



GASONET SERVICE (RJ) LIMITED



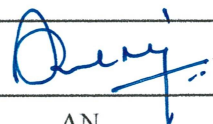
**SUPPLY OF CNG STATIONARY & MOBILE CASCADE IN
HIMACHAL, RAJASTHAN & UTTARAKHAND GA'S**

RESONANCE ENERGY PVT LTD

TECHNICAL VOLUME II OF II

TENDER DOCUMENT NO : GSL/REPL/003/CC

OPEN DOMESTIC COMPETITIVE BIDDING

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SUPPLY OF CNG STATIONARY & MOBILE CASCADE IN
HIMACHAL, RAJASTHAN & UTTARAKHAND GA'S





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	SUPPLY OF CNG STATIONARY & MOBILE CASCADE IN HIMACHAL, RAJASTHAN & UTTARAKHAND GA'S	 Resonance Energy
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1.0 INTRODUCTION

The consortium of Dinesh Engineers Ltd., Resonance Energy Pvt. Ltd., and Tolani projects Pvt. Ltd has been authorized by PNGRB in 11 round of bidding for four Geographical Areas (GA's) of

- 1) Mandi, Kullu, Kinnaur, and Lahaul & Spiti districts in the state of Himachal Pradesh,
- 2) Bikaner & Churu districts in the state of Rajasthan
- 3) Pauri Garhwal, Uttarkashi, Rudraprayag, Tehri Garhwal districts in the state of Uttarakhand,
- 4) Pithoragarh, Almora, Champawat, Chamoli & Bageshwar districts in the state of Uttarakhand

The consortium has establish three companies namely Gasonet Service (HP) Ltd , Gasonet Service (RJ) Ltd , Gasonet service (UK) Ltd, and GA of one and two above has been transferred to GA of Gasonet Services (HP) Ltd , Gasonet Services (RJ) Ltd respectively and GA of 3 and 4 above has been transferred to Gasonet Services (UK)Ltd.

All These companies are engage in City Gas Distribution to supply natural gas for domestic, automobile, industrial and commercial and have corporate office at 807, World Trade, Sector 16, Noida-201301, The corporate is managed by Gasonet service (RJ) Ltd

2.0 BILL OF MATERIAL/ SERVICE REQUIRED:



The intent of this document is to outline minimum requirement for Design, Engineering, Manufacturing, Assembly, Testing, Supply, Testing at manufacturer's works / site, excluding commissioning of CNG storage both Stationary and Mobile storage systems as per Technical specification of tender.

SR. NO.	DESCRIPTION	QUANTITY
1	CASCADE-STATIONARY-CNG (TYPE-1 4500 WL)	08
2	CASCADE -STATIONARY-PNG (TYPE-1 4500 WL)	08
3	CASCADE-MOBILE (TYPE - 3/4 4500 WL)	02
4	CASCADE –MOBILE (TYPE – 3/4 8800 WL)	04

▪ SPARE PARTS :

Supply of spares parts of cascade i.e Pressure Gauge range (0-400 kg/cm²), Cylinder Valve with end tube fitting, Isolation valve, Check valve, Tube Pig Tail, Burst Disc with washer, Spindle & handles for Cylinder valves, Safety Relief device are in bidder scope.

Note : Bidder to quote w.r.t. SOR

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❖ **TECHNICAL SPECIFICATION OF TYPE-1 CNG CASCADE**

3.0 CODES AND STANDARDS

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.

Design Code, IS:7285, 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 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.

CODES AND STANDARDS TO BE FOLLOWED

Latest edition shall be followed

- IS 7285: Specification for seamless steel cylinders for permanent and high pressure liquefiable gases.
- IS 3224:2021: Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders.
- IS 5844 – 2014: Hydrostatic Stretch Test
- IS 5903 – 2014: Safety Devices of Gas Cylinders
- OISD – 179: Safety requirements on compressors, storages, handling and refueling of natural gas for use in automotive sector.

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

PNGRB Regulation: Notification on 9th March 2016 (with Principal regulation notification no. G.S.R 612(E), dated 27th August 2008, amended vide G.S.R 750 (E) dated 14.10.2009, F. No. M (I)/T4S/CGD/1/2010 dated 16.12.2014.

GAS CYLINDER CASCADE: A battery of cylinders connected with each other, a tube trailer, multiple element gas containers and bundle of cylinders, conforming to the specification: BS EN - 13769, BS EN - 13807, ISO-10961 or any other specification accepted by the Chief Controller of Explosive.

All the applicable statutory codes, national laws and local regulations for safety and environment protection shall be followed by the supplier for design, engineering, fabrication etc. The supplier shall obtain from concerned authorities all necessary approvals.

4.0 SITE CONDITIONS

The climatic conditions to be considered for selection, design and derating of equipment shall be as



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indicated below:

- Maximum Wind Velocity : 160 Km/hr
- Maximum Ambient Temperature : 48 °C
- Minimum Ambient Temperature : 3 °C
- Design wet bulb Temperature (WBT) : 27 °C
- Relative Humidity : 90 %
- Altitude, M above MSL : 12.48 meters

The equipment offered shall be suitable for smooth, efficient and trouble free service in the tropical climate prevailing at site as indicated above.

