M/s HPOIL GAS PRIVATE LIMITED

CITY GAS DISTRIBUTION PROJECT OF NAGALAND GAs

TENDER FOR ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA

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(VOLUME II OF II TECHNICAL)

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HPOIL GAS

M/s HPOIL GAS PRIVATE LIMITED

ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA

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ABBREVIATION

DGPS	Differential Global Positioning System
BM	Bench Mark
U/G	Underground
C/C	Center to Center
m	Metre
OFC	Optical Fibre Cable
EIA	Environment Impact Assessment
CRZ	Coastal Regulatory ZONE
CIDCO	City and Industrial Development Corporation

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1. INTRODUCTION

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

2. PURPOSE

This Document is for the Detailed Scope of Work for Survey & associated works & shall be read in conjunction with Technical Specifications (attached refer Annexure I to XI), Schedule of Rates (SOR) & various parts of bidding documents meant for the execution of the proposed.

3. 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	ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA
OWNER	M/s HPOIL
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.
SOW	Scope of Work

4. OBJECTIVE

Routes for this Geographical Areas need to be studied in detail to obtain the following information's:-

4.1 Study of selected route for establishing exact route and ascertaining the correct route length.

4.2 Physical features of the terrain along the route for planning, engineering and execution purposes. This includes crossings for roadways / Railways/ water bodies and other special features on route.

4.3 Soil characterization including corrosion resistivity of soil along the approved route for planning, engineering and execution purposes.

4.4 Study of hydrographical and subsoil properties for water bodies like canal, major drains coming across the route for planning, engineering and execution purposes.

4.5 Study of subsoil properties for Plots of Terminals, CGS Stations etc. for planning, engineering and execution purposes.

4.6 Area Survey for MDPE Network. Obtaining all the details of customers (domestic, industrial and commercial) and superimposing the same on the base maps. The details should be as per mentioned in the technical specification.

4.7 Obtaining approvals / permissions from appropriate respective final State / National and other authorities for the Pipeline route and network, various pipeline crossings like National Highways, Rail, Road, River, Canal Crossings, Other Pipeline crossings or any other utility crossings etc. applicable for both Pipeline and OFC laying

4.8 Observe and record other major parameters along the route for environmental impact assessment.

4.9 Obtain and compile the data in a unified and prescribed manner for planning, engineering, execution, operation & maintenance, and controls in future.

5. SCOPE OF WORK

5.1 The scope of work has been broadly categorized into following:

S.No.	GEOGRAPHICAL AREA	STATE	SCOPE
1.	DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS	NAGALAND	Topographical Survey, Detailed Route Survey, Corrosion Survey, Crossing Survey, Geotechnical Investigations of Plots and Rivers, GPR Survey, Crossing Permissions, NOC for District Authorities

Activities (Major) wise details are as follows:

S. No	ITEM	UNIT	DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS
1.	Reconnaissance Survey	KM	55
3.	Detailed Route Survey	KM	55
4.	Soil Stratification	KM	80
5.	Corrosion Survey	KM	55
6.	Topographical Survey	Acre	5

7.	Area Survey for MDPE Network	Sq KM	100

5.2 The scope of work of contractor specified in this document shall include, but not limited to the following. In case of conflict of this document with enclosed technical specifications, requirements mentioned in this document shall be governing.

The location of starting points and termination points of survey of pipeline shall be decided / fixed by M/s HPOIL / PMC and shall be informed to the Contractor during detailed pipeline route survey.

5.3 Develop a plan and approach methodology to carry out the Survey keeping in mind/ account the needs of pipeline construction, operation, maintenance and safety.

5.4 To identify and procure appropriate satellite imageries, topo sheets and other data from approved sources, and digitize and develop a city map showing latest developments along with the pipeline route actually surveyed duly marked on the developed map.

5.5 Carry out a Check Survey / Route Verification Survey and examine the feasibility of laying a Gas pipeline along the proposed route as shown in the attached drawing and put up to M/s HPOIL / PMC for approval before starting the Detailed Route Survey.

5.6 Carry out detailed Survey of the proposed / selected routes as per attached SOR from the City Gate Station (CGS) or other point through identified mandatory points, if any, to the terminating point in the vicinity of city by deploying:

i) Personnel's having expertise and skills in the fields of remote sensing, engineering surveys and land survey, digitization, image analysis, system analysis and other associated disciplines.

ii) Appropriate techniques of remote sensing, global positioning surveying, digitization & image editing/ processing, system analysis etc. as per requirement.

iii) Needed equipment, tools, hardware and software to carryout work including data analyzers, scanners, digitizers, image editors, image processing software, plotters, database, operating software & hardware; GPS, EDM etc. along with accessories & software.

iv) The map preparation works to be done using conventional City Maps, in a manner so that the final deliverables are subsequently amalgamated with the digitized maps from the satellite Imageries.

5.7 For the City portions, the proposed pipeline route shall be marked on the side of the road edge with least encumbrances, however the Surveyor will indicate all the features identified within the corridor limit specified above on the digitized route map. The Route map along with the detailed sketches for all the crossings etc. shall be prepared in AUTOCAD with appropriate UTM coordinates.

Following features shall be identified and shown in the various outputs of survey.

i) Physical features (Permanent & temporary) like parks, lawns, buildings, shops, etc. along with the Names of Localities, Roads, Streets, Parks, Major Buildings and Plot No's, etc.

ii) Identification of rivers, nallahs, major drains, culverts, manholes etc. along with Invert levels /water level and surrounding ground levels.

iii) Identification of transmission lines (HT & LT.) along with Power line Ratings and location of electric poles, etc.

iv) Detection and Identification of existing Underground utilities, pipelines, cables etc. using underground utility locators and/or GPR (Ground penetrating radars).

v) Identification of Highways, roads, lanes, & bye- lanes. All the details like name of roads, carriageway widths, type of road / pavement like Kuchha / Pukka roads, CC Roads, Bituminous Roads, Tiled footpaths etc. to be clearly specified along with the Reduced levels of Road / Footpath at regular interval along the pipeline route / locations where the levels are abruptly varying.

vi) Identification of Bridges, fly-over & crossings specifying width of crossing, width of waterway, etc.

vii) Permanent structures, cluster/ row of tree etc.

viii) Any other major feature along the pipe route.

ix) Surveyor will point out obstructions along the proposed pipeline route and suggest alternate routes indicating diversions. Further, the Surveyor will make a detailed list of agencies whose permission/ clearance will be required during laying of the pipeline.

x) Surveyor will submit route plans, showing the detailed structures, service lines etc. incorporating the proposed and alternative pipeline routes.

xi) Surveyor will identify area along pipe route where ROU compensation is to be paid and its price implication. Permissions to be obtained from Government agencies i.e. PWD, Municipality, Civil authorities, Defense etc.

xii) Surveyor to submit the estimation of approximate distance to be covered along the pipeline route.

xiii) Surveyor to indicate other important data/ information such as future development plans, proposals for bridges, fly-over's, OFC/HT/LT networks, widening of city roads, sewerage & drainage network etc.

xiv) Wherever the satellite imageries are not required/ available, the work to be done in a manner so that the deliverables are GIS compatible.

xv) Location of very congested locations where it may be unsafe to lay pipeline.

xvi) Locations of State Transport Depots and Private Bus Depots/ fueling stations.

5.8 To handle, process and store the satellite data. The processing to include display and control of raster image, creating histogram/LUT/VLT, editing, assign settings and options, contrast adjustments, image fusion, modify image geometry and spatial enhancement.

5.9 To handle process and store the topo sheets, engineering drawings/ data/ reports, cadastral survey maps/land records, all other information. The processing to include scanning, cleaning & editing of raster images, mapping, filtering, warping, mosaicking, plotting; image fusion /merging with spatial data, corrections, geo-referencing, editing and plotting.

5.10 To carry out the detailed check / route verification survey of pre-determined stretches/ selected routes using approved methodology including use of GPS & EDM specially for major crossings and turning points for assessment of the feasibility of laying the pipeline along the proposed routes, marking the Pipeline alignment in a broad way to enable the further detailed survey, soil investigation etc. along the alignment. The check / route verification survey to include suggestions, modification in the proposed alignment, detours/ diversions and avoidance of routes due to new developments in the area, ghat section, simultaneous collection of data/ information of the local / governmental plans & projects, corridor survey by other companies/ authorities in the vicinity, reservation/ de-reservation of forests & other protected area etc.

5.11 As far as possible only electronic markers be placed for identification of the alignment on digitized route drawings.

5.12 Tie-in of the starting and termination point of the proposed pipeline survey to the grid-control system being used for end facilities and geo-referencing of the route alignment to an approved system.

