                                                     |                                                                     |                                   |       |           | Code                     | Description       | Code        | Description                                          | Code                                                            | Description                     | DOCUMENTS: | 1. | Visual | 12. | Routine test as per relevant IS other standard | 23. | Short time rating | D1. Approved GA drawings | 2. | Dimensional | 13. | Type test as per relevant IS/ other standard | 24. | Operational & functional check | D2. Approved single line/ schematic diagram | 3. | Fitment & Alignment |  |  | 25. | Over Speed Test | D3. Approved | 4. | Physical Test (Sample) |  |  | 26. | Flame Proof Test | data sheet | 5. | Chemical Test (Sample) (Review of test report only) | 14. | Impulse Test | 27. | Clearance and creepage Distance | D4. Approved bill of materials | 6. | Ultrasonic Test | 15. | Partial Discharge Test | 28. | Acceptance Test | D5. Unpriced P.O. copy | 7. | Magnetic Particle Test (MPT) | 16. | Heat run risc test\tempr. | 29. | Material test | D6. Calibration Certificate of all measuring instruments and gauges | 8. | Radiography Test | 17. | Enclosure Protection Test | 30. | Coating Thickness (MMO Anode), Resistivity (MMO Anode) & consumption rate (For Mg, Zn & Zn Ribbon Anode only review of Test report) |  | 9. | Dye Penetration Test | 18. | Calibration | 31. | Contact Resistance anode to cable Joint |  | 10. | Measurement of IR Value | 19. | Noise & Vibration | 32. | Destructive testing |  | a) Before HV Test |  | 20. | Test certificates for bought out components | 33. | Test Station Connection Scheme check, Name plate and terminal check |  | b) After HV Test |  | 22. | Paint shade verification & Thickness check | 34. | Chemical Composition & Open Circuit Potential (For Zn Ribbon Anode, Review of Test report only) |  | 11. | High Voltage test/Dielectric test |  |  |  |  |  |
| Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Description                                                                  | Code               | Description                                                                                                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| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Visual                                                                       | 12.                | Routine test as per relevant IS other standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 23.  | Short time rating                                                                                                                   | D1. Approved GA drawings                                            |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Dimensional                                                                  | 13.                | Type test as per relevant IS/ other standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 24.  | Operational & functional check                                                                                                      | D2. Approved single line/ schematic diagram                         |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Fitment & Alignment                                                          |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 25.  | Over Speed Test                                                                                                                     | D3. Approved                                                        |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Physical Test (Sample)                                                       |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 26.  | Flame Proof Test                                                                                                                    | data sheet                                                          |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Chemical Test (Sample) (Review of test report only)                          | 14.                | Impulse Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 27.  | Clearance and creepage Distance                                                                                                     | D4. Approved bill of materials                                      |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Ultrasonic Test                                                              | 15.                | Partial Discharge Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 28.  | Acceptance Test                                                                                                                     | D5. Unpriced P.O. copy                                              |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Magnetic Particle Test (MPT)                                                 | 16.                | Heat run risc test\tempr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 29.  | Material test                                                                                                                       | D6. Calibration Certificate of all measuring instruments and gauges |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Radiography Test                                                             | 17.                | Enclosure Protection Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 30.  | Coating Thickness (MMO Anode), Resistivity (MMO Anode) & consumption rate (For Mg, Zn & Zn Ribbon Anode only review of Test report) |                                                                     |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Dye Penetration Test                                                         | 18.                | Calibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 31.  | Contact Resistance anode to cable Joint                                                                                             |                                                                     |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Measurement of IR Value                                                      | 19.                | Noise & Vibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 32.  | Destructive testing                                                                                                                 |                                                                     |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| a) Before HV Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                              | 20.                | Test certificates for bought out components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 33.  | Test Station Connection Scheme check, Name plate and terminal check                                                                 |                                                                     |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| b) After HV Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                              | 22.                | Paint shade verification & Thickness check                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 34.  | Chemical Composition & Open Circuit Potential (For Zn Ribbon Anode, Review of Test report only)                                     |                                                                     |                                   |       |           |                          |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | High Voltage test/Dielectric test                                            |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| <b>ABBREVIATIONS USED :</b><br><br>CONTR-CONTRACTOR<br><br>MFR-MANUFACTURER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                              |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| EQUIPMENT DATA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                                                                                                                                     |                                                                     | INSPECTION AND TESTS              |       |           |                          |                   |             | Test Certificates & documents to be submitted to VCS | Acceptance Criteria Standards /IS/ BS/ASME/ Norms and Documents | REMARKS / SAMPLING PLAN         |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                          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| Sl. No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Description (With equipment heading, place of use, and Breif Specifications) | Identification No. | Quantity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      | Manufacturer's Name and Address                                                                                                     | Expected schedule of Final Inspection                               | Raw Material and in process stage |       |           | Final Inspection/Test by |                   |             |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                  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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                              |                    | No/M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | T    |                                                                                                                                     |                                                                     | MFR                               | CONTR | VCS// TPI | MFR                      | CONTR/ TPIA       | CLIENT /VCS |                                                      |                                                                 |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                            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| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CP Cables (1Cx6Sqmm, 1Cx10 Sqmm, 1Cx25Sqmm & 1Cx35Sqmm)                      |                    | Meters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                                                                                                                                     |                                                                     | 1,2,28                            | -     | -         | 1,2,28                   | 1,2,28            | R           | D1, D2, D3, D4, D5, D6, 20, 13                       | I.S., Approved Data Sheet & Specifications                      |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Test Stations (Big & Small Type)                                             |                    | Nos.