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.

5.0 DESIGN BASIS & PHILOSOPHY

5.1 DESIGN BASIS

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

6.0 DESIGN PHILOSOPHY

Storage fulfils three functions.

1. It allows more vehicles to fill than the compressor could fill directly one after the other during peak times.
2. It allows the vehicle to fill at a faster rate than if directly from the compressor.
3. 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 thereby reducing installation time.

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

6.1 GAS COMPOSITION

Component	Design case mole. %
Methane	94
Ethane	1.2
Propane	1
i-Butane	0.4
n- Butane	0.00



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i- Pentane	0.00
n- Pentane	0.00
Carbon Dioxide	1.8
Carbon Monoxide	00
Nitrogen	1.6
SUM	100

NOTE:



- Oxygen: Not more than 0.5% mole.
- Total non-hydrocarbon: Not more than 2.0 mole%
- Total Sulphur including H₂S: Not more than 100 ppm by weight.
- Expected H₂S content not more than 4 ppm by volume
- Water content: Less than 112 kg/MMSCM specific gravity
- Mass density (kg/Sm³) : 0.736
- Molar mass (kg/Kmol) : 17.3551
- Above mentioned is for reference

7.0 SCOPE OF SUPPLY AND SERVICES

Supply of CNG stationary and mobile storage cascades as per clause 2.0 (- 0%, + 5%) at 15°C with following minimum details:

Cylinders & Others

- All cylinders should be designed, constructed and tested in accordance with the Indian Standard 2825, as amended from time to time, IS : 7285 Part II or similar such other standard code approved by the Chief Controller of Explosives
- Robust painted Iron cascade frame. The iron surface shall be properly cleaned, primer and paint selected and applied to have a service life of at least 3 years. The exterior of the equipment is required to be corrosion free for at least three years and to have a fade free life without oxidation of paint surface for at least three years in an environment of bright sunlight with an intense UV content. The bidder to specify the grade of paint intended to be used.
- Material of Flange, Header pipe, female nipple for vent manifold should be of Carbon Steel (CS).
- Interconnecting tubing/piping, fitting, valves.
- Non return valves (NRVs) as required for three bank operation.
- Pressure on each bank (Low, Medium & high Bank).
- Temperature gauge on high Bank.
- All other items required for use of cascade as mobile for transportation of gas shall be properly fitted and the drawing of cascade shall be approved by OWNER prior to supply.

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7.1 SERVICES

The services to be rendered by supplier shall include but not limited to the following:

- Preparation and submission of documents/ drawings as per schedule under point “D” of MR and Gas flow calculations, 4-G static test Calculation of one complete assembled cascade with all the cylinders mounted & filled and sequencing calculations for cascade for maximizing the recovery from the cascade storage for residual cylinder pressure of incoming vehicle for refill pressure 35 barg.
- Obtaining approvals from concerned departments/ agencies/ statutory authorities such as BIS Certificate, PESO etc.
- Procurement of raw materials, bought out components, fabrication, shop assembly.
- Pipe work should be designed, tested and installed to ensure its safe operation at the worst conceivable conditions of flow, pressure and temperature.
- Shop inspection and testing including third party inspection (TPIA) or inspections by OWNER’s delegate and statutory approvals.
- Testing at site, if required.
- Packaging, crating, dispatch of cascades.
- Cascade commissioning assistance.
- Paintings as per the present document.
- Preparation and submission of documents / drawings as per schedule.
- Bidder to submit foundation and other drawings indicating requirement of work to be carried out by Owner within one month of placement of order.
- Supervision during trial run, if required.

8.0 TECHNICAL SPECIFICATIONS

The following specification is to give the supplier the technical and operating conditions the cascades must fulfil. Features other than those indicated herein but which call for a better design, increase in efficiency, enhance reliability, optimization may be accepted subjected to OWNER’s approval. The Supplier may submit their bid for any alternative design as optional item which maybe indicated separately describing all advantages. The cascade shall be shipped in completely assembled condition. Gas supply line and delivery connection shall be made at site.

The supplier shall bid in their main offer, items according to the technical specifications outlined below.

8.1 CASCADE

8.1.1 Cascade shall be a group of identical cylinders of capacity required to meet the specified total water capacity, dimensional and weight limitations. The cascades shall also be provided with structural frame having facility of lifting and placement.

8.1.2 Cascade Storage Capacity

The water storage capacity of cascade shall be as per clause 2.0 (-0%, +5%) water litres at 15 degree C (Cylinders conforming to IS: 7285).