5.13 To carryout mixing of the imagery with ground verification survey/ check survey, editing and plotting.

5.14 To provide suitable office space to M/s HPOIL / PMC representatives within his premises during the entire period of Detail Route Survey in order to carry out inspection, supervision and customization.

5.15 To offer intermediate and final works to the M/s HPOIL / PMC representative for scrutiny, authorize mid-course changes/ modifications, if any, and quality assurance purposes. To provide in-depth and knowledgeable explanation to M/s HPOIL / PMC representative during each stages of the process. [This shall not absolve SURVEYOR from his responsibility to produce work of high quality and maintain the time frame agreed.]

5.16 Based on the suggestions and alterations/corrections by M/s HPOIL /PMC, to submit a draft and on approval a Final Report enclosing final sets of all deliverables in specified copies.

5.17 To obtain all necessary permissions/approvals by the concerned authorities to carry out the survey work related to use of satellite imagery, satellite position based survey, revenue/land survey, entry/ passage/ access to and from private property, reserved forest, restricted/ prohibited area etc.

5.18 To return in good condition to M/s HPOIL / PMC all satellite imagery, topo sheets, maps, drawings, data sheets, survey plans, land records etc. in original obtained for the Detailed Route Survey works. In case of any damage, the Surveyor to renew, replace the same.

5.19 To maintain complete confidentiality of the documents and progress/ development of Route Survey and on completion to furnish an undertaking for having kept no copy of the maps/ images/ records at his end.

5.20 To indemnify M/s HPOIL / PMC & their Representatives from any copyright / statutory violations by his work. Only authorized copies /versions of Software and equipment be used for the entire work.

5.21 To submit daily & weekly progress reports for each survey and attend progress review meetings at designated location with M/s HPOIL / PMC representatives. Presentation of route survey data in the form as defined in the document.

5.22 To provide all fares, transport, accommodation and lodging/boarding expenses to his employees/vendors during travel for the reconnaissance survey.

5.23 All reworks/ resurvey in case of doubt, discrepancy, change in route, problems in methodology, better option etc; shall be undertaken in consultation with M/s HPOIL / PMC on case to case basis, depending on:

- Connectivity with adjoining surveys.
- Geocoding be done and closing of surveys at both the ends.
- Data and inputs to be organized in a prescribed manner and output be generated

as specified in this document / specified by M/s HPOIL / PMC representative.

Note: No compensation and/ or additional time will be allowed for above.

5.24 To consider included all necessary activities, expertise and quality assurance aspect of works & skills in his scope of work, to ensure completeness of details whether explicitly mentioned in the tender document or not, in order to achieve the targeted objective.

5.25 The scope of work shall also include any other item/work required to complete the work in all respects as per specifications, drawings and instructions of M/s HPOIL / PMC Representative whether specifically mentioned herein or not, but is required to fulfill the intended purpose of this tender document.

6. SURVEYORS' RESPONSIBILITIES

6.1 Surveyor shall also be responsible for arranging, acquiring all data/ maps (where not available with M/s HPOIL /PMC, access, permissions and other activities/ services required for and or incidental to performing the work tendered. For use of GPS/DGPS/Drones and other electronic equipment – the necessary permissions from the competent authority shall be Contractor's responsibility.

6.2 Location of Survey of India Bench-marks and determination of their values including tie-in of proposed pipelines profile to the same shall also be Surveyors' responsibility in the feasibility study.

6.3 Main historical data for major rivers & broad assessment of flood at major crossings be also furnished by the surveyor along the pipeline route.

6.4 Surveyor shall be responsible for settling all compensation and disputes arising out of any damages caused by him or his workmen during the execution of work.

6.5 Collection of all information regarding the proposed development plans etc. of the state through which the pipeline passes from the concerned departments of Government of India/State Governments, private/public institutions/ companies etc. within reasonable distance on either side of the proposed pipelines alignment. Information about future plans, irrigation projects, infrastructure projects, afforestation plans, defence, and industrial projects by private/public enterprises in the vicinity be also collected and furnished.

7. EQUIPMENTS

A. Differential Global Positioning System (DGPS)

a. Dual (Min.) frequency DGPS shall be used.

b. The DGPS shall have the facility for RTK (Real Time Kinematics) observations.

c. Data format system for vectorization of data derived from relative positioning.

d. Normally RINEX (Receiver Independent Exchange Format) to be deployed.

e. Database License Agreement: RINEX or other approved.

f. The DGPS points collected shall be clearly visible on the satellite imagery and contractor will plan and submit the DGPS point locations to Client for verification before going to field to collect the data.

B. Electronic Total Station

Compatible with the Data 'Collector of standard make and type shall be used for the detailed survey. Broad minimum specification of total stations shall be:-

Angle Measurement	Horizontal and Vertical accuracy of 1.0 mgon, 3 seconds.
Compensator	Two axes liquid compensator Settings range of +/-0.1gon Setting accuracy of +/-0.6mgon
Distance Measurement	Single prism/3 prisms upto minimum 2.5 km in average atmospheric condition with normal measurement accuracy of 2mm + 2ppm.
Keyboard & Display	Standard -16 characters
Least count	0.5 seconds
Built in Programs	Set station co-ordinates, set horizontal orientation, compute tie distance, 3D setting out, compute target-point coordinates, two way data interchange.
Communication	Activate functions viz interface from external data recording equipment.
Recording	3 meg internal memory for recoding.
Telescope	magnification - 30X shortest sight distance - 2.0m
Temperature Range	measurement (-20°C to 50°C)

The broad minimum specification for Data Collector shall be:

Type	Hand held, weatherproof Data Collector, totally compatible with the Electronic Total Station, the software and the processing software installed on the project CADD microcomputer.
Temperature Range	Operating -30°C to 60°C
Waterproof Sealing	Waterproof against accidental immersion
Display Feature	240 x 64 pixel full graphics LCD, minimum 8 lines x 40 characters with integral backlighting.
Keyboard	Minimum 56 key.

Operating System	Any approved standard
Applications	TDS Survey-Pro Software for multiple job files, raw data and coordinate data reporting, data collection, coordinate data computation, survey adjustment, leveling earthwork, triangle solutions, DTM Stakeout, printing file, transfer and plotting, TFR Transfer software and cables.
Memory	Minimum 2 Mbytes of low power DRAM
Mass Storage	Minimum 10 Mbytest non-volatile solid state flash disk.
Microprocessor	Minimum Clock Speed of 25 MHz
Interfaces	Approved Compatible - PC interface internal

8. SCOPE OF SUPPLY

8.1 M/s HPOIL / PMC shall not supply any material, manpower or equipment for the tendered work [except topo sheets, maps etc. wherever available.]

8.2 The procurement and mobilization / supply in sequence and at appropriate time of all equipment, data, skills, accessories, materials, software's, hardware's and consumables etc. required for completion of all works covered under this contract shall be entirely the responsibility of the Surveyor.

8.3 All positioning system, survey equipment (GPS, DGPS, Auto Levels, EDM, ,Total Station, Drones, etc.), software & hardware, office equipment,, operating personnel including travel cost of operator, their lodging and boarding, local transport, transportation of equipment to and fro, surface transport insurance, any other items required to complete the work as per the requirements of this Tender Document and directions of M/s HPOIL / PMC representative shall be supplied/arranged by the Surveyor at his cost without any liability on the part of M/s HPOIL / PMC. All licenses authorization/levies/charges for connectivity with satellites shall be Surveyors' responsibility.

8.4 The flag marks shall be properly chosen and marked at major crossings, specified locations and major turning points etc on the maps /drawings including the facility of the Path Finder in such a manner that the same are identifiable at the time of subsequent detailed survey & cadastral survey.

9. DOCUMENT / DATA SUBMISSION

9.1 Contents and presentation of survey data/ records shall be reviewed / approved by M/s HPOIL. / PMC in the initial stage on sample drawings/documents to be prepared by

the Surveyor. The Surveyor shall incorporate all comments/ suggestions given by M/s HPOIL. / PMC and prepare all documents accordingly.

9.2 Two sets of paper copy of completed drawings/ data/ documents shall be submitted by the Contractor for M/s HPOIL. / PMC's review in the form of draft report. Comments, if any, shall be incorporated by the Contractor. This report can be demanded in parts and in different phases as per discretion of M/s HPOIL / PMC.

9.3 All drawings, reports, format, etc. forming the part of submission to M/s HPOIL / PMC shall be prepared on approved computer package. All drawings, including, but not limited to alignment sheets, crossing drawings, soil profiles etc. shall be prepared using AutoCAD. All reports, formats, write-ups, charts shall be prepared on computer using software package compatible with MS Office 2007 or higher version.