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                                                                                                                                     |                                                                     | 1,2,3,4,22, 29                    | -     | -         | 1,2,3,4, 22,33           | 1,2,3,4, 22,33    | R           | D1, D2, D3, D4, D5, D6, 20, 13                       | I.S., Approved Data Sheet & Specifications                      |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Sacrificial Mg & Zn Anodes                                                   |                    | Nos.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                                                                                                                                     |                                                                     | 1,2,5                             | -     | -         | 1,2,4, 5, 30, 32*        | 1,2,4, 5, 30, 32* | R           | D1, D2, D3, D4, D5, D6, 20, 13                       | I.S., Approved Data Sheet & Specifications                      | * on 1% of total nos. of anodes |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Spark Gap Arrestor (100 kA)                                                  |                    | Nos.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                                                                                                                                     |                                                                     | -                                 | -     | -         | -                        | -                 | R           | Manufacturer test certificates & Compliance Report   | Approved Data Sheet & Specifications                            |                                 |            |    |        |     |                                                |     |                   |                          |    |             |     |                                              |     |                                |                                             |    |                     |  |  |     |                 |              |    |                        |  |  |     |                  |            |    |                                                     |     |              |     |                                 |                                |    |                 |     |                        |     |                 |                        |    |                              |     |                           |     |               |                                                                     |    |                  |     |                           |     |                                                                                                                                     |  |    |                      |     |             |     |                                         |  |     |                         |     |                   |     |                     |  |                   |  |     |                                             |     |                                                                     |  |                  |  |     |                                            |     |                                                                                                 |  |     |                                   |  |  |  |  |  |

Digitally signed by Bivek Kumar  
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|                                         |                                                     |  |      |                                  |  |  |                                  |   |   |                           |                           |                               |                                                    |                                      |                          |
|-----------------------------------------|-----------------------------------------------------|--|------|----------------------------------|--|--|----------------------------------|---|---|---------------------------|---------------------------|-------------------------------|----------------------------------------------------|--------------------------------------|--------------------------|
| 5.                                      | Polarisation Cell (Solid State)                     |  | Nos. |                                  |  |  | -                                | - | - | -                         | -                         | R                             | Manufacturer test certificates & Compliance Report | Approved Data Sheet & Specifications |                          |
| 6.                                      | External ER Probe                                   |  | Set  |                                  |  |  | 1,2,3,5,13,29                    |   | - | 1,2,3,5,13*,17*,21*,24,29 | 1,2,3,5,13*,17*,21*,24,29 | R                             | D1, D3, D4, D5, D6, 20,12,13                       | Approved Data Sheet & Specifications | *on one no. of each type |
| 7.                                      | CTSU (Computerised Test Station Unit) & CTSU Reader |  | Nos. |                                  |  |  | 1,2,3                            | - | - | 1,2,3,22,24,33            | 1,2,3,22,24,33            | R                             | D1, D3, D4, D5, D6, 20,12,13                       | Approved Data Sheet & Specifications |                          |
| 8.                                      | Permanent Reference Cell                            |  | Nos. |                                  |  |  | -                                | - | - | -                         | -                         | R                             | Manufacturer test certificates & Compliance Report | Approved Data Sheet & Specifications |                          |
| 9.                                      | Mg/Zinc Ribbon Anode                                |  | Mtr  |                                  |  |  | -                                | - | - | 1,2,30,34                 | 1,2,30,34                 | R                             | D1, D3, D4, D5, D6, 20,12,13                       | Approved Data Sheet & Specifications |                          |
| For Manufacturer<br>(Stamp & Signature) |                                                     |  |      | For CONTR<br>(Stamp & Signature) |  |  | For V C S<br>(Stamp & Signature) |   |   |                           |                           |                               |                                                    |                                      |                          |
|                                         |                                                     |  |      |                                  |  |  |                                  |   |   |                           |                           | Q.A.P. NO.<br>VCS/QAP/TCP/001 |                                                    |                                      | REV. 0                   |
|                                         |                                                     |  |      |                                  |  |  |                                  |   |   |                           |                           | SHEET 2 OF 2                  |                                                    |                                      |                          |

# **INSTRUMENTATION WORKS**



PROJECT NUMBER : C261162



DATA SHEET OF OFC & ACCESSORIES

Total Sheets

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Document no.

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| DATASHEET FOR OPTICAL FIBER CABLE                                                  |                      |                                                            |                               |                                                                  | Rev.                                         |      |      |            |       |    |    |
|------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------|-------------------------------|------------------------------------------------------------------|----------------------------------------------|------|------|------------|-------|----|----|
| GENERAL                                                                            | 1                    | Cable No.                                                  |                               | **                                                               |                                              |      |      |            |       |    |    |