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- 8.1.3 Direction in each unit. Each such storage unit should be separated from other units by a distance of not less than 2m. Where horizontal units are placed parallel to each other, cylinder fittings should be arranged so that they do not face cylinder fittings of other units.
- 8.1.4 The water liter capacity of any individual cylinder in-group of cylinders forming cascades shall not exceed 75 liters for 4500 water liter capacity cascades.
- 8.1.5 The design, construction & testing of cylinder shall be as per IS 7285 and approved by Petroleum and Explosive Safety Organization (PESO), Government of India for use in India for specified conditions. -
- 8.1.6 Storage cylinder manufactured older than 2022 shall not be accepted.
- 8.1.7 Working Pressure of cascade cylinder shall be minimum 250 bar g at ambient temperature.
- 8.1.8 Cylinder material shall be seamless alloy steel (Cr-Mo) as per design / drawings approval by approved by Petroleum and Explosive Safety Organization (PESO), Government of India.
- 8.1.9 Cylinder neck threading shall be as per IS 3224- 2002 or as per design approved by PESO, Government of India.
- 8.1.10 Offered Cascades shall be of 75 liters Water Capacity cylinders and supplier shall observe minimum neck threads size of dia 25.4 mm standard. Type 4, Size 2 threads with a taper of 1 in 8 on diameter confirming to IS-3224: 2002 or equivalent.
- 8.1.11 The cylinder shut-off valve shall be with combination Fusible Bursting Disc conforming to requirements of IS 3224: 2002 or as per design approved by PESO, Government of India
- 8.1.12 The burst disc shall rupture on excess pressure as well as excess temperature either individually or combined. The burst disc discharge shall be manifold to a common header for safe venting. Supplier shall indicate burst pressure and temperature.
- 8.1.13 The cylinder shut-off valve orifice shall be designed for high flow to permit the combined flow of 100 kg/min from each bank at pressure of 250 bar g. Supplier to furnish necessary calculations indicating overall pressure drop for each bank, Coefficient of flow (Cv) values, valve orifice size etc.
- 8.1.14 Number of cylinders in the Stationary cascade shall be divided into three independent banks of low, medium and high pressure of different storage volumes. Supplier shall optimize the number of cylinders in each bank for maximizing the recovery from the cascade storage and submit the calculations along with the bid. Supplier may assume the residual cylinder pressure of the vehicle coming for refill at 35 bar g.
- 8.1.15 All Stationary storage system should be supplied in a three bank arrangement. Low bank 50%, Medium bank 30% and High bank 20% of the total storage system.
- 8.1.16 The interconnecting tube work of cylinders manifold in configuration suitable for priority filling and sequential dispensing system by the electronic CNG dispensers at the Retail Outlets.
- 8.1.17 Full bore ball valves for isolation shall be provided at inlet of each fill line and at each bank outlet line. The final end connection at battery limit shall be 3/4" OD with union and double ferrules for directly connecting a 3/4" OD tube.
- 8.1.18 Ball Valve must be of good quality and be appropriately selected frequency of use.
- 8.1.19 Ball valve seats must be suitable for natural gas operation of the gas composition indicated.
- 8.1.20 Valves and fittings subject to corrosion must be either inherently resistant, or be coated with a corrosion inhibiting paint or surface treatment.
- 8.1.21 The interconnecting tube work shall be minimum of 3/4"OD tubing except pressure gauge lines & vent loops. The sizing of connecting tubing between each outlet and its associated cylinders shall be such that where they join the total incoming flow areas shall not be less than outgoing area. The loops in tube work



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shall be provided for absorbing contraction, expansion and vibration piping / tubing shall be suitably clamped to the frame structure.

- 8.1.22 Pipe work should be designed, tested and installed to ensure its safe operation at the worst conceivable conditions of flow, pressure and temperature
- 8.1.23 The system should be “go-no-go” gaugable to demonstrate that fittings are properly tightened. Wherever possible valves and control devices should incorporate the same end connector system. The number of fittings used should be minimized.
- 8.1.24 A Test and Inspection certificate issued by the manufacturer of the cylinder duly countersigned by an Inspector that the Cylinder meets the requirements of the standard or code referred above submitted to PESO shall be provided.
- 8.1.25 All cylinders should be new and unused. Re-certified cylinders are not acceptable. Before using the Cylinder or before refilling the cylinder, which has to be made gas free, air contained therein shall be purged by Nitrogen only. Cylinders of 75 liter water capacity at 15°C are only envisaged. All cylinders in a cascade shall be of same capacity.
- 8.1.26 The Supplier should ensure that Personnel assembling the piping work should be competent in the system employed.
- 8.1.27 The preferred valve types for isolation are ¼” turn ball valves. Such valves have similar material to the attached tube / Fittings.
- 8.1.28 Cylinders in the cascade may be vertically or horizontally placed. In case of horizontal configuration, minimum 30mm cylinder to cylinder gap shall be provided (Conforming to requirements of OISD-179). The material used to separate the cylinders should be sufficiently strong enough and should not absorb moisture. Special precautions should be taken to avoid corrosion at the point of contact.
- 8.1.29 All cylinder valves and fittings must be rated for the full range of temperature and pressures and the manufacturer should stamp or otherwise permanently mark the valve body to indicate the service rating.
- 8.1.30 Double compression ferrule Fittings shall be used in tube connection tubes.
- 8.1.31 Each cylinder shall be hydrostatically tested by the cylinder manufacturer. Third Party Inspection agency shall review the test certificate of the manufacturers.
- 8.1.32 The location of inlet/ outlet tube and pressure gauges shall be as per approved drawing.
- 8.1.33 Cascade to be purged with N2 after testing and shipped with a positive pressure of N2 in the cascade. Suitable arrangement for venting natural gas shall be provided at a level above the cascade shed (or roof) in case of a leakage.
- 8.1.34 Suitable vent to be provided for stationary cascade. The height of the vent should be 3m from the base of the cascade.