9.4 All Data shall be submitted in editable format.

9.5 DRAFT DOCUMENT SUBMISSIONS.

Draft drawings/data/documents, after incorporation of comments by Surveyor, shall be submitted to M/s HPOIL / PMC in the following number of copies.

a)	Drawings (Alignment sheets, Route map	-	Two paper copies in colour and Soft copy on Pen Drive.
b)	Soil Resistivity Report	-	Two paper copies and Soft copy on Pen Drive.
c)	Geo- technical investigation Report	-	Two paper copies and Soft copy on Pen Drive.
d)	Overall Survey Report and Records	-	Two paper copies and Soft copy on Pen Drive.

9.6 FINAL DOCUMENT SUBMISSIONS.

Final drawings/data/documents, after incorporation of comments by Surveyor, shall be submitted to. M/s HPOIL / PMC in the following number of copies.

a)	Drawings (Alignment sheets, Route Map)	Four paper copies in color and soft copy on Pen Drive
b)	Soil Resistivity Report	Four paper copies and Soft copy on Pen Drive
c)	Geo- technical investigation Report	Four paper copies and Soft copy on Pen Drive
d)	Overall Survey Report and Records	Four paper copies and Soft copy on Pen Drive

10. ATTACHMENTS (TECHNICAL SPECIFICATIONS)

a) TOPOGRAPHICAL SURVEY OF PLOTS– ANNEXURE-I

b) DETAIL ROUTE SURVEY– ANNEXURE-II

c) PIPELINE ROUTE CENTRELINE SURVEY – ANNEXURE-III

d) SOIL INVESTIGATION SURVEY– ANNEXURE-IV

e) CORROSION SURVEY– ANNEXURE-V

f) GEOTECHNICAL INVESTIGATION IN PLOTS– ANNEXURE-VI

g) GEOTECHNICAL INVESTIGATION IN RIVER– ANNEXURE-VII

h) AREA SURVEY (MDPE)– ANNEXURE-VIII

i) GPR SURVEY FOR UNDER GROUND UTILITIES– ANNEXURE-IX

j) CROSSING PERMISSION– ANNEXURE-X

k) MOBILIZATION & DEMOBILIZATION- ANNEXURE-XI

ANNEXURE – I

TECHNICAL SPECIFICATION
FOR
TOPOGRAPHICAL SURVEY OF PLOTS

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
REV	**DATE**	**DESCRIPTION**	**PREP**	**CHK**	**APPR**

ENERGISING QUALITY

TECHNICAL SPECIFICATION
FOR
TOPOGRAPHICAL SURVEY OF PLOTS

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1.0 GENERAL

The intent of the survey program for the proposed sites is to obtain sufficient topographical data for finalizing all engineering works and establishment of Reference levels and plot extremities for reference during construction of the project.

2.0 SCOPE OF WORK

2.1 The Terminals/SV plots along with approaches to the plots which are to be surveyed have been identified in the enclosed Tender Document and shall also be clarified by the Engineer in charge during execution of work.

The Survey agency shall carry out detail survey of the area along with showing: -

2.1.1 Physical features, spot levels, invert levels of existing drains and culverts in terms of RL with their cross sections, transmission/telephone lines, service lines etc. land survey by triangulation or other suitable method.

2.1.2 Topographical survey indicating existing permanent and temporary structures including levels & limits.

2.1.3 Drawing of terrain.

2.1.4 Detailed levels and coordinates of existing roads and other units.

2.1.5 Preparation of survey drawings with descriptive note on terrain.

2.1.6 Setting of reference grid lines and temporary benchmarks.

2.1.7 True Norths.

2.1.8 Grids at 3m internal shall be established parallel to true north. Working reference point to be fixed at site with reference to some permanent benchmark.

2.1.9 Any Angle between grid north & True north.

2.1.10 Check the co-ordinations of existing roads and other units with reference to the details indicated by M/s HPOIL / M/s VCS.

2.1.11 Survey of 5M length beyond the periphery of the proposed boundary wall around the proposed site.

2.1.12 Establish the HFL while indicating its source of information.

2.1.13 To identify storm water disposal point with it's levels as per existing site condition.

2.1.14 Plot plan to show all test locations w.r.to plot corner pegs as well as their RL.

2.1.15 Procedure of investigation and method of tests adopted.

2.2 Survey Agencies scope of work includes supplying and fixing 100mm dia wooden pegs embedded upto a depth of 1000mm in ground and exposed 150 mm above ground at all the corners of plots

3.0 TECHNICAL SPECIFICATION

The details to be covered in the contract work shall include the following:

The reading and noting shall be neat, legible and scorings and over-writing shall be duly initialled by the Contractor. All recordings carried out by GPS/DGPS and other electronic equipment shall be authenticated by authorized persons as per approved Quality Assurance Plan.

All surveys shall be carried out using approved methodology and equipment e.g. GPS, DGPS, Total Stations, Auto levels, EDM.

Generally, and unless approved otherwise, the following methods and equipment shall be deployed for the detailed survey.

- GPS/DGPS (Global Positioning System/ Differential Global Positioning System)
  The state of art GPS/DGPS are satellite-based radio navigation system providing 3 – dimensional position used for surveying on land/water. Data format system for vectorization of data derived from relative positioning. Normally RINEX (Receiver Independent Exchange Format) to be deployed.
- Electronic Total Station Compatible with the Data Collector of standard make and type shall be used for the detailed survey.

Detailed survey would be carried out using Differential Geographical Positioning system and/or Geographical Positioning system and Total Stations. Use of total stations shall be made in suitable conjunction with GPS / DGPS to establish the markers.

Location of Bench Marks shall be established in the field by using reinforced concrete blocks as per specification and drawings. 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.

Geo-graphical and UTM co-ordinates on WGS 84 datum of all Survey Points shall be computed and furnished.

Co-ordinates of existing buildings/ structures underground pipelines, canals/ drains, power transmission lines, towers, boundary lines, road intersection, points manholes, trees, etc., have to be established with respect to N-E grid and shown on drawing.

Existing bench mark, new reference pillars, triangulation stations shall be shown in the drawing indicating their co-ordinates.

All survey data collected during the day shall be plotted on the drawing on the same day. All field books shall be maintained and submitted to the Owner on completion of survey and drawings if required.

Geo-graphical and UTM co-ordinates on WGS 84 datum of all Surveyed Points and boundary points of the area shall be computed and furnished in the form of to scale AutoCad Attribute lists compatible with GIS softwares.

3.1 Survey Details:

It shall be general survey work to be used for engineering purposes. The survey shall be oriented towards furnishing informations for project planning and detailed engineering work. The survey shall show all the existing features alongwith levels and important dimensions.

Existing features such as roads, railway tracks, buildings, drains, man-holes, over head & under ground service lines, communication and supply lines, Types and Girth of Trees with locational coordinate and similar permanent and temporary structures shall be shown.

Each survey drawing shall show sets of perpendicular grid lines parallel to actual North, South and East, West with reference to reference point. These are needed for the purpose of orienting and matching the survey drawings with layout of the unit.

Ground levels shall be shown on rectangular grid pattern at intervals of 3 metres. Additional levels to show sudden change of levels shall also be indicated. Contours are to be drawn at 0.50 m intervals.

Inverts levels of existing drains at regular intervals shall be taken. Top levels of man-holes shall also be taken.

Existing levels at regular intervals and at all junctions for roads, top levels, width, curvature at turning points shall be shown. Any other important detail shall also be shown. Co-ordinates of all existing buildings/structures, hutments and other dwellings including power transmission lines, towers etc. Within the area shall also be indicated.

Bench marks, reference points, triangulation stations, any existing bore-holes, oil wells trial pits etc. used shall be clearly identified in the drawing indicating their values/co-ordinates.

Co-ordinates mentioned above shall be surveyed with respect to the reference axes N-S and E-W.

All survey data collected during the day shall be plotted on the drawing sheet on the same day. These drawings shall be used for following, day-to-day progress of work and for quick reference, if needed.

The data and drawing output shall be compatible with GIS platforms.

3.2 Survey Drawing, Scale and Field Report:

All survey drawings shall be made in metric units.

One set of survey drawings showing all specified details shall be drawn in the scale 1:100. Generally, A-1 size sheets shall be used for drawings.

