



E-Tender No.: AGL/Head Office/Contract and Purchase/20/25-26/ET/20
[CNG COMPRESSOR]
ANNUAL RATE CONTRACT FOR PROCUREMENT OF 1200 SCMH GAS
ELECTRIC MOTOR DRIVEN CNG COMPRESSOR



AAVANTIKA GAS LIMITED

(A JOINT VENTURE COMPANY OF GAIL & HPCL)

CITY GAS DISTRIBUTION PROJECT IN
INDORE, UJJAIN, PITHAMPUR & GWALIOR

VOL. II OF II TECHNICAL

ANNUAL RATE CONTRACTFOR
PROCUREMENT OF 1200 SCMH ELECTRIC MOTOR DRIVEN CNG
COMPRESSOR



**TECHNICAL SPECIFICATION
FOR
MOTOR DRIVEN CNG COMPRESSOR
(CAPACITY: 1200 SCMh)**



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1.0 GENERAL

Aavantika Gas Ltd. (AGL) is a joint venture company of M/s GAIL (India) Limited & M/s HPCL. AGL has been set up to supply PNG to household, commercial & industrial sectors as well as to distribute CNG to vehicles including setting up of CNG filling stations with its infrastructure in the cities of Indore, Ujjain & Gwalior.

1.1 scope of work

This specification along with applicable codes as referred, describe the minimum requirements for design, engineering, manufacturing, inspection, testing, supply including packaging, forwarding, insurance, custom clearance, handling and unloading at port as well as at PURCHASER store/site at Indore, Ujjain & Gwalior, package performance test at Bidder 's shop, supply, erection & commissioning at site of "ELECTRIC MOTOR DRIVEN RECIPROCATING ON-LINE GAS COMPRESSOR PACKAGES" as required for dispensing CNG to vehicles at various locations in Indore, Ujjain & Gwalior. Various parts of this specification shall be read in conjunction with each other and in case where the different parts of this specification differ the more stringent requirement shall govern.

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 and for safe and proper operation, shall be deemed to be included in the scope of work by the Bidder.

THE DESCRIPTION OF TOTAL SUPPLY OF PACKAGED COMPRESSOR IS AS UNDER:

Sl. No.	Description	Quantity
1.	Electric Motor driven 1200 SCMh Packaged Reciprocating Compressor Unit	10 Nos.

The provision for overhead mounting of 3000 water liter cascade shall be envisaged & same shall be of enough strength, having working space and ladder arrangement and all four-side platform for easy to maintenance. Mounting of cascade on structure shall be in the scope of bidder. However, cascade shall be provided by purchaser. Structure Stability Certificate issued by reputed structural engineer and verified by TPIA/Chartered Engineer of the unit where cascade will be mounted to be provided during detailed engineering.

The tare weight of one 3000 WLC cascade is Approx. 7 tons (stationary)

1.2 CODES AND STANDARDS

The following National & International Codes & Standards of Latest editions shall be applicable.

OISD 179, NFPA-52: 1995 or equivalent

NFPA – 37

NFPA – 12- CO₂ Flooding system

IS: 325/ IEC or International standards. – Standards for electric Motor

IS: 6382

Applicable ANSI, ASTM, NEC, NEMA code.

API – 618

API – 11P 2nd edition

API – 661 Specifications for Air cooled exchangers

ASME Section – VIII Div – 1/2 Design codes for pressure vessels.

Gas Cylinder Rules 2016.

Standard Specifications of Bureau of Indian Standards (BIS).

Specifications/Recommendations of IEC, Indian Electricity

Rules.Indian Explosives Act.

TEMA – C - Water cooled heat exchangers

ASME / ANSI – B-31.3 Code for Process Piping



1.3 Precedence

In case of any conflict among the various documents of this requisition the following preferential order shall govern:

1. Data sheets/drawings
2. Technical Specification
3. International standards/codes as applicable
4. Indian Standards / codes as applicable

Compliance with these specifications shall not relieve the bidder of the responsibility of furnishing equipment and accessories of proper design, material and workmanship to meet the specified operating conditions.

