



Tender No.: HOGPL/2021-22/C&P/009



HPOIL GAS PRIVATE LIMITED
(A Joint Venture of HPCL & OIL)

**SUPPLY OF TYPE-3/TYPE-4 COMPOSITE CYLINDER CASCADES AT AMBALA-
KURUKSHETRA & KOLHAPUR GA**

COMMERCIAL VOLUME
(OPEN DOMESTIC COMPETITIVE BIDDING)

Tender No.: HOGPL/2021-22/C&P/009

Date: 30.07.2021



TECHNICAL SPECIFICATIONS

1. BRIEF OF WORK: -

HOGPL operates Daughter Booster Stations (DB Stations) in the areas where online stations cannot be set up due to non-availability of steel pipeline network. Compressed Natural Gas (CNG) at pressure up to 250 kg/cm² stored within purpose built cascades is to be transported between Mother Stations & DB Stations.

Design, engineering, manufacturing, assembly, testing, inspection at works, supply, and testing at site of Type 3/Type 4 multi element gas container (MEGC) of 4000-4500 & 8800-9400 Litre watercapacity & cascade as per technical specifications given below:

Maximum & Minimum acceptable capacities of Type 3/ Type 4 Composite cylinder cascades or multi element gas container (MEGC) are between:

- a. **4000 to 4500 Litre Water Capacity (LWC) at 15 Deg C**
- b. **8800 to 9400 Litre Water Capacity (LWC) at 15 Deg C**

2. SCOPE

This document covers minimum requirement for design, engineering, procurement, fabrication / manufacture, assembly, inspection, testing at works and supply at site / OWNER's stores CNG storage cascades.

Codes & Standards to be followed: -

- **ISO 11119-1:** Gas cylinders of composite construction - Specification and test methods - Part 1: Hoop wrapped composite gas cylinders.
- **ISO 11119-2:** Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction, and testing — Part 2: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with load-sharing metal liners
- **ISO 11119-3:** Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes — Part 3: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with non-load-sharing metallic or non-metallic liners or without liners
- **EN-12245:** Transportable gas cylinders - Fully wrapped composite cylinders
- **EN 12257:2002:** Transportable gas cylinders— Seamless, hoop wrapped composite cylinders.
- **IS 3224:2002:** Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders.
- **OISD-STD-179-Rev-** Safety requirements on compressors, storages, handling and refuelling of natural gas for use in automotive sector.
- **ISO 11439:** Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles
- **ISO 7866:** - Refillable seamless Aluminium alloy gas cylinders - Design, construction and testing



- **ANSI NGV2-2000 Type 3 & FMB SS304** - Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers
- **GAS CYLINDER RULES – 2016**
- **FRAME STRUCTURAL STEEL SPECIFICATION-IS: 2062: 1992 GRADE-AADR** complied ISO container (Multi Element Gas Container)
- **ISO 668 Series 1** freight shipping containers– classification, dimensions and ratings
- INDIAN EXPLOSIVES ACT.
- **SAFETY DEVICES OF GAS CYLINDER IS:5903-1970**, Recommendations for safety devices for gas cylinders
- **NFPA 52 (Chapter 4)** - Standards for CNG Vehicular systems
- **ISO 11623** - Transportable gas cylinders - Periodic inspection and testing of composite gas cylinders.
- **IS 5844 (1970)**: Recommendations for Hydrostatic Stretch Testing of Compressed Gas Cylinders.
- **EN 1779** :- standard for selection of a suitable method for leak detection and leak tightness testing
- Any other equivalent standards, guidelines, regulations as applicable
- Gas Cylinder Rules – 2016, Indian Explosives Act -1884 stationary and mobile pressure vessels (unfired) rules (SMPV) 1981
- ANSI, ASTM, NEC, NEMA, ASNZ, NFPA NFPA 52 standards for CNG vehicular fuel systems
- Safety devices of gas cylinders is: 5903 -1970, regulations of insurance association

The design, construction, manufacture, supply, testing and other general requirements of the Storage Cascades should be strictly in accordance with the Applicable Standards and Codes and should comply fully with relevant Indian / International standards, Gas Cylinder Rule 1981, Indian Explosives Act- 1884, Stationary and Mobile Pressure Vessels (Unfired) Rules (SMPV) 1981, CNG Cylinder.

The composite cylinders of Type 3/ 4 should be designed as per Design Code, ISO 11119-2/11119-3/ 11439 and the cascade by itself should be as per ISO 11119-2/11119-3 approved IS:7285-2004 (Part 2), CNG Cylinder Valves, IS:3224-1979 (Amendments 1983,84,85,86,89,92,98), Hydrostatic Stretch Test, IS: 5844 – 1970, Safety Devices of Gas Cylinders, IS : 5903 -1970, regulations of Insurance Association of India and Factories Act while carrying out work as per this specification. The cylinders should have the requisite approval from PESO.

The bidder without any additional cost and delivery implications should carry out any modification suggested by the statutory bodies either during drawing approval or during inspection, if any.

3. SITE ENVIRONMENT

The equipment offered shall be suitable for smooth, efficient and trouble free service in the tropical climate prevailing at Ambala-Kurukshetra & Kolhapur.



The equipment shall be designed to give efficient and reliable performance under outdoor industrial conditions and shall be rendered proof against rats, lizards and other vermin.