3.3 DRAFT REPORT

a) Drawings- Two paper copies in colour, One copy on Pen Drive - Maps & Other Drgs. Etc

b) Reports and Records - Two paper copies in colour, One copy on Pen Drive - Maps & Other Drgs. etc

3.4 FINAL REPORT

a) Drawings- Four paper copies in colour, One copy on Pen Drive - Maps & Other Drgs. etc

b) Reports and Records - Four paper copies in colour, One copy on Pen Drive - Maps & Other Drgs. etc

3.5 Accuracy of Work for Survey

For General Survey (Contour & Topographical Details)

Linear Measurement	**:**	**1 in 10,000**
Leveling	**:**	**± 5 √ km mm (Where KM is distance in Kilometer)**

For High Precision Survey (Grid fixing & reference pillars)

Linear Measurement	**:**	**1 in 50,000**
Leveling	**:**	**± 2 √ km mm**
Leveling	:	± 2 □± 2

3.6 Instruments, Tools and Tackles:

The use of proper instruments is an important factor in survey work. The Contractor shall arrange his own instruments, accessories, tools and tackles, camping equipment and transport necessary for conducting the survey as per precision required.

Experienced and qualified engineers, surveyors and draughtsmen shall be engaged to carry out the work.

Each survey team shall have atleast the following survey instruments and accessories.

i) Minimum One Electronic Total Station
ii) DGPS equipment.
iii) Precision Automatic levels with precision levelling staff
iv) Calculators
v) Precision Measuring Tapes
vi) Drawing office Instrument and accessories

vii) Other supporting tools and tackles
viii) Proper communication equipment for communication with Design office.

Note- The above mentioned list of survey instruments is minimum. The contractor shall provide any other instrument if required to carry out the survey work

ANNEXURE - II

TECHNICAL SPECIFICATION
FOR
DETAILED ROUTE SURVEY

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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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 centerline.

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 form 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 center-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 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 that $24\sqrt{K}$ 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:

Back site - Fore Site = ∑Rise - ∑Fall = First R.L. - Last R.L.

2.10.9 Maximum miss-closure shall not exceed 24√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 center 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 Topographical Maps
b.	Additional Route Map	1:15,000
c.	Alignment sheets covering •Right-of-Use Planimetry in UTM grid •Ground Profile	1:2500 along the line 1:2500 across the line 1:2500 Horizontal
d.	Crossing Details (Road/ Railway/ Stream/ Nala/ Canal/ Crossings)	1:100 Horizontal 1:100 Vertical
e.	Crossing details (River Crossings) •Up to 250 m width •250 to 500 m width •Greater than 500 m width	1:200 Horizontal 1:200 Vertical 1:500 Horizontal 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 equipment 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

ANNEXURE - III

TECHNICAL SPECIFICATION
FOR
PIPELINE ROUTE CENTRELINE SURVEY

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
REV	**DATE**	**DESCRIPTION**	**PREP**	**CHK**	**APPR**

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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. A longitudinal slope along pipeline route shall not exceed 1:5

b. A transverse slope across pipeline route shall not exceed 1:1

c. 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:

a. 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).

b. 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.

c. Overall pipeline route map in 1:5000,000 scale.

d. 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

ANNEXURE - IV

TECHNICAL SPECIFICATION
FOR
SOIL INVESTIGATION SURVEY

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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ENERGISING QUALITY

TECHNICAL SPECIFICATION
FOR
SOIL INVESTIGATION SURVEY

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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 bare 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 Bore holes shall be made at an interval of 250 m along the pipeline route or as per SOR, 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. Interval can be increased to 500 M then to 1 km in case soil strata is found to be same. This will required Approval of Company`s Representative / PMC.

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 rail, roads, 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 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.

ANNEXURE - V

TECHNICAL SPECIFICATIONS
FOR
CORROSION SURVEY

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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1.0 SCOPE

The specification covers the corrosion survey including measurement of Soil Resistivity, Chemical Analysis of soil/ water and other Cathodic Protection related data collection along right of way of the pipelines.

2.0 CODES AND STANDARDS

Equipment and measurement techniques shall unless otherwise specified, conform to the requirement of following latest applicable standards: -

BIS Specifications
BS Specifications and Codes of Practice NACE Publications

3.0 GENERAL

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 measurement which is intended to form a basis for design of Cathodic Protection system for the pipeline to be buried along ROW.

4.0 SOIL RESISTIVITY SURVEY

Unless otherwise specified the soil resistivity measurements shall be carried out at intervals of approximately 500 mtr. Or as per SOR along the ROW. Where Soil Resistivity is less than 100 ohm-mtr and two successive readings differ by more than 2:1 then additional Soil Resistivity readings in between the two locations shall be taken.

To carry out the Soil Resistivity measurement, Wenner's 4 pin method shall be used. Latest Soil Resistivity method shall be used for carrying out Soil Receptivity. The depth of resistivity measurement shall be around the burial depth of the pipeline or as per SOR whichever is higher. At locations where multilayer 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 upto 2.5 mtr (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. In general, electrode spacing shall be approximately equal to 1.5 times the depth of the pipelines.

At places where Right-of-way has not yet been cleared measurement shall be made right over the Center-line of pipeline route surveyed accounting for the cuttings/ fillings also.

Observations shall be made enclosing the soils adjoining the trench wherever pipeline trenching has already been done.

The observations shall be made enclosing the soil immediately surrounding the pipeline route where right of way has been cleared but trenching has not been done.

All measurement shall be taken at right angles to the right of way unless otherwise asked by Owner or his representative at site.

At places in right of way 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.

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 HT lines and plants using earth return in their source of power etc.

Wherever possible/ advised by Owner or his representative depth of water table shall be determined by resistivity observations.

All measurements shall be made and recorded in metric units. While recording the data reference to the nearest point shall be made. The provide visual representation of variations in the resistivity along right of way, 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.

5.0 TESTS ON SOIL SAMPLES

Soil/ water samples shall be collected along the right of way for analysis. Samples shall be collected on an average at one location per every 10 km along right of way 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. The soil samples shall be collected at 1 mtr and 2 mtr depth at each location. The collected soil/ water samples shall be analyzed to determine presence and percentage of corrosive compounds including moisture content, oxygen activity and pH value.

6.0 ADDITIONAL DATA COLLECTION

The following data shall be collected with a view to generate design data of evaluation of Cathodic Protection interaction possibilities due to presence of other services in right of way and its vicinity.

i. Route and types of foreign service/ pipelines in and around, running parallel or crossing the right of way.

ii. Diameter, wall thickness, pressure, soil cover etc. of the foreign pipeline.

iii. Foreign pipeline coating details.

iv. Details of existing cathodic protection systems protecting the services including rating and location of grounds bed test station locations and connections schemes etc. Where pipeline is likely to pass close to any existing ground bed, necessary anode-bed potential gradient survey shall be carried out.

v. Interference remedial measures existing on foreign pipelines/ services/shall be collected from the owner of the foreign pipeline/services.

vi. Graphical rep Transformer Rectifier Unit/ CP Power source voltage/ current readings.

vii. Possibilities of integration/ isolation of the pipeline CP System with foreign pipeline/structure CP System, which may involve negotiation with Owners of foreign services.

viii. Crossings or parallel running of any H.T. AC/ DC overhead line with in approximately 25 mtr from ROW along with details of voltage rating, fault level etc.

ix. Voltage rating, phases and sheathing details of parallel running or crossing under-ground cables with ROW.

x. Crossing and parallel running of electrified and non-electrified railway tracks along with details of operating voltage and type (AC/DC).

xi. Information on existing and proposed DC/ AC power sources and system in the vicinity of the entire right of way.

xii. Major river / canal crossings.

xiii. Major cased crossings.

xiv. Any other relevant information that may be needed in designing and implementing of proper Cathodic Protection scheme for the proposed pipeline.

7.0 REPORT

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 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 four prints and copy on PEN DRIVE by the contractor.
The report format shall be approved from Client.

8.0 INFORMATION REQUIRED WITHBID

Bidder shall provide following information along with the bid:

i. Instruments for carrying out soil resistivity survey.

ii. Measures to avoid foreign pipelines/ HT lines etc. affecting the soil resistivity observations.

iii. Measurement location identification procedure.

iv. Procedure for collection of soil samples.

v. Description of soil test procedure.

vi. Specification of soil testing instruments.

vii. Formats for presentation of results.

ANNEXURE - VI

TECHNICAL SPECIFICATIONS
FOR
GEO-TECHNICAL INVESTIGATION

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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ENERGISING QUALITY

TECHNICAL SPECIFICATION
FOR
GEO-TECHNICAL INVESTIGATION

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1.0 SCOPE OF WORK

The scope of services of the contractor for undertaking soil investigation work shall cover all the work connected with soil exploration at the proposed CNG Station including the setting out of locations of the various exploration points from reference point, conducting all field investigations at site, collection of soil and water samples, field and laboratory tests and submission of final report in 4 (Four) copies and copy on PEN DRIVE.