8.2 MARKING OF CYLINDERS

- a) Every Gas cylinder shall be clearly and permanently marked in accordance with clause 14 of IS 7285 Part (2):2017 & following conditions by stamping, engraving or similar process;
- a.1 on the shoulder of the cylinder which shall be enforced by forging or other means, or
- a.2 on such a part which is inseparably bound with the cylinder and which is not or only negligibly effected by the stresses due to the gas pressure within it.
- b) The name plate shall not be affixed to the cylinder by soldering, if there is risk of corrosion or embrittlement.
- c) In conjunction with the original marking, space shall be provided for stamping the test date obtained at



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- the periodic inspection.
- d) 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.
 - e) All cylinders must be permanently stamped with the word CNG together with the following information:
 - e.1 Manufacturer's, owner's and inspector's marking and rotation number; (These markings shall be registered with the PESO);
 - e.2 Specifying that the cylinder has been manufactured for "CNG only"
 - e.3 A symbol to indicate the nature of heat treatment (such as normalizing, quenching, or tempering) given to the cylinder during manufacture.
 - e.4 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.
 - e.5 Working pressure and test pressure;
 - e.6 Tare weight
 - e.7 Water capacity.
 - f) All the markings, except the manufacturer's marking, which may be on the base, shall be stamped on the neck end of the cylinder.

8.3 MARKING ON VALVES

Valves fitted to the cylinder shall be clearly and durably marked in accordance with clause 14 of IS 3224:2021 & following provisions by stamping, engraving or similar process:

- 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.

8.4 LABELING OF CYLINDERS

- 8.4.1 Every cylinder shall be labeled with the name "CNG ONLY" with letter of at least 25mm high in contrasting color and the name and address of the Purchaser by whom the cylinder was filled with gas.
- 8.4.2 A warning in the following terms shall be attached to every cylinder containing Compressed Natural Gas namely:-
 - i) Do not change the color of the cylinder
 - ii) This cylinder should not be filled with any gas other than CNG.
 - iii) No flammable material should be stored in the immediate vicinity of this cylinder or in the same place in which it is kept.
 - iv) No oil or similar lubricant should be used on the valves or other fittings of this cylinder.



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- v) 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.

8.5 PIPE WORK, VALVES AND FITTINGS

Pipe work should be designed, tested and installed to ensure its safe operation at the worst conceivable conditions of flow, pressure and temperature.

All pipe work should be ASTM 316 stainless steel tube. Double compression ferrule Fittings shall be used in tube connection tubes. And makes of these fittings shall be of SS 316/ SS 304 of Swagelok, Parker and equivalent. The system should be "go-no-go" gaugable to demonstrate that fittings are properly tightened. Wherever possible valves and control devices should incorporate the same end connector system. The number of fittings used should be minimised. The Supplier should ensure that personnel assembling the pipework should be competent in the system employed. The preferred valve types for isolation are 1/4" turn ball valves. Such valves have similar material to the tube they are attached to. Ball valves must be of good quality and be appropriately selected frequency of use. Ball seats must be suitable for natural gas operation of the gas composition indicated. Valves and fittings subject to corrosion must be either inherently resistant, or be coated with a corrosion inhibiting paint or surface treatment.

The gas inlet connection of each bank shall be terminated with 3/4" union after the isolation valve.

8.6 PRESSURE RELIEF DEVICES

- 8.6.1 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.
- 8.6.2 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.

8.7 SAFETY RELIEF DEVICES FOR CYLINDER STORAGE

- 8.7.1 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.
- 8.7.2 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.
- 8.7.3 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 pressures in excess of 30Mpa.
- 8.7.4 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. The maximum pressure in the storage system should not exceed 275 bar (g).
- 8.7.5 Safety relief valves should be provided with means to seal to prevent tampering by unauthorized persons.
- 8.7.6 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.
- 8.7.7 Each safety relief valve should be clearly marked by the manufacturer.



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8.7.8 The cascade cylinders should be supplied with impact test certification.

8.7.9 The mobile storage capacity should be 4500 WL and the dimensions should not exceed L x W x H (According to the Vehicle used) fixing of SS Tubes & Components will be finalised during detail engineering.

8.8 CORROSION PROTECTION

8.8.1 Pressure vessels which are made of materials that are subject to corrosion by atmospheric conditions should be protected by painting or other equivalent means necessary to prevent corrosion.

8.8.2 Importance should be drawn to avoiding corrosion which can limit the working life of a cylinder and affect the fatigue characteristics in serious cases. The implementation of good periodic maintenance anti-corrosion procedures is strongly recommended.