- **MEGC/Cascade is intended to store gas with following technical composition and quality (Typical)**

<u>Gas component</u>	<u>Mole %</u>
Methane	: 88-98%
Ethane	: 02-08 %
Propane	: 1.21%
Other higher hydrocarbon	: <2% V/V such as
Iso-Butane	: 0.05%
N-Butane	: 0.06%
Iso-Pentane	: 0.00%
n-Pentane	: 0.00%
Hexane	: 0.00%
Nitrogen	: 0.33%
Carbon dioxide	: 0.02%
Sulphur content	: < 5 ppm
Moisture dew point	: minus 15° C

The gas is odorized by use of Mercaptan based odorant.

Typical net calorific value = 8500 Kcal/sm³

Typical specific gravity = 0.56 - 0.70

Typical Moisture Dew Point = minus 15° C.

However, during initiated period of pipeline section operator, moisture is expected. Further certain amount of condensate is expected in the event of breakdowns in upstream processing plants.

Typical Compressibility Factor $Z_b = 0.86$ at 250 Barg and 15° C

Typical Molecular Weight = 19

4. DESIGN BASIS

The Supplier should prepare the design basis required to meet the requirement with respect to technical specification and liaise with PMC/ Client to obtain necessary confirmation and approval.

Design Philosophy

Storage fulfils three functions.

- It allows more vehicles to fill than the compressor could fill directly one after the other during peak times.
- It allows the vehicle to fill at a faster rate than if directly from the compressor.
- It prevents the compressor from stopping and starting too often.

It is anticipated that the natural gas feed composition, flow rate and pressure will be fluctuating.



Hence, Supplier should design the CNG storage facilities with optimum degree of flexibility, reliability, operability to accommodate the varying composition of feed, other unexpected contaminants, flow rate and pressure.

The CNG storage facilities should consist of standardised modules, which are assembled into a complete system. Each system should be designed in standardized modular frames. The modular approach allows the CNG Stationary storage and mobile storage facilities to be easily installed there by reducing installation time.

The design life of the CNG storage facilities should be 20 years.

5. CASCADE DESIGN

- 5.1. The CNG cascade mounted on a load body of vehicle for transportation of CNG is known as mobile cascade.
- 5.2. Cascade shall be a group of identical cylinders of capacity required to meet the specified total water capacity. The cascades shall be provided with structural frame having facility of lifting and placement. The cascades shall be provided with structural frame having proper loading & fixing arrangement on LCV/HCV for transportation purpose.
- 5.3. The composite Cylinders shall be Type-3/ Type 4 (Fully wrapped carbon composite aluminum lined Type 3 cylinders or Fully wrapped Type-4 composite cylinder with non-metallic liner) as per design/drawings approval by Petroleum and Explosive Safety Organization (PESO), Govt of India.
- 5.4. All the applicable statutory codes, national laws and local regulations for safety and Environment protection shall be followed by the vendor while design, engineering & fabrication of cascade. The vendor shall obtain all necessary approvals from concerned authorities.
- 5.5. The MEGC/cascade module shall be suitable for mounting and transportation in the vehicle models as:

Liter Water Capacity	Vehicle Model
4000-4500 WL	EICHER 2059 PRO, CNG MODEL OR EQUIVALENT MODEL (Allowable Load Dimensions: Length: 4.325 mtrs X Width : 2.002 mtrs)
8800-9400 WL	TATA 1412 CNG MODEL OR EQUIVALENT MODEL CAB CHASSIS (Allowable Load Dimensions: Length: 6.09 mtrs X Width : 2.438 mtrs)



Tender No.: HOGPL/2021-22/C&P/009

- 5.6. The cascade dimensions shall be such that it should not violate any RTO/PESO norms for transportation when mounted on vehicle load body.
- 5.7. The overall design of Mobile Cascade (like length, height, width & weight of Mobile cascade) shall be in such a way that the vehicle carrying Mobile cascade shall not pose threat of unbalance, toppling considering the road conditions of Kolhapur and Ambala- Kurukshetra & nearby areas where it is supposed to be utilized.
- 5.8. The adequate protection from sun (UV rays) and rain shall be provided to mobile cascade to protect the cylinders from damage. The mobile cascade shall be designed to take care of the wind load, thrust, vibration etc.
- 5.9. Individual cascade shall have all cylinders of a particular type and capacity. All cylinders in a cascade shall conform to a single design code
- 5.10. The mobile cascade shall be designed to provide adequate ventilation / dispersion of gas in the event of any leakage/busting disc failure.
- 5.11. Each MEGC/cascade module shall be provided with identification plate of stainless steel material of adequate size. The identification plate shall carry the name and logo of HOGPL, including MEGC/cascade serial no., name of manufacturer, year of supply & manufacturing, cylinder serial nos., last hydro test date, maximum working pressure, total water capacity of the MEGC/cascade, and next hydro test due date if applicable and HOGPL serial no. (To be left blank) The matter on the identification plate shall be of suitable size and shall be engraved.

