TECHNICAL SPECIFICATION
OF
TYPE-3 / 4 COMPOSITE CYLINDER
CNG CASCADE (9000 WL & 4500 WL (+/- 5%))

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CONTENTS

1. BRIEF PROJECT DETAILS

M/s. Bharat Gas Resources Limited (BGRL) has been set up to develop City Gas Distribution (CGD) Network in various GAs across India for distribution of CNG and PNG to various consumer segments.

2. SCOPE OF SUPPLY & WORK:

The scope of work includes design, engineering, manufacturing, assembly, supply, inspection and testing at works and at site, if required, of CNG Mobile Storage Cascade of 9000 WL (+/- 5%) capacity and 4500 WL (+/- 5%) at 15°C, for filling and storing of CNG at 255 Kg/cm2 (g) at 10 to 52°C as specified in Technical Specification.

Notes:

a. Delivery locations of the cascades shall be intimated to the supplier at the time of dispatch.

3. SITE ENVIRONMENT

a. Ambient temp min/max °C: 6°C / 50 °C
b. Design relative humidity: 90 %
c. Design Temp: 60 °C
d. The equipment offered shall be suitable for smooth, efficient and trouble free service in the tropical climate prevailing at site as indicated above.
e. The equipment shall be designed to give efficient and reliable performance under industrial conditions and shall be rendered proof against rats, lizards and other vermin.

4. INSTRUCTIONS TO BIDDERS

(i) This specification describes the technical specification of the equipment to be supplied at various locations as per material requisition (MR).

(ii) Various parts of the specification shall be read in conjunction with each other. In case where requirements given in different parts differ, the most stringent shall govern.

(iii) The specification states the scope and requirements as completely and clearly as

possible. Any additional work/equipment or technical requirement not mentioned in the specification but required to make the offered system complete in accordance with the specification or required for safe operation shall be deemed to be included in the offer.

(iv) The drawings and reference information mentioned else wherein this specification shall be considered as part of this document. Anything specified in this specification but not clearly shown in the drawings, or vice versa shall be treated as indicated in both specification and drawings and hence binding.

(v) The Bidder shall confirm clause by clause acceptance of technical specification. Comments and/or deviation if any, of the Bidder on Owner's document (including technical specification) shall be given clause wise. Clauses, on which no specific comment or deviation will be indicated in the offer, shall be treated as accepted by the Bidder.

(vi) It will be the responsibility of the Bidder to comply fully with relevant National/ International standards, Indian Explosives Act, Regulations of Insurance association of India and Factories Act, while supplying materials and/or carrying out work as per this specification.

(vii) It shall also be the responsibility of the Bidder to prepare and submit all necessary drawings, calculations, test certificate etc. as required by concerned inspectorate.

(viii) The Bidder, free of cost and without affecting agreed milestones, shall carry out modifications suggested by the statutory bodies.

(ix) The Bidder shall be deemed to have inspected the site area and access and ascertained all conditions affecting the contract. The Bidder shall be deemed to be fully conversant with the complete requirements of the work.

(x) Civil engineering work i.e. foundation, trenches etc. shall be arranged by Owner. The Bidder shall submit foundation and other drawings indicating requirement of work to be carried out by Owner within two weeks of placement of order. In case the requisite information regarding requirement of slots, holes, pipe and other fixing inserts etc. as required for proper installation of equipment is not indicated by the Bidder within two weeks from placement of order, such facilities shall have to be arranged/ provided by the Bidder at their own cost.

(xi) All work shall be carried out to the satisfaction of the Owner. Any work found to be carried out without the approval of Owner or work which is considered to be unsatisfactory and of poor quality of workmanship shall be rectified by the Bidder without any additional cost.

(xii) The Bidder shall not vary the scope of work as detailed in the approved drawings and

specification, without written permission of the Owner. The work shall be done as per approved prints of the drawings only.

(xiii) The Bidder shall complete and fulfill all formalities with the statutory authorities having jurisdiction in the area. Bidder shall also arrange for inspection and approval of installation.

(xiv) The Bidder shall attend weekly progress meetings and all other meetings called by the Owner. The Bidder's representative shall have the authority to make all decisions related to the Contract.

(xv) The Bidder shall provide the weekly progress report in duplicate. The reports shall clearly define all major activities completed during the previous week and identify manning levels, programs etc. The report format shall be provided by / finalized after discussion with the consultant for adherence by the Bidder.