|                                                                                    | 2                    | Application                                                |                               | OFC for Pipeline SCADA / Telecommunication                       |                                              |      |      |            |       |    |    |
|                                                                                    | 3                    | Quantity (Mts)                                             |                               | As per SOR                                                       |                                              |      |      |            |       |    |    |
| CONSTRUCTION                                                                       | 4                    | Standard                                                   |                               | IEC 60793-1-1, 60794-3                                           |                                              |      |      |            |       |    |    |
|                                                                                    | 5                    | Fiber Type                                                 |                               | Single Mode                                                      |                                              |      |      |            |       |    |    |
|                                                                                    | 6                    | Fiber Count                                                |                               | 24                                                               |                                              |      |      |            |       |    |    |
|                                                                                    | 7                    | Color Code                                                 |                               | EIA/TI598B                                                       |                                              |      |      |            |       |    |    |
|                                                                                    | 8                    | No of Buffer and Fiber per Loose Tube                      |                               | 18 buffer tubes and 6 fibers / loose tube                        |                                              |      |      |            |       |    |    |
|                                                                                    | 9                    | Fibre Core Diameter                                        |                               | 8.6 to 9.5 μm (±10%)                                             |                                              |      |      |            |       |    |    |
|                                                                                    | 10                   | Cable Core                                                 |                               | Filled                                                           |                                              |      |      |            |       |    |    |
|                                                                                    | 11                   | Cladding Diameter                                          |                               | 125 μm ± 2 μm                                                    |                                              |      |      |            |       |    |    |
|                                                                                    | 12                   | Primary Coating Material (over Fiber)                      |                               | Ultra Violet cured Acrylic or Silicone                           |                                              |      |      |            |       |    |    |
|                                                                                    | 13                   | Primary Coating Diameter                                   |                               | 250 μm ± 15 μm                                                   |                                              |      |      |            |       |    |    |
|                                                                                    | 14                   | Secondary Coating Material (over Primary Coating)          |                               | Optional *                                                       |                                              |      |      |            |       |    |    |
|                                                                                    | 15                   | Secondary Coating Diameter (if any)                        |                               | 250 μm to 900 μm                                                 |                                              |      |      |            |       |    |    |
|                                                                                    | 16                   | Index Profile                                              |                               | Step or Graded                                                   |                                              |      |      |            |       |    |    |
|                                                                                    | 17                   | Inner Sheath                                               |                               | Natural / Black Polyethylene                                     |                                              |      |      |            |       |    |    |
|                                                                                    | 18                   | Inner Sheath Thickness                                     |                               | 1.2 mm (Nominal)                                                 |                                              |      |      |            |       |    |    |
|                                                                                    | 19                   | Internal and Outer Sheath                                  |                               | Hydrocarbon Resistant, Flame Retardant Polyvinyl Chloride, Black |                                              |      |      |            |       |    |    |
|                                                                                    | 20                   | UV Shielding on Outer Sheath                               |                               | Required                                                         |                                              |      |      |            |       |    |    |
|                                                                                    | 21                   | Thickness of UV resistant Protective Primary Coating       |                               | Cured acrylate 0.062 mm                                          |                                              |      |      |            |       |    |    |
|                                                                                    | 22                   | Outer Sheath Thickness                                     |                               | 3.0 mm (minimum)                                                 |                                              |      |      |            |       |    |    |
|                                                                                    | 23                   | Operational Wave Length                                    |                               | 1310 nm to 1550 nm                                               |                                              |      |      |            |       |    |    |
|                                                                                    | 24                   | Cable Tensile Strength                                     |                               | Better than 2000 N                                               |                                              |      |      |            |       |    |    |
|                                                                                    | 25                   | Bending radius at Min. Installation Temperature            |                               | Minimum Bending Radius:                                          |                                              |      |      |            |       |    |    |
|                                                                                    | 26                   | Bedding                                                    |                               | Polyvinyl Chloride, Black Colour                                 |                                              |      |      |            |       |    |    |
|                                                                                    | 27                   | Armour                                                     |                               | Corrugated Steel Tape Armour                                     |                                              |      |      |            |       |    |    |
|                                                                                    | 28                   | Fiber Identification                                       |                               | Colour Coded Fibers and Tubes                                    |                                              |      |      |            |       |    |    |