No deviations to the technical requirements and to the scope of supply specified in this enquiry document shall be accepted and offers not in compliance to the same shall be rejected. In case a deviation is required due to inherent design of the equipment offered, the bidder shall list all such deviations at one place giving reasons thereon.

1.4 DOCUMENTS/DATA REQUIRED ALONG WITH BID

- (1) Proven Track Record Formats, duly filled in along with general reference list shall be submitted for the earlier supplied CNG compressor packages as per the BEC requirements.
- (2) Checklist duly filled in with regards to scope of supply
- (3) Completely filled in Data Sheets of compressor, motor
- (4) Deviations if any to this Technical Specification
- (5) Tentative Lay out/key plan/General Arrangement Drawing indicating size of skids, center distance between skids and space required along with maintenance requirements
- (6) (a) Utilities requirements (b) Electrical Load summary
- (7) Catalogues of compressor, motor, instrumentation & controls
- (8) Other details are given in VDR.

1.5 SCOPE OF SERVICES

1. Engineering, design and manufacturing.
2. Procurement of raw materials etc., from sub-vendors.
3. Preparation of documentation for design, approval by Purchaser/consultant.
4. Inspection and testing as per T.S.
5. Surface preparation, protective coating and painting as per T.S.
6. Packaging for transportation to site including Re-transportation from site/store to site/ store in case of site is not ready and supply.
7. Erection, testing & commissioning as per T.S.
8. Field trial run and performance test at site.
9. All electrical work related to compressor package (PDB to compressor package & its accessories)
10. Priority panel complete with isolation valve to connect SS tubes.
11. Post commissioning annual maintenance with all spares and consumables.

1.6 SCOPE OF SUPPLY FOR EACH COMPRESSOR PACKAGE

The scope of work/services to be provided by the bidder shall be inclusive of but not limited to:

- Design, Engineering, Manufacture, assembly, testing at manufacturer's works, erection, commissioning, field trial runs, Equipment performance test along with associated electricals, instrumentation etc. as per bid document.



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- 3 nos. mass flow meters to measure the Natural Gas consumption at packages inlet, package discharge (both Coriolis type) and package loss / venting (thermal type) with online test arrangement. Mass flow meter (Model CNG 50 & F Series with integral local display) based on Coriolis principle of Micro motion, USA CNG 50 with 2700 transmitter at Compressor discharge, F-series with 1700 transmitter at compressor suction. Installation and manufacturing of mass flow meter shall be as per as per AGA-11. While installing special care shall be taken to isolate the mass flow meter from piping vibration. Mass flow meter shall be provided in package vent for measuring vent losses. The mass flow meter at the suction & discharge of compressor shall be W&M approved only. The flowmeters should be enabled with MODBUS/RS 485 communications.
- PLC based control system with HMI. PLC shall be provided with mounting rack, CPU, Input output cards, Power supply card, communication card. PLC CPU shall be redundant (1W+1S) with auto switch over without manual intervene. Failure alarm of CPU shall be provided in HMI. A dedicated modbus (RS 485) slave communication port shall be provided for Remote terminal unit (RTU) interface. A separate communication ports shall be provided for GPRS modem for communication with SCADA system.
- PLC shall be mounted in EX proof enclosure. Cabinet specification with Statutory certificate shall be submitted during engineering stage for approval.
- Instrumentation and control system as specified on data sheets, P&ID including Local panel, Console /Local gauge boards, PLC. All the transmitters shall be Ex proof or intrinsically safe. PESO/ATEX certificates shall be submitted.
- Pressure Transmitter and Temperature Transmitters shall be used for CNG Gas application with 4-20 mA output signals to PLC. The units of measurement for flow shall be Kg/hr, for pressure shall be Kg/cm² (g) or and for temperature shall be degree C. Pressure and temperature switches are not acceptable.
- Bidder needs to submit the copy of valid type approval for compressor packages from PESO along with bid.
- Common structural steel skid for the compressor- Motor combination and for all auxiliary systems
- Framework shall be mounted on a suitable skid type base, external-lifting lugs shall be provided at each corner. Foot Print shall be maximum 10 m²
- Air-cooled heat exchanger for inter stage and discharge gas.
- 9 bank Priority Panel at Package Discharge with proper encloser for priority panel.
- All interconnecting oil, gas, water, air piping within the compressor package.
- Impulse and pneumatic piping/Tubing for all valves, fittings as specified & required for mounting the instruments.
- Block and Bleed valves SS316 manifold to be provided for Pressure Gauges and Pressure Transmitters.
- Double isolation valves to be provided on the common vent line and drain line
- Level Switches in Crankcase to monitor oil level along with necessary alarms & Trips.
- Cables
 - All cables from Electrical room to compressor package shall be in bidder's scope. Vendor shall distribute electrical power to all equipment and control system by providing cables and suitable switch-gear distribution panel through heavy duty GI conduit or trenches, all interconnecting cables in compressor package, including complete erection accessories like double compression cable gland, ex proof gland in hazardous area, cable tags, lugs etc. as required.
 - All wire/ cable to be used in compressor and panel shall be of copper conductor and FRLS type through proper cable tray conduit etc.
 - Electrical/Control Cables required for providing connectivity to Co2 system and emergency switch.
 - Supply, laying, glanding, lugging, ferruling, clamping, terminal of Instrumentation cable (signal,