8.9 VALVES

8.9.1 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 pipes 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.

8.9.2 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.

8.9.3 Separate common valve system to be supplied for each storage bank complete with non-return valve.

8.10 CASCADE FRAME

8.10.1 The frame shall not allow lateral and rotational movement of cylinders during regular road transport under any circumstances. Suppliers shall take into account the rough patches / bumpson roads.

8.10.2 Frame shall be free standing and have facility for lifting by crane and forklift the complete assembled cascade. Bottom and top of frame shall be reinforced to prevent any twisting or strain to inter-connections among cascade cylinders during lifting by crane, forklift and during the transport.

8.10.3 Frame structure of each cascade shall be capable of withstanding 4G impact (four times gravity) from any direction without any distortion. Supplier to submit 4-G static test Calculation of one complete assembled cascade with all the cylinders mounted.

8.10.4 Each storage system should be supplied with suitable lifting lugs. Bottom and top of frame shall be reinforced to prevent any twisting or strain to inter connections among cascade cylinders during lifting by crane, forklift and during transport.

8.10.5 Cascade storage system to be skid mounted and complete with removable metal frames and non-metal / non-sparking spacer material.

8.10.6 Cascade and spacer frame to be painted with anti-rust and etching primer under coat. Importance should be drawn to avoiding corrosion which can limit the working life of a cylinder and affect the fatigue characteristics in serious cases. The implementation of good periodic maintenance anti-corrosion



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procedures is strongly recommended.

- 8.10.7 All cylinder tubing, manual isolation valves and pressure relief valves should be protected from knocking by any moving object and should not protrude outside the metal frame or brackets.
- 8.10.8 Frame shall be suitably covered with canopy from top to avoid the ingress of Sunlight & rain water. The storage of the cascade of cylinders should be made in a well – ventilated shed having a light roof or canopy with at least one side open conforming to Gas Cylinder Rule: 2016.
- 8.10.9 All items used in the frame shall be weatherproof.
- 8.10.10 Supplier shall submit structural drawing of the frame giving details of the steel, welding procedure, corrosion protection for approval of Owner / Owner's representative before commencing fabrication work.
- 8.10.11 Frame shall support the cylinder adequately and allow the cleaning of cylinder.

8.11 PIPING / TUBING / FITTING/ PRESSURE GAUGES / TEMPERATURE GAUGES

- 8.11.1 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.
- 8.11.2 All piping should be designed in accordance with engineering calculations based on the requirements of ASME B31.3 in conjunction with EEMUA supplement to ASME B31.3 or equivalent design standards. Standards used should be used in total.
- 8.11.3 All welding piping should be fabricated and tested in accordance with ANSI/ASME B31.3, API 1104 or an equivalent standard. Whichever standard is chosen for use, it should be used in total.
- 8.11.4 All piping to be tested after assembly to a pressure equal to that of the pressure relief device setting and proved leak free.
- 8.11.5 Materials used for the piping shall be stainless steel 316 fully annealed seamless conforming to ASTM A269 with maximum hardness of Rb80 or less and suitable for bending and flaring. OD tolerance shall not exceed +0.005%. The piping/ tubing material shall be of Sandvik / Tubacex/ FAE/ Ratnamani make.
- 8.11.6 All fittings including valves shall be of Swagelok/ Parker/ Hamlet and equivalent make. Material shall be SS 316/ SS 304 conforming to ASTM A182/ A276 Open ends on fittings and vents shall be provided with caps.
- 8.11.7 Double compression ferrule Fittings shall be used in tube connection tubes.
- 8.11.8 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.
- 8.11.9 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.
- 8.11.10 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.
- 8.11.11 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.
- 8.11.12 All end connections, pressure & Temperature gauges, valves and fittings of cascade shall be within tamper proof, wire cage enclosure/ OEM design. These shall be on one side of cascade for ease of operation.
- 8.11.13 Material of vent tubing shall be SS316/SS304 and make shall be of Sandvik / Tubacex/ FAE/ Ratnamani



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and equivalent make.

8.12 PAINTING

EVERY CYLINDER IS PAINTED WITH THE APPROPRIATE IDENTIFICATION COLORS SPECIFIED IN IS: 4379:2021 FOR INDUSTRIAL CYLINDER

COLOR OF THE CYLINDER SHELL ---

WHITECOLOR OF BAND AT NECK AND OF

CYLINDER ----- WHITE

COLOR OF THE FRAME -----YELLOW

8.12.1 The paint shall be chosen, primed and applied as to have a service life of five (5) years. The exterior surface is required to be corrosion free for five (5) years and to have faded free life without oxidation of paint surface for five years in an environment of bright sun light with an intense UV content.

8.12.2 Surface preparation by Shot Blasting as per grade SA 2 1/2, IS 9954 / ISO 8501/ IS 7285 (Part 2):2017. Three coats of paint shall be applied with minimum thickness of 300 micron. The recommended painting system should be of Category C5-I Very high (Industrial) as specified in the Standard ISO 12944 Part 1 to 8. The proposed Painting system shall conform to Table A 5 of ISO 12944 – 5 Standard.