|                                                                                    | 29                   | Cable Marking                                              |                               | Durable Marking Embossed Every One (1) Meter                     |                                              |      |      |            |       |    |    |
|                                                                                    | 30                   | Drum Identification Labels                                 |                               | Required                                                         |                                              |      |      |            |       |    |    |
|                                                                                    | 31                   | OTDR Measurements Test                                     |                               | Required                                                         |                                              |      |      |            |       |    |    |
|                                                                                    | 32                   | End to end attenuation Test                                |                               | Required                                                         |                                              |      |      |            |       |    |    |
|                                                                                    | OPTICAL PROPERTIES   | 33                                                         | Temperature Rating            |                                                                  | -60 to +85 °C                                |      |      |            |       |    |    |
|                                                                                    |                      | 34                                                         | Relative Humidity Suitability |                                                                  | 95%, Non Condensing                          |      |      |            |       |    |    |
|                                                                                    |                      | 35                                                         | Individual Splice Loss        |                                                                  | ≤ 0.1 dB                                     |      |      |            |       |    |    |
| 36                                                                                 |                      | Cutoff Wavelength                                          |                               | λc=1150 -1320 nm, λcc≤1280 nm                                    |                                              |      |      |            |       |    |    |
| 37                                                                                 |                      | Diff. in attenuation Coefficient when measured at both end |                               | ≤0.05 dB/Km (VTA)                                                |                                              |      |      |            |       |    |    |
| 38                                                                                 |                      | Voltage withstand                                          |                               | 10 KV DC                                                         |                                              |      |      |            |       |    |    |
| 39                                                                                 |                      | Numerical Aperture                                         |                               | at least 0.13                                                    |                                              |      |      |            |       |    |    |
| 40                                                                                 |                      | Expected Fiber Life Span                                   |                               | 30 years (min.)                                                  |                                              |      |      |            |       |    |    |
| 41                                                                                 |                      | Crush Resistance                                           |                               | 440 N/cm                                                         |                                              |      |      |            |       |    |    |
| 42                                                                                 |                      | Transmission Attenuation                                   |                               | At 1310 nm = 0.35 dB/km or less                                  |                                              |      |      |            |       |    |    |
| 43                                                                                 |                      | Central Strength Member Material                           |                               | FRP / GRP                                                        |                                              |      |      |            |       |    |    |
| 44                                                                                 |                      | Central Strength Member Diameter                           |                               | *                                                                |                                              |      |      |            |       |    |    |
| 45                                                                                 |                      | Cladding Non-Circularity                                   |                               | < 0.7 %                                                          |                                              |      |      |            |       |    |    |
| 46                                                                                 |                      | Polarization Mode Dispersion at 1310 & 1550 nm             |                               | as per ITU-T G.652 Standard                                      |                                              |      |      |            |       |    |    |
| 47                                                                                 |                      | Weight in kg / 1000 Meters                                 |                               | *                                                                |                                              |      |      |            |       |    |    |
| 48                                                                                 |                      | Overall Diameter of Cable and Tolerance                    |                               | *                                                                |                                              |      |      |            |       |    |    |
| MISC.                                                                              |                      | 49                                                         | Rip Cord                      |                                                                  | Yes ( 1 nos.)                                |      |      |            |       |    |    |
|                                                                                    | 50                   | Electrical Area Class                                      |                               | Zone 1 Group IIA /IIB as per IEC, T3                             |                                              |      |      |            |       |    |    |
|                                                                                    | 51                   | Make                                                       | Model No.                     | *                                                                | *                                            |      |      |            |       |    |    |
| 1                                                                                  | Vendor to specify. * |                                                            |                               |                                                                  |                                              |      |      |            |       |    |    |
|  |                      |                                                            | PROJECT:                      |                                                                  | City Gas Distribution Project of NAGALAND GA |      | C1   | 30-01-2026 | AD    | PK | PK |
|                                                                                    |                      |                                                            |                               |                                                                  | REV.                                         | DATE | PRPD | CHKD       | APPRD |    |    |

| DATASHEET FOR HDPE DUCT                                                             |                                                                                      |                                         |                                                                                                                     |                                                          |                                                     | Rev.       |      |      |      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------|------------|------|------|------|