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- control, communication, ethernet & Power) from instrument to junction box/PLC inside enclosure, GD, flame detectors to PLC, PLC to HMI. Emergency push button outside compressor enclosure to PLC.
- Supply of signals and power cable from Emergency push button (field and control room) to PLC and RS 485 port cable of PLC to RTU. Vendor shall provide all the RS 485 configuration details to RTU vendors/client/consultant required for configuration. Vendor shall also provide their support during configuration.
 - Note -FRLS (Fire resistant low smoke) cables shall be used for gas detectors, flame detectors and emergency push buttons with double compression glanding.
- Separate junction boxes for different type of signals like intrinsically safe signals, alarm, shutdowns, thermocouples, RTDs etc. for interfacing to local panel.
 - NRV at gas suction, inter stage, final discharge point, LCV filling line and priority panel as required.
 - Structural supports within the compressor package for all piping, instruments etc.
 - One no. relief valve at each stage discharge, first (1st) stage suction and Blow Down Vessel.
 - Y- type/conical type strainers, valves, sight flow indicators, check valves, manual drain/ traps etc. as required for various auxiliary systems i.e. frame lube oil, cylinder lubrication system, cooling water systems, conditioning system etc.
 - Coupling/V-belts/pulleys.
 - Separate acoustic enclosure, separated with a partition wall of minimum 3 mm thickness and fabricated in such fashion that it is completely sealed so that gas or fire should not travel from one enclosure to another, for both Compressor and motor as specified, with two number L.E.L detector and two UV detectors in each enclosure.
 - For each compressor, 5 nos. of ESDs must be connected in such a way that (One no. on compressor, One no. on LCP of compressor, One no. in control room, One no. in process area, One no. near dispenser)
 - Common CO2 extinguishing system consisting of two cylinders, piping, valves and control systems as per details given in this specification.
 - Inlet and outlet manual and automatic isolating valves for maintenance & emergency.
 - Manual Call Point (MCP) along with hammer and necessary arrangement, completely integrated with package and CO2 flooding system which can be operated in emergency situation.
 - Erection, Testing & Commissioning of compressor packages.
 - Installation, Testing and Connection of spool piece from compressor inlet filter to compressor package is in the scope of bidder.
 - Piping from air compressor and CO2 cylinders up to enclosures will be in the scope of bidder.
 - All the flanges must be incorporated with appropriate metallic type gasket.
 - Run test and Field Performance Acceptance test at site
 - Training of 2 persons (1 supervisors + 1 operators) at packager's workshop and at sub-vendor's workshop. The traveling boarding and lodging of Purchaser's engineers shall be borne by PURCHASER. Training module shall span for one week and shall cover the equipment constructional features, operational and maintenance procedures etc. (Bidder to indicate separate price, if any).
 - Certificate from Compressor block manufacturer towards guaranteed shaft power calculation at 1200 SCM per hour compression (on given parameter).