8.13 MOBILE STORAGE CASCADES

- All Mobile storage system should be supplied in a single bank arrangement.
- All the Cylinder Specifications, valves, safety relief devices, pressure gauges, pressure Relief devices etc shall remain same as mentioned in the Stationary cascades but not limited so.
- Each cylinder of mobile cascades used for the transport of compressed natural gas shall be a type approved by the PESO/ CCOE.
- Every cylinder used for transportation of compressed gas shall be constructed and tested in accordance with IS: 2825, as amended from time to time, or BS5045:Part1 or (US) D.O.T 3AA or similar such other standard code approved by the Chief Controller of Explosives.
- The design stress shall include an allowance to include an allowance to enable the cylinder to withstand shocks normally encountered by the movements on road, such as acceleration and deceleration for a minimum of 4g (4 times gravity).
- All the attachments to the cylinders shall be protected against accidental damage which may result from collision, overturning or other operational cause.
- All the cylinders shall be designed to withstand the most severe combined stresses to which they may be subjected to by the pressure of the gas, the pumping pressures and shock loading caused by transport conditions.
- The isolation valves and the end connections shall be terminated at the left side of the storage frame.
- End connections shall be such that tube manifold accessible from side of the vehicle and can be connected to station piping from any one side of the vehicle.

8.14 PROTECTION OF VALVES & ACCESSORIES

- All valves and accessories shall be safeguarded against accidental damage or interference.
- Valves and accessories shall be mounted and protected in such a way that risk of accidental rupture of the branch to which the valve or accessory is connected is minimized.



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- Valves and accessories situated at the rear of a vehicle shall be protected by the rear crossmember of the frame of the vehicle against damage.

8.15 EQUIPMENT

- Piping, Fittings and meters:
 - (a) All piping, fittings and meters mounted on the cascade shall be designed to withstand the most severe combined stresses imposed by the following, namely.
 - (i) The maximum designed pressure of the vessel.
 - (ii) The super imposed pumping pressure of the shock loading.
 - (b) The materials used for vessel equipment shall be sufficient ductile to withstand rough usage and accidental damage. Brittle materials such as cast iron shall not be used.
- Protection of piping and equipment;
 - (a) All piping and equipment shall be adequately protected to minimize accidental damage which may be caused by rough usage, collision or overturning;
 - (b) Any equipment or section of piping in which liquid may be trapped shall be protected against excessive pressure caused by thermal expansion of the contents.
- Marking of connections-

All connections on the vehicle which require manipulation by the operator of the vehicle should be clearly marked to prevent incorrect operation. The form of this marking should correspond with the operating procedure laid down for the vehicle.

9.0 INSPECTION AND TESTING

- 9.1.1 Before bringing any items of equipment to site, factory testing should be carried out to demonstrate the function of all equipment within the system if so desired.
- 9.1.2 Supplier shall be given 2 weeks' notice of the date and location of the tests so that the equipment may be witnessed if desired.
- 9.1.3 Upon delivery to the site, all the equipment should be assembled in a complete system. Thereafter, final site acceptance test would be carried out. Such tests should be witnessed and signed off by the Company representative. The Supplier should rectify and replace all defects, faults, failures, etc. and all costs should be borne by Supplier. The costs should include accommodation, travelling, expenses, etc.
- 9.1.4 Supplier shall carry out 4G static calculation of one complete assembled cascade with all the cylinders mounted and filled and submit the same for Owner review.
- 9.1.5 Supplier shall carry out cylinder bursting test of one cylinder from the entire batch produced for supply to OWNER in case offered cylinders are of new design (conforming to the requirement of IS 7285. Supplier shall inform the schedule of the test well in advance to enable Owner or their authorized representative to deputee technical personnel for witnessing the test.
- 9.1.6 Supplier shall carry out all standards shop tests/QA/QC as per recommendation of manufacturer/Chief Controller of Explosives. Copies of the testing/inspection carried shall be furnished to OWNER.
- 9.1.7 Supplier shall furnish record of storage capacity check of each cylinder in a cascade and the same need to be demonstrated to Owner or their authorized representative.
- 9.1.8 Each assembled storage cascade with all tubing, valves shall be pressures tested to ensure existence of no leakage prior to dispatch.
- 9.1.9 Manifold of the cascade shall be tested to 250-bar g. The manifold shall be checked for



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sequencing and no back flow between any two banks with all valves open.

- 9.1.10 Dispatch Clearance to be given by OWNER after final Inspection to be witnessed by OWNER/Third Party Inspection agency appointed by OWNER.



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❖ **TECHNICAL SPECIFICATION OF TYPE-3/4 CNG CASCADE**

Maximum & Minimum acceptable capacities of Type 3/ Type 4 Composite cylinder cascades or multi element gas container (MEGC) are between 8800Litre Water Capacity (LWC). The commercial evaluation shall be based on Per Litre Water Capacity.

Number of Type 3/Type 4 composite cylinder mobile cascades required – As per SOR.

1.0 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-A ADR** 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

2.0 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 odourant.