(xvi) The Bidder shall correct all project original drawings with "As Built" information and shall on completion of erection of the equipment submit originals of all finalized drawings to the Owner.

(xvii) All pages of the offer shall be numbered and contents with page numbers shall be given at the beginning. All pages of the offer shall be submitted in bound volume.

(xviii) Loading/Unloading of equipments and supply up to sites/stores shall be in the scope of bidder.

(xix) 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 Chief Controller of Explosives shall be provided to the Purchaser.

5. GAS COMPOSITION (For reference)

The expected Gas composition of the feed Gas to the CNG Cascade is given below:

Component	%Mole
Methane	88 to 98
Ethane	2 to 8
Propane	0.39
i-butane	0.08
n-butane	0.06
i-pentane	0.00
n-pentane	0.00
Hexane	0.00
N2	0.08
Co2	0.00
Sulphur content	<5 ppm
Odorant	10 PPM
Moisture dew point	-15 Deg. C

Oxygen: Not more than 0.5 mole%

Total Non Hydrocarbon: Not more than 2.0 mole%

Total Sulphur including H2S: about 24ppm by weight,

Water Content :< dry

Specific Gravity (SG): 0.55 - 0.63

6. CODES AND STANDARDS TO BE FOLLOWED

The design, construction, manufacture, supply, testing and other general requirements of the Storage Cascades should be strictly in accordance with the latest Applicable Standards and Codes and shall comply fully with relevant Indian or International standards, Gas Cylinder Rule 2016, Indian Explosives Act-1884, Stationary and Mobile Pressure Vessels (Unfired) Rules (SMPV) 1981, CNG Cylinder Design Code, IS:7285, 2004 (part-2), CNG Cylinder Valves, IS:32241979 (Amendments1983,84,85,86,89,92,98) 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.

The following codes and standards (versions, revisions valid on the date of order) are referenced to & made part of specification:

- The Gas Cylinders rules-2016
- CCOE (PESO India), Petroleum& Explosives Safety Organisation.
- NFPA 52 Standards for CNG vehicular fuel systems and CNG cylinder code "IS:7285-2004 (PART-2).
- ASME / ANSI B31.3, Piping Process Code
- ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- EN12245: Transportable gas cylinders- Fully wrapped composite cylinders
- OISD 179 Safety requirements for compression, storage, handling and refueling of CNG 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 19078 Gas cylinders – Inspection of the cylinder installation, and requalification of high pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles,
- ISO 11623, Gas cylinders – Composite construction—Periodic inspection and testing
- ECE R110 "High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles"
- NFPA 52: Vehicular Natural Gas Fuel Systems Code.
- STATIC AND MOBILE PRESSURE VESSELS (UNFIRED) RULES (SMPV) (Latest Edition).
- CNG CYLINDER DESIGN CODE IS: 7285 2004 (Part-2).
- CNG CYLINDER VALVES, IS: 3224 (Latest Edition).
- HYDROSTATIC STRETCH TEST IS: 5844 (Latest Edition)
- SAFETY DEVICES OF GAS CYLINDERS IS: 5903 (Latest Edition)- Regulations of Insurance Association

- INDIAN EXPLOSIVES ACT
- ANSI, ASTM, NEC, NEMA, ASNZ
- ANSI NGV-2 : Compressed Natural Gas Vehicle Fuel Containers
- **ISO 11119-1:** Gas cylinders of composite construction - Specification and test methods - Part 1: Hoop wrapped composite gas cylinders
- ISO 11119-2 : Gas cylinders of composite construction
- **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

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

7. EXTENT OF SUPPLY AND SERVICES

7.1 SUPPLY

Supply of CNG storage cascades along with Interconnecting tubing / piping, fitting, valves of water liter capacity as specified in Schedule of rates (SOR) with following minimum details:

7.1.1 Cylinders

7.1.2 Each cylinder equipped with cylinder shut –off valve and fusible burst disc.

7.1.3 Cascade frame shall be MS welded; shot blasted and epoxy painted instead of Galvanized.

7.1.4 Non return valves (NRVs) as required.

7.1.5 Pressure gauge on each bank.

7.1.6 Supply of anchor bolts and nuts.

7.1.7 Canopy

7.1.8 Safety Relief Valve and Pressure Relief Valve.

7.1.9 Any other item required for completing the cascade assembly.

7.2 SERVICES

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

7.2.1 Preparation and submission of documents/drawings as per schedule.

7.2.2 Obtaining approvals from concerned departments/agencies/statutory authorities.

7.2.3 Procurement of raw materials, bought out components, fabrication of cylinders and shop assembly.

7.2.4 Shop inspection and testing including third party inspection and statutory approvals.

7.2.5 Testing at site, if required.

7.2.6 Supervision during trial runs, if required.

7.2.7 Packaging, crating, dispatch of cascades.

8.0 TECHNICALSPECIFICATIONS

The following specification is intended to give the vendor the technical and operating conditions the cascades must fulfill. Features other than those indicated herein but which call for a better design, increase in efficiency, enhance reliability, optimization may be accepted subject to approval from owner / consultant. The vendor shall bid in their main offer items according to the technical specifications outlined below:

8.1 CASCADE

8.1.1 Each CNG cascade module (cascade enclosed in a container module) shall have storage capacity as per SOR / MR. The number of cylinders in the cascade shall be clubbed to single bank with minimum 3/4" OD SS Tube with common isolation valve additional to cylinder valves.

8.1.2 All cylinder pigmenting shall be as per directions of Chief Controller of Explosives (CCOE), PESO,Government of India and assembled into a free standing, galvanized steel welded frame enclosed in a container module. MEGC (Multiple-element gas container) / cascade module shall have provision for lifting by crane from top of frame with full weight of cylinders filled with compressed natural gas (at 255kg/cm2 pressure) and shall have tie down clamps at the top and bottom. Bottom and top of frame shall be reinforced to prevent any twisting or stress to cylinder connection during lifting by crane. Frame painting specification shall be indicated in the GA drawing, and successful bidder to submit the same for client's / consultant's approval.

8.1.3 Maximum height of the MEGC/cascade module offered, for transportation of CNG through Medium / Heavy Commercial vehicles, shall be as per the rules governed by Regional Transport Office (RTO) India.

8.1.4 The overall design of MEGC / cascade module (like height, width & weight of MEGC / cascade module) shall be in such a way that the vehicle carrying MEGC/cascade module shall not topple.

8.1.5 MEGC / cascade module shall be painted all side with Client logo of adequate size. Each cylinder shall have proper accessibility to operate cylinder valves in case of gas venting due to any cause. MEGC / Cascade module shall be provided with standard container locking type arrangement and also there shall be provision for bolting of MEGC/Cascade module to the mounting vehicle.

8.1.6 The frame structure shall not allow lateral and rotational movement of cylinders during regular road transport under any circumstances. Bidder shall take into account of rough road conditions. All items used in the frame shall be weather-proof suitable for outdoor installations.

8.1.7 Each MEGC / cascade module shall be provided with identification plate of stainless steel material and of adequate size. The identification plate shall carry the name and logo of Client's 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 Client's serial no. The Information on the identification plate shall be of suitable size and shall been graved.

8.1.8 Each bank of MEGC / cascade module shall have 4" liquid filled pressure gauge (0-400kg/cm2g) connected in the tubing with a 3-valve manifold (isolation and vent) at refilling point and decanting point. Thus each MEGC / cascade module shall have three pressure gauges. One common Temperature gauge of the range 0-200 deg C shall also be provided.

8.1.9 Construction, licensing & inspection, markings, fitment, handling, storage and all other relevant aspects of cylinders and fittings shall be governed under latest edition of 'The Gas Cylinders Rules-2016' and all cylinders and valves shall be approved by Chief Controller of Explosives (CCOE) PESO, Government of India. In case any factor, parameter or requirement given in the tender or offered by the vendor is changed or modified by CCOE

(PESO) or any other Indian Statutory Authority be for delivery of MEGC / cascades to site, same shall be carried out without any extra cost implication to Client and to the satisfaction of CCOE or statutory authority, as the case may be.

8.1.10 Cylinders in the cascade shall be horizontally placed. In case of horizontal configuration a minimum gap of 30 mm or as per the statutory requirements & subjected to Client approval between cylinders to cylinder shall be provided and maintained. The material used to separate the cylinders shall be sufficiently strong enough, and shall not absorb moisture. The separation material shall be antistatic in nature. Special precautions shall be taken to avoid corrosion at the point of contact.

Individual Cylinder valves must be accessible for routine operation and emergency operation.