6. Piping / Tubing / Fitting/ Pressure gauges / Temperature gauges

- 6.1. The sizes of all inter-connection tubing (including tubing between main header to individual cylinders) shall be according to requirement of code ANSI-B-31.3 (Main header shall be minimum 3/4" O.D. Sizing & inter connection between main header to individual cylinders shall be minimum 1/2" OD sizing) in conjunction with EEMUA supplement to ASME B31.3 or equivalent design standards. Standards used should be used in total.
- 6.2. The loops in tube work shall be provided for absorbing contraction, expansion, and vibration if any. The piping/tubing shall be suitably clamped to the frame structure. Material used for tubing shall be SS 316 high quality annealed seamless conforming to ASTM A269 with maximum hardness Rb80 and suitable for bending and flaring. Tubing shall be Sandvik/FAE/Tubacex or equivalent make approved by HOGPL.
- 6.3. The cascade shall have 2 nos. filling and decantation point at right hand side of cascade.
 - The 1/2" NPTF stem (QRC) shall be provided for filling and decantation. (MAKE : PARKER)
 - The 3/8" NPTF stem (QRC) shall be provided for filling and decantation. (MAKE : PARKER)
- 6.4. Double compression ferrule Fittings of (Swagelok, Parker, SSP make or equivalent make approved by HOGPL) shall be used in the connection tubes
- 6.5. Vendor to ensure that only one make, out of the specified makes of fittings /valves shall be used in a MEGC/cascade module and no mixing of makes shall be permitted.



- 6.6. Vendor to design the flow rate of whole MEGC/cascade in such a way that gas velocity (erosion velocity) is kept low. The tube, fittings and valves shall be designed for maximum possible flow.
- 6.7. The MEGC shall be equipped with one main cabinet at right hand side of the cascade. It must be equipped with following components,
- Shut off valves – for cylinder sections
 - Distribution block (manifold)
 - Main shut off valve – for cascade isolation while filling/decantation Coupling for filling and decantation 1/2" & 3/8" Quick release coupling nipple
 - Vent valve & vent line
 - Pressure gauge 4" (0 to 400kg/cm²) – 3 nos.
 - Temperature gauge 63 mm
 - Electrostatic earthing reel
- 6.8. The entire tubing and fittings shall be tested for any leakage prior dispatch of cascade. All piping to be tested after assembly to a pressure equal to that of the pressure relief device setting and proved leak free.
- 6.9. All the gauges installed in the cascade/MEGC shall be calibrated and certificate shall be submitted to HOGPL.
- 6.10. The weight of the entire cascade assembly shall not exceed the following:
- 4000 to 4500 LWC cascade: 3.2 Tonnes
 - 8800 to 9400 LWC cascade: 7.5 Tonnes
- 6.11. All rigid piping, tubing and other components on the storage system should be designed for the full range of pressures, temperatures and loadings to which they may be subjected with the factor of safety of at least 4 based on the tensile strength at 20°C. Any materials used including gaskets and packing should be compatible with natural gas and its service conditions.
- 6.12. All fittings including valves shall be of SANDVIK / PARKER /SWAGELOK make. Material shall be SS 316 conforming to ASTM A269. Open ends on fittings and vents shall be provided with caps.
- 6.13. Double compression ferrule Fittings shall be used in tube connection tubes.
- 6.14. Liquid filled pressure gauge of diameter 4", (0-400 kg/cm²) with a 3- way isolating valve or 2 – valve manifold block on each bank shall be used. Thus, each cascade shall have three pressure gauges. Pressure gauges shall be securely mounted.
- 6.15. Every CNG storage unit including each manifold group or bulk storage tank should be provided with a suitable pressure gauge for each bank. The pressure gauge should be directly connected to the tank or storage system. The gauge should be dial graduated to read approximately double the operating pressure.



- 6.16. A good quality industrial pressure gauge should be used with a dial face of at least 63mm or larger. Gauges should be built to requirements of BS 1780 or ANSI/ASME B40.1 or OISD-179 equivalent.
- 6.17. Temperature gauge of diameter 4" with necessary arrangement on high bank only shall be used. Thus each cascade shall have only one Temperature gauge on high bank.
- 6.18. All end connections, pressure & Temperature gauges, valves and fittings of cascade shall be within tamper proof, wire cage enclosure. These shall be on one side of cascade for ease of operation.
- 6.19. Material of vent tubing shall be SS 316 and make shall be of SANDVIK / TUBACEX. make.
- 6.20. Storage cascade system should be supplied in a three-bank arrangement. Low bank 50%, Medium bank 30% and High bank 20% of the total storage system

7. Cylinders:-

- 7.1. The cylinders shall be manufactured as per applicable relevant standard such as:
 - **ISO 11119-2:** Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction, and testing — Part 2: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with load-sharing metal liners
 - ISO 11119- 3: Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes — Part 3: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with non-load-sharing metallic or non-metallic liners or without liners
 - ISO 11120 - Refillable seamless steel tubes of water capacity between 150 L and 3000 L — Design, construction and testing
 - EN-12245: Transportable gas cylinders - Fully wrapped composite cylinders
 - The cylinders shall be constructed as per ISO 11119-1, ISO 11119- 2, ISO 11119- 3, EN 12245 or any other international standard having approval from statutory authority under gas cylinders rules as per OISD-STD-179 – Rev.
- 7.2. Any other equivalent standards, guidelines, regulations as applicable and approved by competent authorities.
- 7.3. The Cylinders in a cascade must be structurally supported and held together as a unit and secured in a manner that prevents movement in relation to the structural assembly and movement that would result in the concentration of harmful local stresses. The frame design must ensure stability under normal operating conditions.
- 7.4. Cylinders in the cascades shall be placed as per OISD-STD-179. In case of horizontal configuration, minimum 20 mm cylinder to cylinder gap shall be provided. The material used to separate the cylinders should be strong enough to take care of load.
- 7.5. Manufacturing date of the cylinders offered shall not be more than one year old as on bid submission date. Test certificates shall be duly endorsed by authorised approving body and issued before delivery.
- 7.6. Cylinder Painting, if required, shall be as per statutory norms.
- 7.7. Neck thread of cylinders shall conform to the IS 3224 or equivalent standard approved by



Tender No.: HOGPL/2021-22/C&P/009

Petroleum and Explosive Safety Organization (PESO), Govt of India.