| GENERAL                                                                             | 1                                                                                    | Duct Identificaiton No.                 |                                                                                                                     | **                                                       |                                                     |            |      |      |      |
|                                                                                     | 2                                                                                    | Application                             |                                                                                                                     | Duct to include Pipeline OFC                             |                                                     |            |      |      |      |
|                                                                                     | 3                                                                                    | Quantity                                |                                                                                                                     | As per SOR                                               |                                                     |            |      |      |      |
| CONSTRUCTION                                                                        | 4                                                                                    | Description                             |                                                                                                                     | HDPE duct suitable for direct burial application         |                                                     |            |      |      |      |
|                                                                                     | 5                                                                                    | Standard                                |                                                                                                                     | TEC GR No GR/CDS-008/04 Aug'19                           |                                                     |            |      |      |      |
|                                                                                     | 6                                                                                    | Duct Drum Length (Mts)                  |                                                                                                                     | 1000 Mts                                                 |                                                     |            |      |      |      |
|                                                                                     | 7                                                                                    | Outer Diameter (mm)                     |                                                                                                                     | 40 mm ± 0.4mm                                            |                                                     |            |      |      |      |
|                                                                                     | 8                                                                                    | Pressure Rating (kg/cm2)                |                                                                                                                     | 10 kg/cm2                                                |                                                     |            |      |      |      |
|                                                                                     | 9                                                                                    | Lubrication                             |                                                                                                                     | Solid permanent lubricant across drum length             |                                                     |            |      |      |      |
|                                                                                     | 10                                                                                   | HDPE Density (kg/m3 at 27 degC)         |                                                                                                                     | 940 to 958 kg/m3 at 27° C                                |                                                     |            |      |      |      |
|                                                                                     | 11                                                                                   | HDPE Melt Flow Index                    |                                                                                                                     | 0.2 to 1.1 grams per 10 min. at 190 °C                   |                                                     |            |      |      |      |
|                                                                                     | 12                                                                                   | Color                                   |                                                                                                                     | Orange - uniform across drum length                      |                                                     |            |      |      |      |
|                                                                                     | 13                                                                                   | Identification                          |                                                                                                                     | Black, Length mark at every meter                        |                                                     |            |      |      |      |
|                                                                                     | 14                                                                                   | Preinstalled Tape                       |                                                                                                                     | Factory installed Bull-line Pull tape or 4 mm PP rope    |                                                     |            |      |      |      |
|                                                                                     | 15                                                                                   | Tensile strength                        |                                                                                                                     | Min. 20 N/mm2 (Testing as per IS-14151 (Part-I))         |                                                     |            |      |      |      |
|                                                                                     | 16                                                                                   | Elongation                              |                                                                                                                     | Min. 350% (Testing as per IS-14151 (Part-I))             |                                                     |            |      |      |      |
|                                                                                     | 17                                                                                   | Internal Coefficient of friction        |                                                                                                                     | ≤ 0.08                                                   |                                                     |            |      |      |      |
|                                                                                     | 18                                                                                   | Environmental stress crack resistance   |                                                                                                                     | No failure as per ASTM D 1693                            |                                                     |            |      |      |      |
|                                                                                     | 19                                                                                   | Impact strength (striker weight 10kg)   |                                                                                                                     | No crack or split as per IS:12235                        |                                                     |            |      |      |      |
|                                                                                     | 20                                                                                   | Crush resistance 50kg Load              |                                                                                                                     | Deflection with load<10% & Deflection after recovery <2% |                                                     |            |      |      |      |