8.1.11 Each cylinder shall be equipped with a high flow shut-off valve and safety relief device consisting of fusible plug and burst disc assembly. The cylinder valve shall conform to the requirements of IS: 3224 or as per design approved by Chief Controller of Explosives (CCOE), PESO, Govt. of India. The fusible plug and burst disc assembly shall rupture on excess pressure as well as excess temperature either individually or combined, as per internationally accepted standards and code of practices. Vendor shall indicate burst pressure and temperature.

8.1.12 Neck threads of the cylinders shall conform to the requirements of IS: 3224 or equivalent standard approved.

8.1.13 Each cylinder shall be marked clearly and permanently as per the provisions of the requirements of rule 6 of the Gas cylinder Rules, 2016, Service expiry date

8.1.14 Every batch of cylinders shall be inspected and certified, these certificates should have particulars set forth in schedule II of the Gas Cylinder Rule, 2016.

8.1.15 Bidder shall ensure that there are no mis-punch, double punch, etc. on the cylinders which are used in the cascade. In case particular cylinder rejected due to mis-punch or double punching during hydro testing then bidder will replace the same cylinder at free of cost.

8.1.16 The individual valve shall have provision to close/ isolate the connected individual cylinder in MEGC/ Cascade module so that venting of all cylinders shall be avoided in the case of valve failure. The fusible plug and burst disc discharge shall be manifold to a common header with SS 316 fittings at single location for safe venting in vertical direction facing sky. Valves shall be approved by CCOE (PESO) Government of India.

8.1.17 All cylinder valve fittings and pipe fittings shall be rated for the full range of design temperatures and pressures and the valve/fittings shall show stamp or otherwise permanently mark on the body to indicate the service ratings.

8.1.18 Ball valves for isolation shall be provided on each inlet /outlet connection along with separate bleed valve. End terminations for connection shall be minimum ¾" OD tube fitting.

8.1.19 The MEGC/cascade cylinders shall have single bank configuration and all inter-connection tubing (including tubing between main-header to individual cylinders) of minimum 3/4" O.D size. Sizing shall be according to requirements of code ANSI B31.3, looped for contraction, expansion and stress relief. Piping/tubing shall be suitably clamped. Materials used for the tubing shall be stainless steel 316 - high quality fully annealed seamless confirming to ASTM A269 with maximum hardness Rb80 or less and suitable for bending and flaring. O.D tolerance shall not exceed +/-0.005". The piping/ tubing material shall be of Sandvik / Tubacex make only.

8.1.20 MEGC / cascade module shall be provided for protection from sun and rain & to protect the cylinder valves and other fittings against any damage. The MEGC / cascade module shall be designed to take care of the wind load, thrust, vibration etc. The MEGC / cascade module shall be designed to provide adequate ventilation / dispersion of gas in the event of any leakage.

8.1.21 Bidder shall transport the type III / IV cascade from their store yard to the designated location of Client and install and commission at their own cost.

8.1.22 Bidder shall provide details of connection between Compressor & type III / IV cascade, type III / IV cascade & Dispenser

8.1.23 Bidder shall supply and keep min. inventory of all the consumables, spares at their store for Maintenance of MEGC/ cascade.

8.1.24 Bidder shall provide all drawings (construction, GA, P&ID etc.) related to type III / IV cascade.

8.1.25 Bidder shall arrange for TPI agency for inspection of MEGC / Cascade before supply to the Client site, Bidder can appoint any of the NABCB approved TPI agency The Bidder shall be totally responsible for all the coordination with the agency carrying out the Testing. TPI agency shall be PNGRB /PESO Approved.

8.1.26 Bidder shall arrange all required statutory authority documents from the country of origin and CCOE (PESO) India approval of all cylinders in original to the third party inspector and / or Client's representative during inspection and testing.

8.1.27 Each MEGC / cascade module with all tubing, fittings, and valves shall be pressure tested with air/nitrogen at required pressure 1.5 times of MAWP to ensure no leakage prior to dispatch and the same will be witnessed by TPI/Client's representatives.

8.1.28 MEGC/Cascade assembly shall be purged with Nitrogen at required pressure prior to dispatch .at min 2 bar.

8.1.29 Priority panel location in the MEGC/cascade shall be confirmed by Client if applicable.

8.1.30 Once MEGC/ cascades module have been received and connected to client sites, Bidder shall depute his representative to demonstrate satisfactory operability of the system within specified parameters for a period of two (2) days after commissioning.