All field investigation, laboratory tests and reports etc. shall be done in accordance with the latest relevant Indian Standard Codes. Reference to any code in these specifications shall mean the latest revision of the code unless otherwise mentioned. In the event of any conflict between the requirements in these specifications and the referred codes, the former shall govern.

2.0 TECHNICAL SPECIFICATIONS OF WORK

The details to be covered in the contract work shall include the following:

i. SOIL INVESTIGATION WORK

ii. FIELD INVESTIGATION AND TEST

This specification deals with Field Investigation/ tests and laboratory tests involved in ascertaining soil stratification & engineering properties of the soil at proposed project site.

The field investigations/ tests comprise of the following:-

EXPLORATORY BORE HOLES

The location of these shall be indicated by M/s HPOIL /M/s VCS before commencement of field activities. The location and number of these bore holes can be altered at site, if found necessary by M/s HPOIL /M/s VCS. All bore holes shall be of 150 mm diameter and shall be sunk into soil to a depth of 10m / 15m or upto refusal strata, whichever is earlier.

The exploratory work at site shall be carried out by using shell and auger equipment.

Disturbed samples for boring shall be collected every 1.5m or change in stratum and representative samples placed systematically for proper logging of the strata. The existing ground level shall be marked in terms of RL. Proper logging shall be done with description of different strata encountered with their reduced levels. All boreholes after completion of work shall immediately be filled in with a mixture of bentonite slurry and clay-sand mixture.

Sampling

In cohesive and semi cohesive soils, undisturbed samples conforming to IS:2132 shall be taken using open tube samples with an area ratio of less than 15% so as to obtain a core of sample of 100mm diameters and 450mm long at every change in stratum or at intervals of 1.5 metre which ever is less. The tube shall be properly marked and the ends of the sample tube shall be sealed properly with wax of thickness not less than 25mm and capped properly immediately after the sample is recovered from the bore holes to ensure no loss of moisture with time while retained in the tube. Sample tubes shall be immediately shifted to the laboratory for testing

Disturbed samples

Representative disturbed samples obtained from boring at every staggered 1.5m interval in depth and change in stratum shall be placed in suitable jars labeled properly for onward transmission to the laboratory. These samples shall be sent to the laboratory immediately after the boring is completed. All SPT samples shall also be similarly preserved.

Undisturbed Sampling

In cohesive and semi-cohesive soils, undisturbed samples conforming to IS:2132 shall be taken using open tube samples with an area ratio of less than 15% so as to obtain a core of samples of 100mm diameters and 450mm long at every change in stratum or at intervals of 1.5m whichever is less. The tubes shall be marked and the ends of the sample tube shall be sealed properly with wax of thickness not less than 25mm and capped properly immediately after the sample is recovered from the boreholes to ensure no loss of moisture with time while retained in the tube. Sample tubes shall be immediately shifted to the laboratory for testing.

Standard Penetration Test (SPT)

The S.P.T. shall be performed at the base of boreholes as per IS:2131 with the first test at a depth of 0.5 m and thereafter at every change in stratum or at intervals of 1.5 metre whichever is less in both cohesive and non-cohesive soil. The S.P.T. shall also be conducted at termination depth of Borehole. Test may also be required to be carried out in compact sand which in normal terminology will be refusal strata. No. of blows required to penetrate every 150mm shall be recorded in case of normal sand, silt or clay as per IS:2131. In case of dense/ hard stratum, the penetration (in mm) for every 20 blows per test shall be recorded. All these field records are to be submitted along with bore logs.

Bent rods and damaged/ defective nipples shall not be used for the test and shall be replaced immediately by proper ones. Centering spacers shall be used at every 6 meters or at smaller intervals in depths to reduce the effect of whipping of rods. Samples collected in process of conducting S.P.T. shall be preserved as disturbed sample. Graphs shall be drawn for each penetration test. Collection of undisturbed samples and conducting S.P.T. tests will be done alternatively.

Plate Load Test

In-situ Cyclic Plate load shall be carried out at a depth of 1.5 to 2.0 m and at the location Decided by EIC. The test shall done in accordance with the provision of the IS:1888 and IS:5249. The testing shall be done for the ultimate load based in the "preliminary 5 days " report. All the required field records, tables, graphs etc and the final observation shall be furnished in the report.

The plate load tests on soil shall be carried out in the trial pits specified in enclosed Drawing and / or at such other locations as directed by the Engineer. This test is to be carried out at 1.5 to 2.0 m below the natural ground level as indicated in the above drawing as directed by the Engineer. The plate sizes to be used shall depend on the nature of the soil, a 45 cm square plate will be used in clayey soil and in sandy soils, three plates of size varying between 30 cm to 75 cm will be used. The test shall be carried out in a manner as to give dependable assessment of bearing capacities of the soils at particular level. The results of the test shall also be used for arriving at the modulus of subgrade reaction and deformation modulus of soil.

The tenderer shall furnish in his tender the complete details of the equipment and method he proposes to follow:

The excavation and side protection during the test and back-filling after the test shall be carried out by the contractor. If ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. The cost of dewatering shall be borne by the contractor.

The contractor will submit, for approval of the Engineer, a detailed arrangement drawing for the tests and satisfy the Engineer about its adequacy in respect of strength and safety and of its being capable of giving accurate data. However, the contractor shall have to modify the arrangement at his own cost if it is ultimately found to be deficient.

The contractor must get the dial and pressure gauges calibrated by an approved testing laboratory before commencing the direct load tests at the site and produce the certificates of the tests to the Engineer. There shall be adequate number of standby gauges available at the site for quick replacement of faulty gauges. The contractor shall bring not less than two dial gauges and one pressure gauge as standby.

In no case settlement observations by means of level and staff shall be accepted.

The tests shall be carried out as described in IS:1888 unless otherwise specifically directed. The application of load may be by gravity or by reaction as detailed out in the above standard.

The test plate shall be pre-loaded with a load of 700 Kg./Sq.m. retained for a reasonable period and then replaced to take out all slacks of the arrangement. All settlement observations shall start thereafter. Unless the ultimate bearing capacity 11 7.01 can be calculated from the available soil data, the contractor shall assess ultimate bearing capacity of the soil under test. Increments of the load shall be of about one fifth of the ultimate bearing capacity. The increments shall continue to an extent that allows locating the 'Yield Value of the Soil' as defined in IS : 1888 or upto practicable limit of testing.

While releasing the loads, the rebounds are to be observed in a similar manner as the settlement observations.

Standing Ground Water Level

Records shall be maintained of the level at which water is struck and the level of any rapid in flow shall also be be left open for a period of two hours to observe the rise of water in the casing. Boreholes can be continued thereafter, upto the end of the day. The level of the water in the casing at the end of the day and at the beginning of the next day shall be recorded properly. For studying the ground water table no drilling mud will be permitted for stabilising the hole.

Laboratory Tests

Laboratory tests shall be conducted on selected samples collected from site to establish the physical and chemical properties of soil. Following tests shall be done as appropriate in accordance with latest relevant Indian code of Practice.

i) Natural moisture content
ii) Void ratio
iii) Liquid plastic and shrinkage limits
iv) Specific gravity
v) Dry density and bulk density
vi) Direct Shear test
vii) Consolidation/ swelling test
viii) Particle size analysis
ix) Triaxial test (undrained quick test)
x) Test on core samples
xi) Chemical properties of the soil & sub-soil water
xii) CBR test

Atterberg Limits

Liquid and plastic limit tests shall be conducted on all cohesive soils for classification purposes and for predicting engineering properties. The results of limit tests shall be plotted on the plasticity chart of A. Cassagrande.Shrinkage limit shall also be determined for a few soil samples.

Particle Size Analysis

Particle size analysis shall be done on all clayey and sandy samples. Both sieve and hydrometric analysis shall be conducted and gradation curves shall be plotted to show the particle size distribution.

Shear Tests

Shear tests shall be conducted on the undisturbed samples. A few unconfined compression tests shall be conducted on clayey samples but the majority of clayey samples in undrained condition shall be subjected to triaxial tests. The cohesion values and angle of internal friction are to be determined either by Mohr's circle or by any other method.

Particular attention shall be paid for conducting triaxial tests, each of which shall be done on a minimum of 3 specimens. Specimens shall be prepared by trimming and not by pushing small tube in a large tube.

Consolidation Tests

A few consolidation tests shall be carried out on undisturbed samples of clayey soil, to estimate the settlement of foundation from "e-log p" curves, compression index - Cc and co-efficient of consolidation – Cu. Consolidation test shall be done in manner that will not allow the sample to swell.