- Supply of all essential spares as specified, erection & commissioning spares.
- Mandatory one set of priced spare parts catalogue (for records), as built drawings, P&IDs, SLDs, Wiring diagram and critical logic diagram/interlocks, elevation plan, GAD and Operation & Maintenance catalogue with each compressor package.
- Separator/ Knockout drums/volume drums with solenoid valve operated auto & manual drains as required. Moisture separator cum regulator in the system shall also be accepted. Bypass valves for automatic drain system shall be as per manufacturer's recommendation.
- Arrangement for hazardous waste management and submission of certificate form 10 for the same for compliance of waste management to be ensured.
- Inlet twin suction gas filter of filtration level up to 5 microns with oil drain valve & DP gauge and temporary suction Y type In-line strainer at the compressor inlet).
- Two stage filtrations at discharge so as to limit oil carryover is to be provided
- Wires mesh type Guard for heat exchanger fan.
- If applicable, secondary lubrication system with check valve protector, HP Filter (for all lubricating points) & DNFT flow switches with standby pump. Secondary lubrication system with divider block shall be provided.
- Erection, O&M and all others relevant manuals for compressor & its accessories, priority panel, electrical motor & all field instruments.
- Priority Panel at Package Discharge as per Priority fill system
- Annual O&M during one year warrantee period with spares, consumables, man power and lubricants.
- O&M charges (post warrantee period) with spares, consumables, man power and lubricants including complete overhauling of compressor & motor, if required.

Exclusions

The following are excluded from the scope of the Bidder:

- All civil works and foundation design. However, the Bidder shall furnish all the relevant data for design of pedestal/ foundation. However, grouting of equipment including supply of material is a part of erection.
- Piping between priority panel to cascade / dispenser.

1.7 Safety

- 1.7.1 All controls shall operate in a fail-safe mode i.e., failure of any control shall not lead to running of equipment in unsafe mode. Fail safe control shall be available through both software and hardware for all trips.
- 1.7.2 Area Classification: The hazardous area classification Class-I, Division I, Group D as per NEC or Zone I, Group II A/ II B as per IS/ IEC. Certificate from recognized agency to the effect that equipment supplied and/or installed conform to above area classification shall be submitted. All Devices shall meet the requirement for the specified area classification in which they are installed, including instrumentation leads.
- 1.7.3 All exposed rotating parts shall be provided with adequate guards of non-sparking type.
- 1.7.4 Drive belt if used shall be of fire retardant and anti-static type.
- 1.7.5 Piping shall be arranged in a manner so as to provide clear headroom and accessibility within the package. Adequate clearances shall be provided for all the engineered components for O&M point of view.
- 1.7.6 Each enclosure shall have two IR type L.E.L detectors and two Ultra Violet (UV)/IR fire detectors in each enclosure to cover the enclosures effectively.