8.1.31 All fittings including ball valves shall be of material SS316 confirming to ASTM A269. MEGC/ Cascade isolating ball valves shall be full bore ball valves.

8.1.32 Cascade shall be protected from the effects of the weather by a canopy designed to facilitate the dispersion of free or escaped gas and shall not permit gas to be trapped.

8.1.33 Cascade storage dimension:

The cascade dimension shall be such that it should not violate any RTO/PESO norms for transportation. The overall design of the mobile cascade (like height, width, Length and weight shall be in such away that vehicle carrying mobile cascade shall be free from the unbalance, toppling while transportation of CNG and while installation. The Type-III / IV mobile cascade module shall be designed in such a way that it shall be suitably mounted / accommodated for transportation on the vehicle carrying existing GLType-1CNG Cylinder of 4500WL (having Dimension of L - 5.2M x W – 2 M x H - 2.1 M.

8.1.34 The cylinder shall be designed as per applicable standards stated by PESO approved by Chief Controller of Explosive (CCoE) / IS: 7285 Part II and/Petroleum and Explosives Safety Organization (PESO),Government of India for use in India for specified conditions.

8.1.35 Working Pressure of cascade cylinder shall be maximum 255 Kg/cm2 (g) at 15°C.

8.1.36 All cylinders shall be new and unused. Re-certified cylinders are not acceptable. All cylinders in a cascade shall be of same capacity.

8.1.37 Cylinder shall be as per design approval by Chief Controller of Explosive (CCOE)/ Petroleum and Explosives Safety Organization (PESO) Government of India.

8.1.38 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 255 Kg/cm2 (g). Vendor to furnish necessary calculation indicating overall pressure drop for each bank, Coefficient of flow (Cv) values, valve orifice size etc, bidder shall also furnish the PV chart at specified operating temperature range condition for Type-3 cylinders cascade.

8.1.39 ¾" Full bore ball valves for isolation shall be provided at inlet of each fill line and at each bank outlet line. It shall be also provided with quick release coupling + nipple of appropriate size for hooking up for the purpose of filling and decanting at CNG station.

8.1.40 ¾" Full bore ball valves for isolation shall be provided at outlet of cascade. It shall be also provided with quick release nipple of 1/2" size(Swagelok /Parker make) for hooking up for the purpose of filling and decanting at CNG station.

8.1.41 Cascade shall have the valves fitted on the same side within the cascade opposite to the refueling point and arranged in a manner that any gas leakage is discharged upwards.

8.1.42 All cylinders shall be arranged to face one direction in each unit.

8.1.43 The interconnecting tube work of cylinder manifold shall have configuration suitable for priority filling and sequential dispensing system by the electronic CNG dispensers.

8.1.44 The cylinders shall be permanently and clearly marked for “CNG only” and also labeled as "CNG ONLY" in letter at least 25 mm high in contrasting color in a location which shall be visible after installation.

8.1.45 There shall not be any back flow between any two banks with all valves open or intermixing between bank .

8.1.46 All cylinder valves and fittings must be rated for the full range of temperature and pressureand the manufacturer shall stamp or permanently mark the valve body to indicate the service rating.

8.1.47 All cylinders are to be hydrostatically tested and approved by third party certification body approved PESO / Bureau of Indian Standards (BIS). Test certificates shall be duly endorsed by approving body and issued before delivery.

8.1.48 Approval of third party certification body i.e. Bureau of Indian Standards (BIS)/PESO for all the cylinders to be submitted. Certificates shall be duly endorsed by approving body and issued before delivery.

8.1.49 Canopy for the cascades shall be provided and its height shall be as per Industrial practice.

8.1.50 Cascades shall be in the single bank configuration.

8.1.51 The cascade having horizontal cylinders and sited parallel to other cascade shall be arranged so that cylinder fittings do not face each other.

8.1.52 The composite Cylinders shall be Type 3 ((Fully wrapped carbon composite Aluminum liner Type 3 cylinders) or Type 4 (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

8.1.53 Cascade venting tubes shall not be with welded connection. It shall be with nut ferrule connection. All vents should be connected to common header i. e vent from pressure gauge , tubing manifold . SRV /PSV vent shall be separately connected to header it should not be merged with PG/tubing manifold vent lines. The size of vent header should be min 2 “ and shall be protected with rain ingress cap . Vent from cylinder safety disc should be connected to common header with separate line.

8.1.54 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.