Swelling Test

For soils of expansive nature, swelling tests on a few samples shall be selected for conducting swelling test to determine swelling pressure and magnitude.

Specific Gravity and Bulk Density

These shall be determined as per the standard procedures.

Chemical Analysis of Soil and Sub-soil Water Samples

Water samples from a few bore holes shall be taken and chemical analysis shall be done for sulphate, chloride content and pH value, particularly to determine the aggressiveness to concrete, steel and GI pipes. Care shall be taken to ensure that they are not diluted with rain or surface water during recovery from the

boreholes. Similarly, a few soil samples shall be chemically tested to determine the sulphate contents, chloride content and pH values and other aggressive components as per IS - 2720.

TEST RESULTS AND REPORT

The Contractor shall submit the detailed report wherein information regarding the geological detail of the site, summarised observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report shall be submitted.

The report shall include but not limited to the following

Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarised strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, shall be enclosed.

Recommendations: The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Owner. The observations and recommendations shall include but not limited to the following:

Topography of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc. Slope stability characteristics shall be specifically highlighted.

Recommended type of foundations for various structures.

Allowable bearing pressure on the soil at various depths (1m to 3m depth in general or more depth as per site condition) for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations shall be submitted. Factor of safety for calculating net safe bearing capacity shall be taken as per relevant codes and standard practices.

Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

In case of loose filled up soil or compressible soil recommendation for Pile foundation (End bearing Pile or skin friction pile or under-ream pile) as appropriate shall be recommended along with Geo-technical design of piles. Horizontal Sub-grade Reaction is to be provided by Contractor as per relevant IS code for Pile Foundation design

DRAFT REPORT

a) Drawings- Two paper copies in colour, one copy on Pen drive

b) Reports and Records - Two paper copies in colour, one copy on Pen drive

FINAL REPORT

a) Drawings- Four paper copies in colour, Two copies on Pen drive

b) Reports and Records - Four paper copies in colour, Two copies on Pen drive

3.0 LIST OF INDIAN STANDARDS REFERRED

1	IS: 1498	Classification and Identification of Soils for General Engineering Purposes.
2	IS: 1888	Method of Load Tests on Soils.
3	IS: 1892 (1979)	Code of practice for subsurface investigation for foundations [CED 43: Soil and Foundation Engineering].
4	IS:2131	Method for Standard Penetration Test for Soils
5	IS: 2132	Code of Practice for Thin Walled Tube Sampling of Soils.
6	IS: 2720	Method of Test of Soils (Relevant Parts)
7	IS: 4434	Code of practice for In Situ Vane Shear Test for Soils.
8	IS: 4968-Part-I	Method for subsurface sounding for soils – Dynamic Method Using Cone without Bentonite Slurry.
9	IS: 4968-Part-II	Method for subsurface sounding for soils – Dynamic Method Using Cone and Bentonite Slurry.
10	IS: 4968-Part-III	Method for subsurface sounding for soils static cone penetration test.
11	IS: 5249	Method of Tests for Determination of In situ Dynamic Properties of Soils.

ANNEXURE - VII

TECHNICAL SPECIFICATION
FOR
GEOTECHNICAL INVESTIGATION IN RIVER/WATER BODY CROSSINGS

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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1.0 SCOPE

The Scope of Work under this tender is to carry out Geotechnical investigation by drilling boreholes of up to 20m depth boreholes and collecting soil samples for field / lab investigations. The Soil/ Rock samples collected shall be preserved and stored at locations indicated by Client.

2.0 TECHNICAL SPECIFICATION OF WORK

2.1 Field Investigation and Test

2.1.1 Exploratory bore holes and core drilling

a) BY SHELL & AUGER

All bore holes shall be of minimum 150mm in diameter. The exploratory work at site shall be carried out using shell and auger equipment. The boreholes shall be terminated at a depth, whenever with chiseling and subsequent cleaning with bailer, the bore hole cannot be advanced more than 300mm in one hour. The casing shall be extended upto a maximum depth which could be possible as per site conditions. No bentonite mud shall be used to advance boring. Chiseling shall be carried out with minimum 0.5mm tonne cross type chisel falling from a height of 2.0m. Chiseling and cleaning with bailer shall be done alternately, each operating from 5 to 10 minutes. Refusal to chiseling shall be considered after one hour of chiseling or when progress is less than 30 cms. for each 200 drops, whichever is later. The bore holes thereafter shall be extended by core drilling method using Nx size drilling bits until 50% core recovery is achieved. Cores shall be properly preserved in core boxes and shall be handed over to M/s HPOIL / M/s VCS if required. Whenever clay or other soft material is interspersed in rocky strata, the drilling shall continue deeper into rock to ascertain such formation. Disturbed samples from boring shall be collected at every 1.5 metres or change in stratum and representative samples placed systematically for proper logging of the strata. The existing ground level shall be marked. Proper logging shall be done with description of different strata encountered with their reduced levels. Profile of the different strata shall be plotted joining all adjacent boreholes apart from individual boreholes. All bore holes after completion of work shall immediately be filled in with a mixture of bentonite slurry and clay sand mixture.

b) BY MUD CIRCULATION DRILLING

In case the site conditions require the bore drilling shall be employed using Mud circulation method. It should be adopted in all type of soils. Minimum diameter of bore holes shall be 150mm if the rate of progress of boring in hard strata is observed to be slow (Not more than 20 cm in two hours) contractor may be permitted to adopt core drilling with Nx size bit. However,

the bit for core drilling shall be with double tube core barrel and this core drilling operation shall be at no extra cost to the owner so long as to core recovery is less than 25%. Commencement of rock coring shall be considered at a depth below which

the core recovery is min 25%. For rock strata encountered having RDQ 50% Diamond Head of Nx size drilling bits shall be used.

Termination of bore holes shall not be permitted unless drilling can be completed in desired length as given in Tender.

2.2 Depth of Bore holes

2.2.1 Depths indicated for bore holes or trial pits or any other depth correspond to the depth from general ground level unless otherwise specified.

2.2.2 Boring shall be done to a minimum depth of 20 meters and maximum depth upto 25 meters or as specified by the Engineering-In-charge from the ground level / River / major water bodies Bed level of each location and the location shall be marked in the drawing (The depth of Bore hole may increase / decrease as per the directive of M/s HPOIL / M/s VCS).

2.3 Sampling

2.3.1 Undisturbed Sample

In cohesive and semi cohesive soils, undisturbed samples conforming to IS:2132 shall be taken using open tube samples with an area ratio of less than 15% so as to obtain a core of sample of 100mm diameters and 450mm long at every change in stratum or at intervals of 1.5 metre whichever is less. The tube shall be properly marked and the ends of the sample tube shall be sealed properly with wax of thickness not less than 25mm and capped properly immediately after the sample is recovered from the bore holes to ensure no loss of moisture with time while retained in the tube. Sample tubes shall be immediately shifted to the laboratory for testing.

2.3.2 Disturbed samples

Representative disturbed samples obtained from boring at every staggered 1.5m interval in depth and change in stratum shall be placed in suitable jars labeled properly for onward transmission to the laboratory. These samples shall be sent to the laboratory immediately after the boring is completed. All SPT samples shall also be similarly preserved.

2.3.3 Preservation of Soil/Rock Samples from Bore Holes

The Soil and Rock Samples extracted during the boring shall be preserved in Wooden boxes. The samples shall be properly marked and labeled before packing and the

Wooden boxes shall be marked with Bore hole number, date of drilling, name of Engineer, location and all other relevant details. Duly labeled boxes shall be sealed, transported and stored at a locations shown by E-I-C/ Owner.

2.3.4 Standing Ground Water Level

Records shall be maintained of the level at which water is struck and the level of any rapid inflow shall also be recorded. On reaching such level the borehole shall be left

open for a period of two hours to observe the rise of water in the casing. Bore hole can be continued, thereafter, up to the end of the day. The level of water in the casing at the end of the day and at the beginning of the next day shall be recorded properly. For studying the ground water table no drilling mud will be permitted for stabilizing the hole.

2.4 Laboratory Tests

2.4.1 Introduction

Laboratory tests shall be conducted on selected samples collected from site to establish the physical and chemical properties of soil. Following tests shall be done as appropriate in accordance with latest relevant Indian code of practice.

i) Natural moisture content
ii) Void ratio
iii) Liquid, Plastic and Shrinkage limits
iv) Specific gravity
v) Dry density and Bulk density
vi) Shear Tests
vii) Particle size analysis
viii) Identification of core
ix) Chemical properties of the soil and subsoil water

2.4.2 Atterberg Limits

Liquid and plastic limit test shall be conducted on all cohesive soils for classification purposes and for predicting engineering properties. The results of limits tests shall be plotted on the plasticity chart of A. Casagrande. Shrinkage limit shall also be determined for half of the soil samples.