- 1.7.7 All material used in the package shall be flame retardant.
- 1.7.8 The Compressor Package shall trip if any of the enclosure is opened while the machine is running. However, the bidder shall provide enclosure door by - pass selector switch to facilitate routine checking while compressor is running.
- 1.7.9 Relief Valves shall be provided at suction and discharge and in between inter stages of compressor with setting as per cl. 11.18.5 of ISO 13631:2002 with R.V. venting as per cl. 11.18.6 of ISO 13631:2002. All vented lines to be connected to common relief valve header.
- 1.7.10 CO2 flooding system:**
- The package shall be protected by automatically operated CO2 flooding system designed as per NFPA-12 which should have minimum following features: -
1. Gas Detection by installation of hydrocarbon gas detector (IR type) and transmitter with adjustable alarm levels (0-100%) with preset of 10%, 20% and 50%. Package should have at least 2 nos. gas detectors.
 2. Installation of flame detector (UV-IR type) and transmitter, alarm on detection of flame. Package should have at least 2 nos. flame detectors.
 3. CO2 flooding system shall consist of 2 nos. of min 45 kg CO2 cylinders each. However actual size of the cylinder shall be as per compressor enclosure size. Necessary calculation shall be submitted by the bidder during detailed engineering. One cylinder will act as main cylinder & other as stand by, which shall have identical arrangement and connected to the system. The cylinders shall be protected from weather and direct sunrays as per Gas Cylinder Rules, 2004. Cylinders shall be fitted with actuated Valves, Solenoid valves etc. for automatic actuation. Control philosophy shall be such that in case main cylinder fails, the standby cylinder shall discharge automatically. For this, the vendor shall provide suitable device such as pressure switch (intrinsically safe type) to detect the failure of main cylinders failure. One manual switch / call point shall be provided to operate the CO2 cylinder from remote control room. Pull down lever on cylinder valve for manual operation shall be provided.
 4. No extra utility as air, inert Gas shall be made available by OWNER/used by the supplier to operate the system other than the UPS.
 5. Cylinder should be ISI marked as per IS: 7285 and CCOE approved.
 6. The System shall be designed to operate on 24 V DC supply. FRLS (Fire resistant low smoke) cables shall be used for the wiring of the system.
 7. Interlock of CO2 Flooding system with compressor as per following sequence:
 - i. Compressor shall trip on detection of gas at pre-set level.
 - ii. Compressor shall trip on detection of flame at pre-set level and automatic discharge of CO2 gas shall take place from the main cylinder simultaneously.
 - iii. Maintenance Override Switch shall be provided to keep the system off during maintenance.
 - iv. Compressor shall not start if the CO2 Flooding System is faulty, not working, Switched OFF during maintenance etc.
 - v. Selector switch shall be provided to put Main/Stand by Cylinder in line at the turn of a switch as per requirement.
 - vi. Alarm panel for CO2 Flooding System shall be integral with the main compressor panel. Necessary displays as system ON, OFF, FAULT, RESET, Gas/ Flame indication, Remote actuation of solenoid valve, distinguished hooter etc., shall be provided for CO2 flooding system.
 8. One blinking aviation lamp shall be provided at top of compressor canopy suitable for hazardous area for fire indication along with Emergency siren/hooter of sufficient capacity.



9. CO2 Cylinders shall be provided outside the package at a safe place, where it is not exposed to fire in case of fire in the compressor. Facility shall be made to operate the system both manually from remote with the help of a switch/ call point and with help of pull-down lever on cylinders.
10. Online weight (CO2) loss indication device to be provided to ascertain the health of the CO2 flooding system. Co2 cylinders to be marked with details such as serial no., make, HST date and due date as per applicable codes and standards.
11. All installation and instruments shall be compatible for hazardous area Class 1, Division 1, Group-D for Methane Gas.
12. Technical specifications, Operation and Maintenance Manual, CCOE Certificate, Approval/ Manufacturing certificates for cylinders and cylinder valves, gas detectors, flame detectors, solenoid valves etc. shall be furnished by the supplier along with system. Software and hardware, calibration procedure shall be provided by the supplier along with the supply sufficient enough to handle the system independently. Necessary tools and tackles (1 set) shall be provided with each package.
13. System shall be tested by the supplier after commissioning at site by creating fire signal and actual discharge of CO2 Gas from the Cylinders. The cylinders have to be refilled by the vendor at no extra cost to purchaser after testing. If the system fails during testing, subsequent testing and refilling would be at vendor's cost.
14. Warning and Operating instructions to be displayed at equipment as per the statutory/ safety regulations.
15. Flameproof online weighing system, complete frame with shed and all accessories should be of good quality, weighing scale should be of reputed make.
16. Following warning and caution signage shall be marked on the housing/package:
"No Smoking"
Caution notice "This Machine may automatically start at any time".
"Flammable Gas"
17. AGL branding to be incorporated in compressor package.