8.1.55 Supplier to submit structural drawing of the frame.

8.1.56 Gas storage facility shall be protected from the effects of the weather by a canopy designed

to facilitate the dispersion of free or escaped gas and shall not permit gas to be trapped.

8.1.57 **Frame Painting:** 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.)

8.1.58 Materials used for the piping shall be stainless steel 316 fully annealed seamless confirming to ASTM 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 Swagelok/Parker/SSP/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.

8.1.59 Piping / Tubing shall be suitably clamped to the frame structure.

8.1.60 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.

8.1.61 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.

8.1.62 The cascade cylinder shall be purged with N2 and maintained at 2bar (g) pressure before dispatch.

8.2 Pressure Relief Valve

8.2.1 Single independent SRV for venting of the cascade in case of a run away pressure is accepted. Suitable isolating valve which shall be readily accessible when installed in the storage bank. The isolating valve shall not be capable of closing off the pressure relieving device.

8.2.2 Relief devices shall be positioned in such away as to avoid discharge of high pressure gas to the operator or persons in close vicinity and suitably extended.

8.2.3 SRV Pressure shall not exceed 20% above MAWP of the system.

8.2.4 Vent of the SRV shall be left outside canopy for direct venting into the atmosphere in case of functioning.

8.3 Painting

Painting of Cylinder shall as per CCOE Approval.

9.0 STORAGECYLINDERS

9.1 All the Cylinder Specifications, valves, safety relief devices, pressure gauges, pressure Relief devices etc shall remain same as mentioned above.

9.2 All cylinders used for the transport of compressed gas shall be type approved, in writing, by the Chief Controller of Explosives / Petroleum & Explosives Safety Organization

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).

9.3 All the attachments to the cylinders shall be protected against accidental damage which may result from collision, overturning or other operational cause.

9.4 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.

9.5 All end connections for quick release coupling, pressure 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. After opening the doors only flexible hose quick release coupling connections to the cascade are authorized.

10.0 INSPECTION AND TESTING

10.1 Vendor shall carry out 4-G static calculation of one complete assembled cascade with all the cylinders mounted and filled. CNG Cascade to be 4G tested and test to be certified by TPI / Chartered Engineer

10.2 Vendor shall carry out cylinder burst test of one cylinder from the entire batch produced for supply to owner in case offered cylinders are of new design. Vendor shall inform the schedule of the test well in advance to enable Owner or their authorized representative to depute technical personnel for witnessing the test.

10.3 Vendor shall carry out all standard shop tests / QA / QC as per recommendation of manufacturer / Chief Controller of Explosives or Petroleum and Explosives Safety Organization (PESO). Copies of the testing /inspection carried shall be furnished to owner.

10.4 Vendor shall furnish record of storage capacity check of each cylinder in a cascade and the same need to be demonstrated to Owner / Consultant or their authorized representative.

10.5 Each assembled storage cascade with all tubing, valves shall be pressure tested to ensure existence of no leakage prior to dispatch.

10.6 All tests / checks described above or recommended by manufacturer / Chief Controller of Explosives or Petroleum and Explosives Safety Organization (PESO) shall be witnessed

by Third Party Inspection Agency.

10.7 Third Party Inspection is in the scope of bidder. Third Party shall be PNGRB / PESO Approved.

10.8 In case any problem or abnormality found / occurs in cascade during commissioning or warranty period, bidder has to get it solved within 24 hours of lodging of complaint by owner.

10.9 Owner / Consultant or its representative / third party or both shall have access for stage-wise and final inspection to those parts or areas of the plant where work or testing of the equipment is being performed, including packaging items.

11.0 DOCUMENTATION

11.1 Following documents shall be submitted with the offer (Technical Bid):

11.1.1 Drawing of cylinder of specified parameters and proposed to be used in offered cascades, approved from Chief Controller of Explosives / Petroleum and Explosives Safety Organization (PESO), Government of India, Nagpur.

11.1.2 Schematic of cascade piping

11.1.3 Drawing of cascade frame and assembly.

11.1.4 Bill of quantities with weight of each component

11.1.5 Make of bought out items.

11.1.6 Detailed time schedule for supply indicating time period required for cylinder manufacturing, cascade frame fabrication, shop testing, dispatch of material from works and delivery at site.

11.1.7 Dimensions & schematic drawings of cascades offered.

11.2 Following documents shall be submitted after release of order :

11.2.1 Schematic of cascade piping, drawing of cascade frame and bill of quantities with weight of each component and make for Owner / Consultant's review and approval.