- 7.8. Each cylinder shall be marked with the cylinder number, service expiry date, working pressure, test pressure, water capacity & tare weight clearly and permanently as per requirements of Gas Cylinder Rule 2016.
- 7.9. Individual Cascade shall have all cylinders of a particular make, type and capacity. All cylinders in a cascade shall conform to a single design code.
- 7.10. The cascade cylinders should be supplied with impact test certification.

7.11. Labeling of cylinders

- 7.11.1. Every cylinder shall be labelled with the name "CNG ONLY" with letter of at least 25mm high in contrasting colour & shall follow all statutory rules.
- 7.11.2. A warning in the following terms shall be attached to every cylinder containing Compressed Natural Gas namely:-
- Do not change the color of the cylinder
 - This cylinder should not be filled with any gas other than CNG.
 - No flammable material should be stored in the immediate vicinity of this cylinder or in the same place in which it is kept.
 - No oil or similar lubricant should be used on the valves or other fittings of this cylinder.
 - Please look for the next date of test, which is marked on a metal ring inserted between the valve and the neck of the cylinder, and if this date is over, do not accept the cylinder.

7.12. Marking of cylinders

- 7.12.1. Every Gas cylinder shall be clearly and permanently marked in accordance with the following conditions by stamping, engraving or similar process;
- on the shoulder of the cylinder which shall be enforced by forging or other means, or
 - on such a part which is inseparably bound with the cylinder and which is not or only negligibly affected by the stresses due to the gas pressure within it.
- 7.12.2. The name plate shall not be affixed to the cylinder by soldering, if there is risk of corrosion or embrittlement.
- 7.12.3. In conjunction with the original marking, space shall be provided for stamping the test date obtained at the periodic inspection.
- 7.12.4. Markings shall be as carried out and the letters and numerals used shall be such shape and size that the marking is clear and easily readable and does not give place for misreading.
- 7.12.5. All cylinders must be permanently stamped with the word CNG together with the following information:
- Manufacturer's, owner's and inspector's marking and rotation number; (These markings shall be registered with the PESO);
 - Specifying that the cylinder has been manufactured for "CNG only"
- 7.12.6. A symbol to indicate the nature of heat treatment (such as normalizing, quenching, or tempering) given to the cylinder during manufacture.
- 7.12.7. The date of the last hydrostatic or hydrostatic stretch test, as the case may be, with the code mark of recognized testing station where the test was carried out. The code mark shall be registered with the PESO.
- Working pressure and test pressure;



Tender No.: HOGPL/2021-22/C&P/009

- Tare weight
- Water capacity.

7.12.8. All the markings, except the manufacturer's marking, which may be on the base, shall be stamped on the neck end of the cylinder.

8. Cascade Frame: -

- 8.1. The frame structure shall not allow lateral and rotational movement of cylinders during regular road transport under any circumstances. Vendor shall take into account of rough road conditions. All items used in the frame shall be weather- proof suitable for outdoor installations.
- 8.2. Refer ISO 6346 for the dimensions of ISO framework for transportation. The cascade frame shall meet the requirement of OISD-STD-179-Rev.
- 8.3. The entire cascade frame dimensions shall not exceed the following dimensions

CAPACITY: 4000- 4500 LWC cascade

- Length - \leq 3.6 Meter
- Width - \leq 1.95 Meter
- Height - \leq 2.2 Meter

CAPACITY: 8800- 9400 LWC cascade

- Length - \leq 5.7 Meter
- Width - \leq 2.438 Meter
- Height - \leq 2.6 Meter

- 8.4. Mobile cascade frame shall be painted/ pasted with HOGPL logo & branding of adequate size as specified by HOGPL EIC from all side of frame.
- 8.5. The frame shall be designed in such a way that, each cylinder shall have proper accessibility to operate cylinder valves in case of gas venting due to any cause.
- 8.6. Supplier shall submit structural drawing of the frame giving details of the steel, welding procedure, corrosion protection for approval of HOGPL representative. The service provider shall carryout Non Destructive Test (NDT) to check porosity in the welded joints. The service provider shall carryout test at his own cost and submit the report to HOGPL.
- 8.7. Frame structure of mobile cascade and its fastening under the maximum permissible load shall be capable of absorbing the applied static forces in all the given directions as per ADR rules (The European Agreement concerning the International Carriage of Dangerous Goods by Roads).
- 8.8. The service provider shall carryout Finite element analysis (FEA) of cascade frame structure to check stress concentrations at various points & to ensure fail safe structure. The service provider shall carryout the analysis at his own cost and submit the reports to HOGPL.
- 8.9. These cascades shall have lugs fitted for lifting and in no case magnetic device to be used for lifting



Tender No.: HOGPL/2021-22/C&P/009

purposes.