2.0 UTILITIES & BATTERY LIMITS

2.1 Utilities

- 2.1.1 Any auxiliary motor shall be provided with star delta/ soft starter (three phase controlled) type starter. Single phase motor will be not acceptable above 1 hp rating.
- 2.1.2 Bidder shall make his own provision for Instrument air if required with an electric motor driven air compressor with a suitably sized receiver & Refrigerant type air drier system. Air Compressor motor should be 415 V squirrel cage motor DOL / star delta starter having overload protection, single phase preventer. A Rain guard of MOC carbon steel minimum thickness of 2 mm should be provided over the air compressor.
- 2.1.3 Drain should be through a common header and discharge to be allowed in pot outside the package (capacity not more than 2.5 litres) to avoid spillage around the compressor package.
- 2.1.4 All electrical and instrumentation terminals shall be as specified.
- 2.1.5 Purchaser shall provide 415 V, 3Ph, 50Hz electric power for compressor motor drive at a single point.
- 2.1.6 Purchaser shall provide the 230V, 50Hz, 1Ph UPS for LCP at single point in the electrical room.

2.2 Battery limits

- 2.2.1 All customer interface connections, gas Inlet shall be brought out to the package edge and terminated in nozzles with isolation valves having flange connection and Gas outlet (priority panel outlet connection) shall be terminated through high pressure 3/4" full flow ball valves with 3/4" end connectors.



- 2.2.2 As and where specified on the data sheets all vents (i.e. Relief valve, distance piece and packing) shall be manifold and terminated at skid edge outside the enclosure and vented to safe height of 3.0 m at package roof.
- 2.2.3 All drains from different process equipment, distance piece and packing shall be manifold and terminated at single point for customer interface duly flanged with isolation valve. Drains should be through a common header and discharge to be allowed in a pit to avoid spillage around compressor package.
- 2.2.4 UPS and non-UPS power shall be made available from power distribution board (PDB) in the electrical room. Supply, Erection and termination of all cables and accessories from feeder in electrical room shall be in the bidder's scope.
- 2.2.5 Electronics earth pit shall be made available at a distance of about 5 meters from compressor package. Cable from this earth pit shall be in the bidder's scope. Owner's earthing main ring shall be made available at compressor foundation. Cable to control panel body earth inside the compressor packages shall be in the bidder's scope.

3. BASIC DESIGN

3.1 General

- 3.1.1 The Compressor shall meet all the technical requirements as specified in:
Data Sheets: As enclosed
Technical Specification:
Code and specification API-11P, API-618, OISD 179, NFPA, ANSI, ASTM, NEC, NEMA, Indian Electricity Rules, and Indian Explosives Act are referenced to & made part of specification.
Compressor and its auxiliary's design shall be in conformity with API 11P, second edition, API 618.
- 3.1.2 Gas composition given under Design Case shall be used for Compressor selection, Sizing and performance guarantee estimates. However, compressor shall be suitable for continuous operation with the indicated gas composition range and operating parameters given in this tender.
- 3.1.3 Suction line pressure varies from 16 to 19 kg/cm². Bidder to note suction pressure regulator is required. Suction pressure transmitters shall be provided to protect the compressor from very high and low pressure.
- 3.1.4 Bidder's offer shall be based on firm and final compressor / electric motor make and models on which basis the offer shall be evaluated and no alternate compressor / electric motor make and models or change of make and models to lower frame shall be entertained.
- 3.1.5 Note that the pressures given on the data sheet are at the compressor package battery limits, Bidder shall consider all pressure losses at suction, inter-stage and discharge at the specified capacity (with no negative tolerance) for compressor and indicate the same on the data sheets.
- 3.1.6 The inter stage and final stage cooler tube material shall be carbon steel. Bidder to submit cooler sizing calculation for record purpose.
- 3.1.7 In case of lubricated cylinder & packing design, single plunger per point force feed mechanical lubricator shall provide lubrication to compressor cylinders. Lubricators with double ball check valve shall be provided at each lubricator point. Digital no flow timer shall be provided to stop the compressor in case of loss of cylinder lubrication.
- 3.1.8 The bidder along with the offer shall furnish the recommended lubricating oil type, grades & specification along with their quantity and frequency of change. The recommended oil shall be compatible with gaskets, o- ring, seals, packing, lubricator parts and other parts coming into contact.
- 3.1.9 Coolant tank must be provided with proper opening for flush/ clean of the tank, so that coolant level trip system works properly. Switch position should be such that sludge doesn't deposit on float sensor. Material of coolant make up tank should be ss304.