|                                                                                     | 21                                                                                   | Oxidation induction tect (> 30 mins)    |                                                                                                                     | Satisfactory                                             |                                                     |            |      |      |      |
|                                                                                     | 22                                                                                   | Bending radius                          |                                                                                                                     | Min 1.25 mtr                                             |                                                     |            |      |      |      |
|                                                                                     | 23                                                                                   | Thickness of inner lubricant layer      |                                                                                                                     | ≥0.35 mm                                                 |                                                     |            |      |      |      |
|                                                                                     | 24                                                                                   | Heat Reversion                          |                                                                                                                     | Max 3%                                                   |                                                     |            |      |      |      |
|                                                                                     | 25                                                                                   | Ovality                                 |                                                                                                                     | 1.0 mm as per IS:4984                                    |                                                     |            |      |      |      |
|                                                                                     |                                                                                      | 26                                      | Hydraulic Test ,<br>Duration: 165 hrs st<br>Induced stress: 3.5 Mpa<br>Acceptance test duration: 48 hrs at 80 Deg C |                                                          | No failure or leakage as per IS: 4984               |            |      |      |      |
|                                                                                     | ACCESSOI                                                                             | 27                                      | Maximum pulling force                                                                                               |                                                          | 300 Kg                                              |            |      |      |      |
|                                                                                     |                                                                                      | 28                                      | Plastic Coupler                                                                                                     |                                                          | Push-fit type having Push-Lock mechanism            |            |      |      |      |
|                                                                                     |                                                                                      | 29                                      | Air Pressure Testing of Coupler                                                                                     |                                                          | 15 Kg/cm2 min period of 2 hours without any leakage |            |      |      |      |
| 30                                                                                  |                                                                                      | End plugs, Cable Sealing Plug & End Cap |                                                                                                                     | Required                                                 |                                                     |            |      |      |      |
| TESTS                                                                               | 31                                                                                   | End Cap material                        |                                                                                                                     | Hard rubber/plastics fitted to HDPE Ducts                |                                                     |            |      |      |      |
|                                                                                     | 32                                                                                   | Duct Integrity Test                     |                                                                                                                     | Required                                                 |                                                     |            |      |      |      |
|                                                                                     | 33                                                                                   | Pressure Test                           |                                                                                                                     | Required                                                 |                                                     |            |      |      |      |
|                                                                                     | 34                                                                                   | Crush and Deformity Test                |                                                                                                                     | Required                                                 |                                                     |            |      |      |      |
| MISC.                                                                               | 35                                                                                   | End Plug Test                           |                                                                                                                     | Required                                                 |                                                     |            |      |      |      |
|                                                                                     | 36                                                                                   | Make                                    | Model No.                                                                                                           | **                                                       | **                                                  |            |      |      |      |
| Notes: ** TBD                                                                       |                                                                                      |                                         |                                                                                                                     |                                                          |                                                     |            |      |      |      |
| 1                                                                                   | Vendor to specify. *                                                                 |                                         |                                                                                                                     |                                                          |                                                     |            |      |      |      |
| 4                                                                                   | HDPE duct specification shall confirm to IS 7328, IS 4984 and ASTM D-1963 standards. |                                         |                                                                                                                     |                                                          |                                                     |            |      |      |      |
|  |                                                                                      |                                         | PROJECT:                                                                                                            | City Gas Distribution Project of NAGALAND GA             | C1                                                  | 30-01-2026 | AD   | PK   | PK   |
|                                                                                     |                                                                                      |                                         |                                                                                                                     |                                                          | REV.                                                | DATE       | PRPD | CHKD | APPR |