- 8.10. The cascade shall have provision for easy access and egress on a low platform or hard compacted ground and this platform or hard ground shall be under a lightroof or canopy designed to facilitate the dispersion of free or escaped gas and shallnot permit gas to be trapped.
- 8.11. The service provider shall provide valve operating procedure & directions for opening and closing of valves at suitable place in the cascade near valves.
- 8.12. The valve keys shall be provided near the valves for easy and timely operation of valves (if valve knobs are not fitted).
- 8.13. The frame must securely retain all the components of the bundle and must protect them from damage during conditions normally incident to transportation. The method of cylinder restraint must prevent any vertical or horizontal movement or rotation of the cylinder that could cause undue strain on the manifold or cylindershell. The total assembly must be able to withstand rough handling, including being dropped or overturned. (Refer CGA TB 25 Design Considerations for Tube Trailers / Tube Modules)
- 8.14. The frame must include features designed for the handling and transportation of the bundle.
- 8.15. The frame structural members must be designed for a vertical load of 2 times themaximum gross weight of the bundle. Design stress levels shall not exceed as per IS 800.
- 8.16. The frame must not contain any protrusions from the exterior frame structurethat could cause a hazardous condition.
- 8.17. The frame design must prevent collection of water or other debris that wouldincrease the tare weight of bundles filled by weight.
- 8.18. The floor of the bundle frame must not buckle during normal operatingconditions.
- 8.19. Each new Cascade design for 4000- 4500 litre water capacity & 8800-9400 Litre Water Capacity must have a design approval certificate. The manufacturer shall obtain approval of a new design along with the Copies of all engineering drawings, calculations, and test data necessaryto ensure that the design meets the relevant specification from a firm of repute e.g. FM / UL or any PESO/CCOE approved competent person/agency.
- 8.20. Seamless cylinders longer than 2 m (6.5 feet) shall be mounted horizontally for transportation on a motor vehicle or in an ISO framework or other framework of equivalent structural integrity in accordance with CGA TB–25.
- 8.21. The service provider shall provide door arrangement from the side of cylinder valves (in case of enclosed cascades). The doors shall haveproper hinges and locking arrangement. This will enable closing of cylinder valve in case of safety/bursting disc failure.
- 8.22. The cascade shall have adequate space for maintenance work. As these cascadesare being used



for mobile purpose, a platform shall be provided at the side of cylinder valve mounting for ease of maintenance.

8.23. Frame Painting:

- 8.23.1. Surface preparation by Short Blasting as per grade SA 2 ½ as per IS 9954/ISO 8501-1, shall be carried out. Three coats of paint shall be applied with minimum thickness of 300 micron. (Permissible thickness in each coat shall be within 80 to 120 micron.)
- 8.23.2. Materials used for the piping shall be stainless steel 316 fully annealed seamless confirming to mASTM A269 with maximum hardness of Rb80 or less and suitable for bending and flaring. OD tolerance shall be (+) 0.005". All fittings including valves shall be of SANDVIK / TUBACEX, SSP and Hylok make. Material shall be SS 316 conforming to ASTM A 182 / A 479 / A 276/ A 269. Open ends on fittings and vents shall be provided with caps.
- 8.23.3. Piping / Tubing shall be suitably clamped to the frame structure.
- 8.23.4. The location of inlet/outlet tube manifold and pressure / temperature gauges shall be towards the length side of cascade for Mobile and width side of cascade for stationary.
- 8.23.5. Material of vent tubing shall be SS 316 conforming to ASTM A 269 and vent height shall be minimum 3 meter above from the working level.
- 8.23.6. The cascade cylinder shall be purged with N2 and maintained at 2 bar (g) pressure before dispatch.

9. Pressure Relief Devices

- 9.1. Each cylinder used for the storage of CNG should be equipped with a suitable pressure relieving device and a suitable isolating valve which should be readily accessible when installed in the storage bank. The isolating valve should not be capable of closing off the pressure relieving device, or should be locked in the open position.
- 9.2. Relief devices should be positioned in such a way as to avoid discharge of high pressure gas to the operator or persons in close vicinity.

10. Safety Relief Devices for cylinder storage

- 10.1. Cylinders manufactured in India, if fitted with safety relief devices in their bodies, shall have such safety devices manufactured and maintained in accordance with IS:5903.
- 10.2. Piping and gas storage systems should be protected against overpressure by safety relief devices. Relief devices installed to protect the storage systems should have sufficient capacity to vent the maximum flow produced by the compressor and should be set to open at a pressure not exceeding 20% above the maximum allowable working pressure of the system or the pressure which produces a hoop stress of 75% of the specified minimum yield strength, whichever is lower.
- 10.3. A combination burst disc/fusible alloy assembly should be incorporated in the cylinder valve. Burst disc should yield at a pressure not less than 1.5 times manufacturer's recommended operating pressure of the cylinder, and not more than test pressure. The disc should relieve



Tender No.: HOGPL/2021-22/C&P/009

pressures in excess of 30Mpa.

- 10.4. In addition to above a mechanical pressure relief valve which opens at a predetermined pressure should be used. This should not be part of the cylinder valve.
- 10.5. Safety relief valves should be provided with means to seal to prevent tampering by unauthorized persons.
- 10.6. Minimum required rate of discharge from the safety valve should be at least equal to any input from the system whether stored or being compressed.
- 10.7. Each safety relief valve should be clearly marked by the manufacturer.
- 10.8. The maximum pressure in the storage system should not exceed 275 bar (g).