Typical net calorific value = 8500 Kcal/sm³

Typical specific gravity = 0.57 - 0.69

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

3.0 Technical specifications of MEGC/Cascade :-

- 3.1 The CNG cascade mounted on a load body of vehicle for transportation of CNG is known as mobile cascade.
- 3.2 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.
- 3.3 The composite Cylinders shall be Type 3 or Type 4 (Fully wrapped carbon composite aluminium 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.
- 3.4 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.
- 3.5 The MEGC/cascade module shall be suitable for mounting and transportation in the vehicle models Tata LPT 1412g CNG or equivalent.
- 3.6 The height of cascade frame shall be up to 2.6 m (max). The cascade dimensions shall be such that



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it should not violate any RTO/PESO norms for transportation when mounted on vehicle load body.

- 3.7 The overall design of Mobile Cascade (like 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.
- 3.8 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.
- 3.9 Individual cascade shall have all cylinders of a particular type and capacity. All cylinders in a cascade shall conform to a single design code
- 3.10 The mobile cascade shall be designed to provide adequate ventilation / dispersion of gas in the event of any leakage/busting disc failure.
- 3.11 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 GSL, 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 GSL serial no. (To be left blank) The matter on the identification plate shall be of suitable size and shall be engraved.

4.0 Cylinders :-

- 4.1 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.
 - Any other equivalent standards, guidelines, regulations as applicable and approved by competent authorities.
- 4.2 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.
- 4.3 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.
- 4.4 Manufacturing date of the cylinders offered shall not be more than one year old as



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on bid submission date. Test certificates shall be duly endorsed by authorised approving body and issued before delivery.

- 4.5 Neck thread of cylinders shall confirm to the IS 3224 or equivalent standard approved by Petroleum and Explosive Safety Organization (PESO), Govt of India.
- 4.6 Painting of Cylinders (if required) : - All cylinder pigmenting should be as per directions of CCOE, PESO, Govt of India
- 4.7 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.
- 4.8 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.

5.0 Cylinder Valves: -

- 5.1 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 of EMER / VTI or any equivalent make may be used excluding Vanaz make valves.
- 5.2 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/SS304 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 GSL.

6.0 Tubing & Fittings: -

- 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) 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 SS316/SS304 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 GSL.
- 6.2 The cascade shall have common filling and decantation point at right hand side of cascade.



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The 3/8" NPTF stem (QRC) shall be provided for filling and decantation.

- 6.3 Double compression ferrule Fittings of (Swagelok, Parker, SSP make or equivalent make) shall be used in the connection tubes
- 6.4 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.
- 6.5 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.
- 6.6 The MEGC shall be equipped with one main cabinet at right hand side of the cascade. It must be equipped with following components,
 - a) Shut off valves – for cylinder sections
 - b) Distribution block (manifold)
 - c) Main shut off valve – for cascade isolation while filling/decantation
 - d) Coupling for filling and decantation 3/8" Quick release coupling nipple
 - e) Vent valve
 - f) Pressure gauge 4" (0 to 400kg/cm²)
 - g) Temperature gauge 63 mm
 - h) Electrostatic earthing reel
- 6.7 The entire tubing and fittings shall be tested for any leakage prior dispatch of cascade.
- 6.8 All the gauges installed in the cascade/MEGC shall be calibrated and certificates shall be submitted to GSL.

7.0 Cascade Frame: -

- 7.1 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.
- 7.2 Refer ISO 6346 for the dimensions of ISO framework for transportation. The cascade frame shall meet the requirement of OISD-STD-179-Rev.
- 7.3 The cascade frame dimensions shall not exceed the following dimensions
 - a) Length – 5.5 Meter
 - b) Width – 2.5 Meter
 - c) Height – 2.6 Meter
- 7.4 Mobile cascade frame shall be painted/ pasted with GSL logo & branding of adequate size as specified by GSL EIC from all side of frame.
- 7.5 The frame shall be designed in such a way that, each cylinder shall have proper accessibility to



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operate cylinder valves in case of gas venting due to any cause.

- 7.6 Supplier shall submit structural drawing of the frame giving details of the steel, welding procedure, corrosion protection for approval of GSL 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 GSL.
- 7.7 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).
- 7.8 The service provider shall carryout Finite element analysis (FEA) of cascade frame structure to check stress concentrations at various points & to ensure failsafe structure. The service provider shall carryout the analysis at his own cost and submit the reports to GSL.
- 7.9 The cascade module shall have 4" liquid filled pressure gauge (0-400 Kg/Cm²) connected in tube with a 3 way valve manifold at refilling/decantation point. Thus each cascade module shall have at least two pressure gauges.
- 7.10 These cascades shall have lugs fitted for lifting and in no case magnetic device to be used for lifting purposes.
- 7.11 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 light roof or canopy designed to facilitate the dispersion of free or escaped gas and shall not permit gas to be trapped.
- 7.12 The service provider shall provide valve operating procedure & directions for opening and closing of valves at suitable place in the cascade near valves.
- 7.13 The valve keys shall be provided near the valves for easy and timely operation of valves (if valve knobs are not fitted).
- 7.14 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 cylinder shell. 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)
- 7.15 The frame must include features designed for the handling and transportation of the bundle.
- 7.16 The frame structural members must be designed for a vertical load of 2 times the maximum gross weight of the bundle. Design stress levels shall not exceed as per **IS 800**.
- 7.17 The frame must not contain any protrusions from the exterior frame structure that could cause a



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hazardous condition.