2.4.3 Particle Size Analysis

Particle size analysis shall be done on all clayey and sandy samples. Both sieve and hydrometric Analysis shall be conducted and gradation curves shall be plotted to show the Particle size distribution.

Contractor has to judicially assess the size of gravels, boulders etc found during boring at site and will provide the justification of variation of sample from the actual site condition and Grain size analysis done in Laboratory.

2.4.4 Shear Tests

Shear tests shall be conducted on the un-disturbed samples. The cohesion value and angle of internal friction are to be determined by Mohr's circle method.

2.4.5 Specific gravity and Bulk density

These shall be determined as per standard procedure.

2.4.6 Standard Penetration Tests

Standard Penetration Tests shall be conducted as per IS Specification in bore hole nos. as specified. These shall be conducted at interval of 1.5m starting first test of 0.5-meter depth below existing ground level. The disturbed representative samples shall be visually classified, labeled for identification and properly preserved for laboratory testing.

3.0 SPECIAL INSTRUCTION

3.1 Each boring and field test shall be conducted under the direct supervision of a qualified and experienced engineer. The bore hole locations shall first be fixed at site with reference to a permanent reference point. A report incorporating all field observation test findings and recommendations for the type of foundation for gas pipeline and methodology for river crossing shall be submitted.

3.2 All data/information is including any unusual data/ information obtained during the execution of the work shall be immediately brought to the notice of M/s HPOIL / M/s VCS.

3.3 Survey and leveling work for establishing location and levels of bore holes and the contractor shall carry out other exploratory work. However, reference point/ lines will be provided by M/s HPOIL / M/s VCS to successful bidder for carrying out such work. Depending on site condition, the locations and nos of test can be altered at site, if found necessary by Engineer-in-charge.

3.4 All field investigations, laboratory tests and reports etc., shall be done in accordance with the latest relevant Indian Standard Codes.

4.0 EQUIPMENT

The Contractor shall provide the following equipment & manpower (minimum) required for carrying out the Soil Investigation works and relevant calibration certificates shall be submitted by Contractor:

A. EQUIPMENTS (MINIMUM)

i. Auger Boring Machine – TWOr Numbers
ii. Drilling Machines -- Two Numbers
iii. Positioning System (GPS) – Two Numbers
iv. Floating Platform -- As per requirement

B. MANPOWER (MINIMUM)

i. Engineer / Supervisor – One Number
ii. Geologist – One Number

5.0 REPORT

Brief report as per standard specification shall be prepared and submitted to M/s HPOIL / M/s VCS as soon as the field and laboratory works are completed in a draft form for review and comments. All the information as mentioned below shall be furnished in the draft copy of final report. After reviewing, contractor shall be informed about comments/ remarks, if any, the same shall be incorporated. The report shall also include but not limited to following: -

1. A drawing of the river/ water body crossing showing in plan, the spot levels and contours along with all the locations of boreholes for geo-tech investigation with respect to the bank edges and the proposed pipeline route and a cross section showing river bed profile along the proposed pipeline route with underlying soil characterization.
2. General geological information of the site.
3. Procedure of investigation and method of various testing adopted.
4. Detailed bore-logs indicate co-ordinates, reduced level, and ground water table etc., subsoil section along various profiles indicating boreholes nos. depth wise in situ tests like SPT.
5. All field and laboratory test results shall be plotted against depth and in tabular form.
6. Summary of results obtained from various tests and their interpretation to evaluate various soil parameters.
7. Comparing the result of Grain Size Distribution obtained from the laboratory test along with field test and interpretation of size of Boulders, Gravels etc. Contractor shall assess the presence of Boulders, Gravel etc. (if any) from field observations. For this presence of an experienced Geologist is mandatory at the Site of work.
8. Classification of strata as per Indian Standard (IS) Code.
9. Silt factor for scourable soil strata, borehole and depth wise shall be furnished in a tabular form.
10. Stable slope near bank both in natural as well as excavated states.
11. Longitudinal lateral friction co-efficient between pipeline and soil.
12. Stable trench slope along the width of the river through.
13. Proposal on the type of foundation for gas pipeline and methodology for river crossing.
14. Anti-buoyancy measures at specified locations.
15. Presence of high levels of chlorides, sulphates and other chemically aggressive elements in soils shall be reported and protective measures suggested.
16. All data be digitized and supported with geo-tagged photographs wherever necessary.

ANNEXURE - VIII

TECHNICAL SPECIFICATIONS
FOR
AREA SURVEY FOR PIPE NETWORK

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	AK
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1.0 METHODOLOGY

Pipeline routes and (if possible DRS location) will be marked and handed over to the Tenderer.

The Tenderer will be provided with pipe routes showing an indicative location of the pipe relative to the road edge on the base map developed by the contractor using high resolution satellite images. In case an obstruction is observed by Tenderer, after consultation with OWNER shall decide whether survey should be along the proposed route or there should be some detouring. The basis of such a detouring should also be clearly noted.

The Tenderer shall carryout a quick survey along the proposed route to find out the accuracy of the available maps and modify the details that has some bearing in laying of the pipe with respect to the proposed guidelines supplied by OWNER. Survey should include the details of the proposed pipeline network such as the total length in the respective area. Survey of the proposed pipeline route shall indicate the following on a route map along with detailed sketches wherever required: a) Physical features (Permanent & temporary) like parks, lawns, buildings, shops, rows of trees etc. b) identification of rivers, nallahs, canal, drains, culverts, survey lines manhole etc. c) Transmission (HT & LT) towers/ poles. d) Highways, roads, lanes & by-lanes. e) Bridges, flyovers and crossings. f) Permanent structures, g) any other major feature along the pipe route.

2.0 LAND BASE CREATION

Land base creation through field survey using DGPS/ total station as per specified accuracy and additional survey of building areas within boundary wall / compound wall, society / building periphery, up to domestic, commercial and industrial customers points of the pipeline as per network.
Survey shall be done inside apartments / societies also for correcting building foot prints digitized over HRSI (High Resolution Satellite Imageries) & checking TF positions where ever pipeline supply points exists. And collect the coordinate of pipeline, turning, crossing within the society premises

All building / apartment / society Areas to be checked for exact location of permanent hard structures, all boundaries and peripheries, fixed assets, TF points, building corners, gates etc. for existing pipeline.

As part of ground survey for all land base features, relative distance / position of one feature w.r.t other feature shall be verified / rectified through DGPS/ ETS at precise level as per ground reality to meet the specified relative accuracy.
Contractor shall record as many nos. of survey points as possible in capturing each and every feature topology & precise position as per ground reality without any human / system errors.

Contractor shall attach detailed specifications of proposed DGPS &Total stations as well as proposed methodology for achieving required land base accuracy.
All permissions required for field / survey/dig verification activities shall be managed by Contractor only. Client can issue a letter for the mentioned activity as per project scope only.

The Tenderer shall submit the measured lengths along the pipe route. All the control points such as Turning points, intermediate points along the pipe route collected using DGPS/ total station should have proper working and shall be communicated with existing structures. The surveyor should specify the road category whether govt. road or private road.

The survey should include identifications of type of buildings i.e. housing/commercial /shopping etc. in the area under consideration along with plot boundary.

i. House No., Number of Stories and no. of houses in one storey.
ii. Plot Size
iii. Distance between House to House
iv. Road & Back lane width
v. Kitchen Location.
vi. Drain centerline/sewage lines
vii. Name of Locality/Colony

TheTenderershallprovideitsfieldsurveyorsfordata–entry/updationofmaps /drawings being carried out by the CAD operators of Contractor and approve the same, checking for correctness and completeness of the maps with respect to the data supplied by the Tenderer surveyor.

The format for collection of data would be approved by Owner.

3.0 LIST OF EQUIPMENTS

The survey team shall be equipped with the minimum following field Survey Equipment:

3.1 Total Station- 2 Nos.
3.2 Auto level Station- 2 Nos.
3.3 DGPS- 2 Nos.
3.4 Pipeline Locator -1 No.

4.0 DELIVERABLES

4.1 Deliverables to be submitted for Detailed Area Network Survey

4.1.1 Submission of Area Map of final route selected, superimposed on Satellite Imagery along with KMZ and Shape file format.

4.1.2 Submission of drawing sheet showing area details along with ground features such as field bund, Road, Cart track, Power line, River, Nala, Canal, Stream, Pump House and other details etc. (as per sample format attached) and drawing should be compatible to GIS platform.