| PRESSURE GAUGE                                                                                                                                              |         |                                              |                        |                      |                 |                              |         |      |  | Rev. |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------------------|------------------------|----------------------|-----------------|------------------------------|---------|------|--|------|--|
| GENERAL                                                                                                                                                     | 1       | Tag No                                       |                        |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 2       | P&ID Number                                  |                        | Quantity             |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 3       | Manufacturer                                 |                        | Model No.            |                 | *                            |         | *    |  |      |  |
| GAUGE                                                                                                                                                       | 4       | Type                                         |                        | Bourdon, Solid Front |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 5       | Case                                         | Type                   | Reading              |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 6       |                                              | Material               | SS 316               |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 7       |                                              | Mounting               | Local                |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 8       |                                              | Bezel                  | Bayonet              |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 9       |                                              | Glass Type             | Shatter Proof Glass  |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 10      |                                              | Blowout Device         | Required             |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 11      | Gasket Material                              |                        | *                    |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 12      | Dial Size                                    | Dial Color             | 150 mm               |                 | White with Black Marking     |         |      |  |      |  |
|                                                                                                                                                             | 13      | Enclosure Class                              |                        | IP - 65              |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 14      | Range                                        |                        | 0-60 kg/cm2          |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 15      | Liquid Filled                                |                        | Glycerin             |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | ELEMENT | 16                                           | Type                   | Accuracy             | C-type Bourdon* |                              | ±1% FSD |      |  |      |  |
|                                                                                                                                                             |         | 17                                           | Element Material       | Socket Material      | SS 316          |                              | SS 316  |      |  |      |  |
|                                                                                                                                                             |         | 18                                           | Movement Material      |                      | SS 316          |                              |         |      |  |      |  |
| 19                                                                                                                                                          |         | Conn. Size/Type                              | Connection Location    | 1/2" NPTM            |                 | Bottom                       |         |      |  |      |  |
| 20                                                                                                                                                          |         | Zero Adjustment                              |                        | Micropointer         |                 |                              |         |      |  |      |  |
| SEAL                                                                                                                                                        | 21      | Blow Out Protection                          | Over-Range Protection  | Required             |                 | Required, 130% of Full Scale |         |      |  |      |  |
|                                                                                                                                                             | 22      | Type                                         | Model No.              |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 23      | Wetted Parts Material                        | Seal Material          |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 24      | Housing Lower Material                       | Housing Upper Material |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 25      | Conn. Size/Type                              | Connection Rating      | N/A                  |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 26      | Seal Flush Conn.                             | Over Range Material    |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 27      | Seal Fill Fluid                              |                        |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 28      | Design Pressure                              |                        |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | 29      |                                              |                        |                      |                 |                              |         |      |  |      |  |
|                                                                                                                                                             | MISC.   | 30                                           | Snubber                |                      | Not Required    |                              |         |      |  |      |  |
| 31                                                                                                                                                          |         | Siphon                                       |                        | N/A                  |                 |                              |         |      |  |      |  |
| 32                                                                                                                                                          |         | Manifold                                     |                        | 2-way Manifold       |                 |                              |         |      |  |      |  |
| 33                                                                                                                                                          |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| Notes:                                                                                                                                                      |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| 1 Vendor to specify. *                                                                                                                                      |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| 2 Calibration, material certificates shall be provided by the Vendor.                                                                                       |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| 3 Tagplate (SS 316) stamped with instrument tag number and service in 10mm characters shall be attached via SS wire (1 mm).                                 |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| 4 Pressure gauge shall be selected in such a manner that normal operating pressure is approximately in the middle third of full scale (30% - 70% of range). |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
| 5 Pressure gauge shall be fitted with blow-out protection at back and shall have a over-range protection of 130% of max. reading.                           |         |                                              |                        |                      |                 |                              |         |      |  |      |  |
|                                                                            | CLIENT: | HPOIL GAS PVT LTD                            |                        | C1                   | 30-01-2026      | AD                           | PK      | PK   |  |      |  |
|                                                                                                                                                             |         | CITY GAS DISTRIBUTION PROJECT OF NAGALAND GA |                        | REV.                 | DATE            | PRPD                         | CHKD    | APPD |  |      |  |