- 7.18 The frame design must prevent collection of water or other debris that would increase the tare weight of bundles filled by weight.
- 7.19 The floor of the bundle frame must not buckle during normal operating conditions.
- 7.20 Each new Cascade design beyond 4500 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 necessary to 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.
- 7.21 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.

The service provider shall provide door arrangement from the side of cylinder valves (in case of enclosed cascades). The doors shall have proper hinges and locking arrangement. This will enable closing of cylinder valve in case of safety/bursting disc failure.

- 7.22 The cascade shall have adequate space for maintenance work. As these cascades are being used for mobile purpose, a platform shall be provided at the side of cylinder valve mounting for ease of maintenance.

8.0 Special conditions:-

- 8.1 If required GSL 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.
- 8.2 The vendor shall ensure safe handling of cascade during transportation from vendors factory to GSL stores. Any damage/mishap to the cascade during transportation shall be borne by vendor.
- 8.3 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.
- 8.4 The doors shall be fitted to the cascade for easy access of cylinder valves in case of safety disc/fusible plug rupture.
- 8.5 Any non-compliance to the specifications and standards shall be immediately brought in to notice of GSL.

9.0 Spares:-

- 9.1 Vendor shall provide necessary spares and consumables required for start-up and commissioning at no extra cost to GSL.
- 9.2 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.



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10.0 Special Tools and Tackles:-

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

11.0 Factory inspection and Field Performance Test:-

- 11.1 Once the cascades get ready or imported at the vendors plant, the vendor shall raise the inspection call. Accordingly GSL Engineer will arrange Third party inspector for inspection of cascade as per QAP of cascade.
- 11.2 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 GSL.

12.0 Warranty:-

- 12.1 Vendor shall warrant all material and equipment to be free from defects in design, material and workmanship.
- 12.2 Vendor shall warrant all cylinders to satisfy the requirements of the intended use and be appropriate for application.
- 12.3 Repair/replace any equipment which proves to be defective in accordance with the General Purchase Conditions.
- 12.4 Vendor shall assume responsibility for obtaining manufacturer's warranty of all bought out items.
- 12.5 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.
- 12.6 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.
- 12.7 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.

13.0 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.





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- a) 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
- b) Approval certificate from Petroleum & Explosives Safety Organization (PESO) India of Type 3/Type 4 cylinders being offered
- c) PO copies of supply for at least 5 no. of Type 3/Type 4 composite cylinder cascades with minimum capacity of 4500 LWC in India in the form of MEGC/cascade for the similar application on lease/supply basis in past five financial years.
- d) 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).
- e) Inspection release note/ a certificate from the client towards proof of delivery of MEGC/Cascade/Cylinder against the Purchase order
- f) Tender shall be accompanied with actual offered Type-3/Type 4 MEGC/cascademodule GA and P&ID drawings and if any.
- g) Detailed QA/QC & shop test procedure

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TENDER DOCUMENT NO: GSPL/REPL/03/CC		Date: 05/11/2022



14.0 Documents to be submitted before delivery of cascades

Bidders shall submit following documents along with the mobile cascades

1. Production test report of cascade (submitted by cascade manufacturer)
2. CCOE (PESO) India approval certificate of cylinders / filling permission for the Type-3/Type 4 composite cylinders cascade.
3. CCOE (PESO) India approval certificate for the cylinder valves & bursting disc along with approved drawings.
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 equivalent* make.

* The material should be successfully supplied & working in any of the CGD companies operating in India.

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
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. One copies to be submitted for each cascade, serial number wise.
7. Test certificates of material used for construction of container/cabin
8. Test/calibration certificates of gauges, isolation valves and mounting blocks used in distribution line of cascade
9. Structural analysis & finite element analysis (FEA) reports of cascade frame (duly certified by authorised inspection agencies like TUV, SGS & Bureau VERITAS or equivalent)
10. Conformance of container service life throughout the life of MEGC/Cascade cylinders.
11. Painting and welding procedure adopted for fabrication of cascade canopy/ISO container
12. Test certificates for all welded joints of cascade frame structure

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13. Purchase documents

14. Bidder shall submit static calculations (As referred in Clause-6 of Cascade Frame details) for cascade along with the confirmation on the vehicle considered as per details mentioned above in Technical specifications of MEGC/Cascade (Clause-6).

15.0 Documents to be submitted along with cascades

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.
2. 3 sets of hydro test certificate (1 original + 2 copy) for each MEGC/cascade (cylinder serial no. wise).
3. All final drawings shall also be given in digitized form on CD compatible to latest AutoCAD software version
4. Inspection release note/ a certificate from the client towards proof of delivery of mobile cascades against the Purchase order