4.1.3 CSV files in soft copy of Raw Data capturing during the Total Station Survey.

4.1.4 Co-ordinates of CSV file shall be DGPS co-ordinate as per UTM Grid System.

4.1.5 Drawings pertaining to survey shall be prepared on computer using AutoCAD (latest version). Agency will give soft copy of all drawings to the Owner/Client/Client for records. Soft copy of the files shall be on CD or other media as agreed to by Agency and Owner/Client/Client. Alignment sheet format shall be used to plot all survey details from the pipeline survey with the following scales:

- Plot Plan Drawings : 1:500
- Contour Drawings : 1:500

5.0 DATA PRESENTATION

Contractor shall ensure that Data collected during the surveys – both spatial and non – spatial shall be updated on the base maps (GIS Maps) on approved GIS software.

ANNEXURE - IX

TECHNICAL SPECIFICATION

FOR

SURVEY OF UNDERGROUND SERVICES USING GPR

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
REV	**DATE**	**DESCRIPTION**	**PREP**	**CHK**	**APPR**

ENERGISING QUALITY

TECHNICAL SPECIFICATION
FOR
SURVEY OF
UNDERGROUND SERVICES USING GPR

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TECHNICAL SPECIFICATION FOR SURVEY OF UNDERGROUND SERVICES USING GPR

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 ±10%.

The accuracy level of depth of services shall be in the order of ±100mm.

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 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.

ANNEXURE - X

TECHNICAL SPECIFICATIONS
FOR
PERMISSIONS

0	29.07.2025	ISSUED AS STANDARD SPECIFICATION	PA	PA	DK
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ENERGISING QUALITY

TECHNICAL SPECIFICATION
FOR
PERMISSIONS

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1 SCOPE:

a) Obtaining Pipeline Crossing Permissions

Scope of services to be provided shall include

- Collection of application format for approval / permission from respective State / Central Authorities.
- Preparation of applications / drawings in the required format.
- Submitting the application with all supporting documents and drawings to the respective Authorities.
- Follow-up and expediting the approval process with the Respective Authorities.
- Obtaining approvals / permissions from the respective final Authorities.
- Arranging signing of agreements if any with concerned Authorities.
- Any other work required to be carried out in relation to any of the above

Obtaining approvals / permissions from appropriate respective State / National and other statutory authorities for the various pipeline crossings en-route such as National Highways, State Highways, other Roads, Rail, River, Canal / Drain/Govt. Land Crossings or any other utility crossing sets.

Owner/Client shall provide necessary letters to the State Govt. / Central Govt. / any other authorities as and when necessary. Necessary technical details of the pipeline for making the applications shall be provided by the Owner/Client. Any statutory and license fees applicable will be paid / reimbursed by the Owner/Client on production of original demand note documentary evidence from the concerned authorities.

It shall be deemed that the Agencies is well acquainted with the nature of work and implications involved in performing the above activities including collection of the required input data from the concerned offices of Revenue Dept. The price offer of the Agencies against this work shall be inclusive of all the expenses to be incurred by them for all the contingencies involved in delivering and discharging the scope of work.
Deliverables:

Each crossing proposal shall contain following information

1. Correspondence letter

2. Crossing permission, payment details

3. Agreement (if any)

4. Data in MIS Format to be included in RoU/RoW Master Software as per standard format so as to have easy access to Owner/Client and also reference material w.r.t. Chainage and type of crossing. [Format attached separately]
Summary of crossings permission, payment deposited agreement..

2.0 PROGRESS REPORTS

Daily progress reports pertaining to the Reconnaissance survey shall be submitted to Authorized Representative of the Client in the following formats

Status of Crossings Permissions

CLIENT:

Pipeline Section

SUB SECTION -
STATUS OF CROSSING PERMISSION AS ON DATE

SL. No.	Type of Crossing	Summary of Progress Achieved.			Total Till date	Permission left	Payment made to authority	Agreement done	Remarks
		Total no. of crossing	Till Previous week	During this week					

Status of Statutory clearance

CLIENT:
StatusofStatutoryClearancefor ---------- CGD Projects
Sub Section -

SL. No.	File No.	Type of crossing	Pipe line Chainage in Km.	. Authority	Date of proposal submitted	Date of permission received	Refundable deposit in Rs.	Non - Refundable deposit in Rs.	Total amount in Rs.	Mode of Payment	Date of payment&Agreement	Remarks

CLIENT:			
XXXXX CGD PROJECT			
DAILY PROGRESS REPORT			
Date : PR No: 0			
Section:___(Ch 0/000 Km to 00/000Km)			
Kms			
Crossing Details			

Asphalted Road at ch 0/000 Km.	Asphalted Road at ch.0/000 Km.	Asphalted Road (ch.0/ Km. State Highway crossing at 0/000 Km Railway Line crossing at Ch 00/046Km.	

Note :	* The physical progress report as per site has been shown.

ANNEXURE-XI

MOBILIZATION, DEMOBILIZATION AND RELOCATION OF EQUIPMENT'S, NECESSARY PLANT AND PERSONNEL

A. MANPOWER (MINIMUM) FOR EACH GA

1. Team Leader - One Number
2. Engineer / Supervisor – Two Numbers out of which one engineer for Liasoning for Permission activities.
3. Geologist – One Number
4. Surveyor – One Survey Teams (three numbers of surveyors in each Survey Team).
5. Draftsman - One Number
6. Semi-Skilled labour as per site requirement
7. Unskilled labour as per site requirement

B. EQUIPMENTS (MINIMUM) FOR EACH GA

1. Total Station – One Numbers
2. DGPS instruments (Base & Rover) -- One Set
3. Level Instrument - One Number
4. GPR Instrument - Two Numbers
5. Auger /Boring Machine – One Numbers
6. Drilling Machines - One Numbers
7. Survey Boat (Owned / Hired) – As per requirement
8. Positioning System (GPS) – One Number
9. Echo Sounder - One Number
10. Floating Platform - As per requirement

Note: The above list of manpower / Equipment is minimum and shall be increased if desired by HPOIL /PMC.

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HPOIL GAS	**ROUTE SURVEY & ASSOCIATED FACILITIES OF PIPELINE ROUTE AND STATIONS AT DIMAPUR, KOHIMA, CHUMUKEDIMA, NIULAND & OTHER DISTRICTS IN NAGALAND GA OF M/S HPOIL**	Energising Quality

LIST OF MINIMUM EQUIPMENT & MANPOWER TO BE DEPLOYED AT SITE

MINIMUM REQUIREMENT FOR THE SURVEY TEAM AND EQUIPMENT'S FOR EACH GA

A. MANPOWER (MINIMUM) FOR EACH GA

1. Team Leader - One Number
2. Engineer / Supervisor – Three Numbers out of which one engineer for Liasoning for Permission activities.
3. Geologist – One Number
4. Surveyor – Three Survey Teams (three numbers of surveyors in each Survey Team).
5. Draftsman - One Number
6. Semi-Skilled labour as per site requirement
7. Unskilled labour as per site requirement

B. EQUIPMENTS (MINIMUM) FOR EACH GA

1. Total Station – Two Numbers
2. DGPS instruments (Base & Rover) -- One Set
3. Level Instrument -- One Number
4. GPR Instrument - Two Numbers
5. Auger /Boring Machine – Three Numbers
6. Drilling Machines -- Two Numbers
7. Survey Boat (Owned / Hired) – As per requirement
8. Positioning System (GPS) – One Number
9. Echo Sounder -- One Number
10. Floating Platform -- As per requirement

Note: The above list of manpower / Equipment is minimum and shall be increased if desired by HPOIL /PMC.

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LIST OF INDIAN STANDARDS REFERRED

1	IS: 1498	Classification and Identification of Soils for General Engineering Purposes.
2	IS: 1888	Method of Load Tests on Soils.
3	IS: 1892	Code of practice for Site Investigations for Foundations.
4	IS: 2131	Method for Standard Penetration Test for Soils.
5	IS: 2132	Code of Practice for Thin Walled Tube Sampling of Soils.
6	IS: 2720	Method of Test of Soils (Relevant Parts)
7	IS: 4434	Code of practice for In Situ Vane Shear Test for Soils.
8	IS: 4968-Part-I	Method for subsurface sounding for soils – Dynamic Method Using Cone without Bentonite Slurry.
9	IS: 4968-Part-II	Method for subsurface sounding for soils – Dynamic Method Using Cone and Bentonite Slurry.
10	IS: 4968-Part-III	Method for subsurface sounding for soils static cone penetration test.
11	IS: 5249	Method of Tests for Determination of In situ Dynamic Properties of Soils.