11. Valves

- 11.1. Each cylinder shall be provided with a shutoff valve. The cylinder shut-off valve shall be with combination Bursting Disc **OR** pressure activated pressure release device (PPRD) **and** Fusible Plug **OR** Thermally activated pressure release device (TPRD) conforming to requirements of IS-3224 or equivalent standard approved by Petroleum and Explosive Safety Organization (PESO), Govt of India. The valves shall be of approved make of HOGPL.
 - 11.1.1. All Valves fitted to gas cylinders shall comply in all respects with the following Specifications namely:
 - a) In respect of Industrial Gas Cylinder, IS: 3224
 - b) Valves for cylinders shall have outlets provided with left hand screw threads for the pipe or connections.
 - c) The valves shall be attached to the cylinder neck by screwing and not by making any permanent attachment or inserting adapter in between.
 - d) The design of spindle operated valves shall be such that when fitted to the cylinders it shall not be possible to withdraw the spindle under normal operating conditions.
- 11.2. The individual valve shall have the provision to close/isolate the connected individual cylinder in cascade module so that venting of all cylinders shall be avoided in case of burst disc/ fusible plug failure. The burst disc/ fusible plug discharge (vent) shall be manifold to a common header with SS316 fittings at a single location for safe venting in vertical direction facing sky. The valve & bursting disc shall have provision for fitment of tubing in order to ensure manifolding to common header. Vendor shall provide the burst pressure and temperature details to HOGPL.
- 11.3. Each gas storage unit should have a quick action gas storage isolation valve installed in the steel supply pipe immediately adjacent to its gas storage unit to enable individual shut off and isolation of each unit. These valves will be within fence enclosure.
- 11.4. Separate common valve system to be supplied for each storage bank complete with non-return valve.
- 11.5. **Marking on valves**

Valves fitted to the cylinder shall be clearly and durably marked in accordance with the following provisions by stamping, engraving or similar process:



Tender No.: HOGPL/2021-22/C&P/009

- i) Specification of the valves.
- ii) Year and quarter of manufacture.
- iii) Manufacturer's symbol.
- iv) Working pressure.
- v) The name or chemical symbol of the gas for which the valve is to be used.
- vi) The type of screw threads on the outlet namely left-handed (L.H) or Right handed (R.H).
- vii) Inspector's stamp



Tender No.: HOGPL/2021-22/C&P/009

SPECIAL CONDITIONS OF
CONTRACT (SCC) FOR TYPE-3/TYPE
-4 COMPOSITE CASCADES



1. DELIVERY

- 1.1. The date of Bill of Lading/LR shall be considered as the date of delivery for LD calculations
Warranty:-
- 1.2. Vendor shall warrant all material and equipment to be free from defects in design, material and workmanship.
- 1.3. Vendor shall warrant all cylinders to satisfy the requirements of the intended use and be appropriate for application.
- 1.4. Repair/replace any equipment which proves to be defective in accordance with the General Purchase Conditions.
- 1.5. Vendor shall assume responsibility for obtaining manufacturer's warranty of all bought out items.
- 1.6. Vendor shall replace any part not found performing to the specified requirements for at least 18 months from date of delivery or 12 months from the date of successful commissioning. The parts replaced during the warranty period shall have to perform, to the specified requirements for 12 months from the date of replacement or else shall be replaced free of cost.
- 1.7. Vendor shall submit detailed maintenance philosophy during warranty period and after warranty till the life of MEGC/cascade module. Vendor shall also state the maintenance related issues and scope of work throughout life of the MEGC/Cascade module.
- 1.8. The bidder shall have the single point responsibility for all contractual purposes and shall be overall responsible for quality and performance of the package and complete execution of the contract as per the scope, terms and conditions defined in the tender.

2. Warranty:-

- 2.1. Vendor shall warrant all material and equipment to be free from defects in design, material and workmanship.
- 2.2. Vendor shall warrant all cylinders to satisfy the requirements of the intended use and be appropriate for application.
- 2.3. Repair/replace any equipment which proves to be defective in accordance with the General Purchase Conditions.
- 2.4. Vendor shall assume responsibility for obtaining manufacturer's warranty of all bought out items.
- 2.5. Vendor shall replace any part not found performing to the specified requirements for at least 18 months from date of delivery or 12 months from the date of successful commissioning. The parts replaced during the warranty period shall have to perform, to the specified requirements for 12 months from the date of replacement or else shall be replaced free of cost.
- 2.6. Vendor shall submit detailed maintenance philosophy during warranty period and after warranty till the life of MEGC/cascade module. Vendor shall also state the maintenance related issues and scope of work throughout life of the MEGC/Cascade module.



Tender No.: HOGPL/2021-22/C&P/009

2.7. The bidder shall have the single point responsibility for all contractual purposes and shall be overall responsible for quality and performance of the package and complete execution of the contract as per the scope, terms and conditions defined in the tender.

3. Documents to be submitted along with the tender documents

Bidders shall submit following documents, self-attested as a part of technical specifications along with the tender for technical evaluation.

- 3.1. Valid documents towards proof of being manufacturer/Authorized Sales Representative of the Type 3/Type 4 CNG cylinders for MEGC (Multiple Element Gas Cylinder)/cascade.
- 3.2. Approval certificate from Petroleum & Explosives Safety Organization (PESO) India of Type 3/Type 4 cylinders.
- 3.3. In case of local packager/supplier copy of Technical Collaboration agreement between the manufacturer and the packager/supplier (works where bidder intends to carry out packaging).
- 3.4. Inspection release note/ a certificate from the client towards proof of delivery of MEGC/Cascade/Cylinder against the Purchase order
- 3.5. Tender shall be accompanied with actual offered Type-3/Type 4 MEGC/cascade module GA and P&ID drawings and if any.
- 3.6. Detailed QA/QC & shop test procedure