11.2.2 The supplied cylinders shall have the certification from CCOE, Government of India, Nagpur for suitability of each cylinder for filling and storage of CNG upto 255 Kg/cm2 (g) at 15 deg C in India.

11.2.3 Vendor shall furnish the material test certificates for all bought out items like cylinder raw material, tubing / piping, valves, check valves and fittings with the shipment.

11.2.4 QA / QC report for manufacture of cylinder and testing shall be furnished.

11.2.5 Bidder shall furnish "As built" drawing of each CNG cascade with serial number indicating schematic, structural dimensions and bill of material with shipment.

12.0 PROTECTION DURING SHIPPING

The cascade shall be packaged to with stand rough handling during ocean shipment and in land journey. It shall be vendor's responsibility to rectify any deterioration / damage that occurs during shipment. Sling points shall be clearly indicated on crates.

13.0 EXPERIENCE RECORD PROFORMA FOR CASCADE

Sl. No.	PARAMETER	Information on offered model	Information on Existing Cascade (Location)	
			1	2
1	No. of Units Supplied			
2	Service	CNG		
3	Working Pressure of Cascade in bar (g)			
4	Site min./ max. Temp.			
5	Normal flow from each bank Kg/hr.			
6	Cascades water capacity - Litres			
7	Water capacity of single cylinder used in cascade–Litres.			
8	Material of Cylinder			
9	Thickness of cylinder wall and disc end in mm			
10	Size of the Cascades			
11	Type of Cascades (Stationary/mobile)			
12	Valve make			
13	Valve type and Dia.			
14	Nos. of banks in cascade			
15	Nos. of cylinders in low bank			
16	Nos. of cylinders in medium bank			
17	Nos. of cylinders in high bank			
18	Water capacity of cylinders individual bank litres.			
19	4-G calculation for one complete assembled package			

20	Cylinder burst test for one cylinder			
21	Design standard code used			
22	Total weight of cascade in-Tons			
23	Burst pressure and temperature for burst disc in bar(g)			
24	Hydrostatic or Hydrostatic Stretch test			
25	Pressure test for Leakage			
26	Design case gas composition			
27	Approved Manufacturer License certificate from CCOE Nagpur			
28	Dimensions of the Total package			
29	Warrantycertificates			
30	Dimension of package max.			
31	Calibration certificates for all instrument gauges etc of package			
32	Test certificates of all instruments with cylinder, tubing's, fittings of total package			
33	Date of commissioning of cascade			
34	Where cascades are supplied: Address and Fax/ Telephone no. of Contact person			
35	Major problems encountered if any			

14.0 Cylinder Specification

S. No.	Category	Specification
1.	Design code	All relevant codes given in clause no. 6 of this specification.
2.	Working pressure	250 barg at 15ºC
3.	Material	Type 3((Aluminum lined carbon fiber wrapped) or Type 4 (Plastic lined Fully wrapped composite cylinder)
4.	Painting of cylinders	All cylinder pigmenting should be as per directions of Chief Controller of Explosives (CCOE), PESO, Govt. of India & relevant Manufacturing standard.
5.	Capacity of cylinder	*

6.	No. Of cylinders	*
7.	Manufacturing process	*
8.	Neck threads	*
9	Design Temperature of Cylinder in deg C	
10	Design Pressure of Cylinder in bar	
11	Maximum allowable working pressure in bar	
12	SRV set Pressure	
13	Test pressure of cylinder	
14	Burst Test Pressure	
15	Burst disc material	
16	Burst disc set pressure	
17	Cylinder Valve Type	
18	Valve Make and model, material	
19	Type approval number	
20	Valve design temperature	
21	Valve design pressure	
22	Test pressure of	
	Valve	
23	Temperature range fusible plug	
24	Valve end connection size	
25	Valve thread type	
26	Weight of cylinder	
27	Weight of frame	
28	Dimension of frame Lx W xH in mm	

29	Weight Overall assembly with empty cylinder	
30	Gas mass per cylinder at 250 barat 15deg C	
31	Gas mass in cascade at 250bar	
32	Gas mass in cascade at 40bar	
33	QRC coupling size	
35	Gap between cylinder in frame	
36	Cylinder clamping material and details	
37	Cascade cylinder stacking arrangement (row & column)	
38	Common vent header material land size.	
39	Height of common vent line	

*To be filled by bidder.