4. Documents to be submitted before delivery of cascades

Bidders shall submit following documents along with the mobile cascades

- 4.1. Production test report of cascade (submitted by cascade manufacturer)
- 4.2. CCOE (PESO) India approval certificate of cylinders / filling permission for the Type-3/Type 4 composite cylinders cascade.
- 4.3. CCOE (PESO) India approval certificate for the cylinder valves & bursting disc along with approved drawings.
- 4.4. Certificates of SS fittings & Valves issued by M/s Swagelok, M/s Parker, M/s SSP & SS tubes issued by M/s FAE, M/s Tubacex or M/s Sandvik or any other makes approved by HOGPL.
- 4.5. Details of stainless-steel tubing, fittings, and valves
 - Make & year of manufacture
 - Material composition
 - Mill test certificates of steel used in manufacture of tubes.
 - Hydro testing tests, chemical & physical tests and other certification
 - Tensile test, hardness test, Eddy current test, Leak test of Tubes
- 4.6. Final G.A. drawing of MEGC/cascade module(including structure), MEGC/cascade tubing schematic, along with Bill of material giving all items installed per cascade, their part numbers,



make and weight. Two copies to be submitted for each cascade, serial number wise.

- 4.7. Test certificates of material used for construction of container/cabin
- 4.8. Test/calibration certificates of gauges, isolation valves and mounting blocks used in distribution line of cascade Structural analysis & finite element analysis (FEA) reports of cascade frame (duly certified by authorized inspection agencies like TUV, SGS & Bureau VERITAS or equivalent)
- 4.9. Conformance of container service life throughout the life of MEGC/Cascade cylinders.
- 4.10. Painting and welding procedure adopted for fabrication of cascade canopy/ISO container
- 4.11. Test certificates for all welded joints of cascade frame structure
- 4.12. Purchase documents
- 4.13. Bidder shall submit static calculations for cascade along with the confirmation on the vehicle considered as per details mentioned above in Technical specifications of MEGC/Cascade

5. Documents to be submitted along with cascades

- 5.1. 3 sets of Operations & maintenance manual per MEGC/cascade module & soft copy of the same. The instruction manual shall describe in detail the construction and recommended procedure for maintaining, operating and troubleshooting the supplied MEGC/cascades enclosed in a container module. The manual shall also include technical literature, catalogues, data sheets and servicing manuals of all bought out items.
- 5.2. 3 sets of hydro test certificate (1 original + 2 copy) for each MEGC/cascade (cylinder serial no. wise).
- 5.3. All final drawings shall also be given in digitized form on CD compatible to latest AutoCAD software version
- 5.4. Inspection release note/ a certificate from the client towards proof of delivery of mobile cascades against the Purchase order

6. Special conditions: -

- 6.1. If required HOGPL may ask the vendor to provide training for safe operation and maintenance of MEGC/cascade. The vendor shall provide the training at his own cost.
- 6.2. The vendor shall ensure safe handling of cascade during transportation from vendor's factory to HOGPL stores. Any damage/mishap to the cascade during transportation shall be borne by vendor.
- 6.3. The vendor shall provide site commissioning assistance for cascades. The service provider shall send skilled technician who will be able to attend any leakages observed during commissioning of cascade.
- 6.4. The doors shall be fitted to the cascade for easy access of cylinder valves in case of safety disc/fusible plug rupture.



Tender No.: HOGPL/2021-22/C&P/009

6.5. Any non-compliance to the specifications and standards shall be immediately brought in to notice of HOGPL.

7. Spares: -

7.1. Vendor shall provide necessary spares and consumables required for start-up and commissioning at no extra cost to HOGPL.

7.2. All the spares shall be properly tagged, coded, wrapped and packaged so that they will be preserved in original condition under the normal conditions of storage.

8. Special Tools and Tackles: -

8.1. Vendor shall supply all Special Tools and Tackles required, if any for normal maintenance. These special tools shall cover the requirements of the individual equipment.

8.2. Vendor supply shall include 4 nos of D - shackle ½” for lifting of MEGC/Cascade module by crane.

8.3. Bidder to provide list of Special tools & tackles for commissioning. Bidder to submit 2-year Mandatory Spare rate as considered in respective items of SOR as per annexure A along with bid.

9. Factory inspection and Field Performance Test: -

9.1. Once the cascades get ready or imported at the vendors plant, the vendor shall raise the inspection call. Accordingly, vendor arrange Third party inspector for inspection of cascade as per QAP of cascade. The cost of TPI shall be borne by bidder.

9.2. Once MEGC/cascades module have been received and connected to our sites, vendor shall depute his representative to demonstrate satisfactory operability of the system within specified parameters for a period of two (2) days after commissioning. There shall not be any back flow between any banks with all valves open during actual operation. If any leakage, back flow or any other malfunction is observed or noticed on any MEGC/cascade during test period, vendor shall do the necessary repairs and repeat the test afresh without any additional cost to HOGPL.

10. EXPERIENCE RECORD PROFORMA FOR CASCADE

Supplier must fill the following format, which is essential to access the bidder's capability.

S. No.	Parameter	Information on offered model
1.	No. of units	
2.	Service	
3.	Working pressure of cascade in bar g	
4.	Site min/ max temp.	
5.	Normal flow from each bank kg/hr	



Tender No.: HOGPL/2021-22/C&P/009

6.	Cascade water capacity-liters	
7.	Water capacity-liter of single cylinder used in cascade	
8.	Material of cylinder	
9.	Thickness of cylinder wall and disc end in mm	
10.	Material of vent tubing	
11.	Piping material and make	
12.	Valve make	
13.	Valve type and dia.	
14.	Nos. of banks in cascade	
15.	Nos. of cylinder in low bank	
16.	Nos. of cylinder in medium bank	
17.	Nos. of cylinder in high bank	
18.	Water capacity of cylinders in individual banks	
19.	Contact person	
20.	4G static calculation for one complete assembled package	
21.	Cylinder burst test for one cylinder	
22.	Design standard (Code) used	
23.	Total weight of cascades in tones	
24.	Burst pressure and temperature for burst disc in bar g and deg C.	
25.	Hydrostatic or Hydrostatic Stretch Test	
26.	Pressure test for leakage	
27.	Design case gas composition	
28.	Approved Manufacturer License certificate from PESO	
29.	Dimensions of the Total package	
30.	Warranty certificates	
31.	Dimension of package max.	
32.	Calibration certificates for all instrument gauges etc of package	
33.	Test certificates of all instruments with cylinder, tubing's, fittings of total package	
34.	Date of commissioning of cascade	
35.	Approval from PESO Nagpur	
36.	Dimensions of package Max.	
37.	Date of commissioning of cascade	
38.	Where cascades are located: Address and fax/telephone no. of	
39.	Major problems encountered, if any	



11. CHECK LIST FOR SCOPE OF SUPPLY

- Vendor shall furnish all the equipment's of Storage Cascade System instruments and gauges and safety devices as per the enquiry document. Anything required over and above what is specified, for safe and satisfactory operation of the equipment package shall be included by the Vendor in his scope.
- Vendor to write YES/NO against each item. Vendor is required to include complete scope, as such 'NO' is not warranted. However, in case for any of the items if supplier's reply is 'NO', supplier should give reason for the same:
- Vendor's scope of supply shall include but not limited to the following:

Sr. No	Description	Specified by Purchaser YES / NO	Included by Vendor YES / NO	Remarks
1.0	Each Storage cascade Package complete with:			
1.1	Specification - Indian Standard 2825, as amended time to time. Similar such other standard code approved by PESO for TYPE – III Cylinder/TYPE IV CYLINDER	YES		
1.2	Cylinder material - Standard code approved by the Chief Controller of Explosives.	YES		
1.3	All the fittings, Valves, Safety devices, gauges are as per IS 3224 or standard code approved by the Chief Controller of Explosives.	YES		
1.4	Tubing's are of rigid type ASTM 316 stainless steel tube.	YES		
1.5	All cylinders are Hydro static Tested	YES		
1.6	Water capacity of single cylinder used in cascade – Litres.	YES		
1.7	Nos. of banks in cascade- three bank system for Stationary Cascade	YES		
1.8	One Cylinder should be burst test	YES		
1.9	4-G Stationary calculation for one complete assembled package is done	YES		



Tender No.: HOGPL/2021-22/C&P/009

1.10	Working Pressure of Cascade min. 250-255 bar (g)	YES		
1.11	Pressure test for Leakage on cylinders with assembled condition	YES		
1.12	Isolation Valve complete with venting line valve and end plug installed on the inlet of the cylinder	YES		
1.13	Copy of Calibration certificates for all instrument gauges etc of Cascade package, Test certificates of all instruments with cylinder, tubing's, fittings of total package	YES		
1.14	BOQ with weight of each component			
1.15	Drawing of cylinder of specified parameters approved by CCOE			
1.16	Drawing of cascade frame			
1.17	Storage cascade with frame assembly is shipped in fully and assembled condition only to be mounted on anchored bolts laid at site.			
1.18	GA drawing of the cascade			
1.19	Warranty for a period of 12 months is provided from the date of final site acceptance of CNG facilities by the Company's.			
1.20	Make of bought out items			
1.21	Detailed time schedule for supply indicating time periods required for cylinder manufacturing, cascade frame fabrication, shop testing, dispatch of material from works at delivery site			
2.0	Spares			
2.1	Mandatory spares as per requirement (Indicate separate price for each item)			
3.0	Inspection and Testing			
3.1	As specified on the Inspection and testing clauses			



Tender No.: HOGPL/2021-22/C&P/009

4.0	Supplier Data and drawings			
4.1	All data & drawings as required per VDR format as per Material Requisition.			
5.0	Supervision during the Trial Run if required at site the CNG storage cascade system			
5.1	Additional Items not specified by purchaser but recommended by bidder for safe smooth and normal operation. (Bidder shall indicate separate list of such items in his proposal)			
6.0	Technical Parameters to be confirmed by supplier			
6.1	Pressure range from 19 bar (g) -250 bar at 15 °C			
6.2	Fill Pressure Kg/cm ² g or [bar(g)] -200			
6.3	Operating Temperature range - [-20°C to 65°C]			
6.4	Design Code : As per latest Gas Cylinder Rule and latest revision of EN 12245 and ISO 11439, for Neck threads and cylinder valves IS 3224 or equivalent standard approved under the gas cylinder rules 2016, ASME/ ANSI B31.3, ASTM A269, OISD-179, Indian Explosive rules, NFPA 52 with latest revision or prior approval of Chief Controller of Explosives(CCOE) PESO, Government of India			
6.5	Calibration traceability - To NIST as per ISO 5168	YES		
6.6	Enclosure weatherproof to - IP65, NEMA 4x	YES		
6.7	Process Temperature effect - ± 0.01% of nominal flow rate/degree C on zero offset	YES		
6.8	All valves as per IS 3224 or as Applicable standard code or approved by CCOE			
6.9	Safety Relief devices as per IS: 5903 or Applicable standard code or approved by PESO			