- 3.1.10 Gauge panel with physical gauges for temperature and pressure shall be provided and should be visible from outside of the package. Lcd display as an extension of plc display is not acceptable.
- 3.1.11 Proper oil draining system for the package is required. Packager should provide proper pocket system in package structure for draining coolant/ oil from inside the package. Package base frame block must be interconnected & slope must be provided.
- 3.1.12 Level trips of oil & coolant must be provided with wire open alarm according to manufacturer safe design.
- 3.1.13 Package inlet flow meter should have isolation valve in upstream and NRV/valve at downstream of flow meter. Flow meters which are on piping should be connected with flexible hoses and should have proper clamping support to avoid vibration so that correct reading is observed.
- 3.1.14 All cables entries should be from bottom/side in the flp boxes (local control panel). There should be no cabling from the bottom of the package. All the cables should be routed from the side or top for easy trouble shooting.
- 3.1.15 All instruments and their cables should be at appropriate distances from the exhaust line/hot parts.
- 3.1.16 Status of all field instruments viz. Switches should be displayed on plc.
- 3.1.17 Direction of flow should be marked on the pipe line and nomenclature of all vessel (e.g. 1st stage discharge dampener etc.) Should be written on them. Cross head inspection windows should be transparent for easy of inspection during running. Set values should be prominently marked on the gauges or as per manufacturer standard.
- 3.1.18 Offered package shall be complete with compressor, electric motor, piping, cooling system, suction and discharge filters, priority fill system, control panel safety and control devices and other accessories required for automatic and safe operation of the system. The supply shall include all interconnecting piping/tubing/cables. Cooling system shall be of closed-circuit type. Only lubricated and air-cooled compressor block is acceptable.
- 3.1.19 The compressor package control system shall be designed for unattended safe operation in automatic mode and shall unload, start, load, stop safely. The compressor shall start in auto in case high bank storage pressure falls below 200 kg/cm²(g) and stop once the pressure in all three banks of storage cascade reaches upto 250 kg/cm²(g).
- 3.1.20 9 line (3 bank) priority fill system to be provided.
- 3.1.21 Priority system should be designed so that the gas flow from stationary cascade to dispenser is possible even with the Compressor shutdown & de-energized.
- 3.1.22 Compressor shall be designed to ensure flow capacity as follows:

S No	Suction Pressure	Flow Capacity
1.	Flow capacity as on-line compressor at suction pressure of 16 kg/cm ² (g) discharge pr. 250 kg/cm ² (g)	1200 sm ³ /hr

Maximum BKW = As per bidders design

Motor Rating = To be indicated by the Bidder

Maximum power requirement including the accessories to be indicated by the bidder and shall be minimum for the requested performance.

Noise level shall not exceed 72±3dBA at 1m from the compressor package enclosure.

- 3.1.23 Framework shall be mounted on a suitable skid type base, external-lifting lugs shall be provided at each corner. Duplex Suction filter, air compressor & CO₂ flooding system can be placed separately (outside of the canopy) and Electrical control panel can be placed in remote safe area for optimization of the foot print size.
- 3.1.24 An automatic restart shall be provided on restoration of power with a 10-second delay after temporary interruption. Existing alarm condition shall remain indicated.
- 3.1.25 The compressor shall be vented into BDV before restarting in order to avoid overload to the main drive. In any case venting of gas to atmosphere is not allowed. There is need to have a blow down vessel so that gas is vented to vessel. The size of the BDV should be sufficient to allow main drive to start. BDV volume to be designed in such a way that gas accumulated in the process should not be vented out in any case of stopping/emergency push of package. Calculation for BDV volume shall be considering 20% higher than calculated volume and it should be calculated on higher range (19 kg/cm²(g)) of the operating pressure (14 kg/cm²(g) to 19 kg/cm²(g)). Bidders shall submit calculation for same at the time of designing/drawing.



3.2 Allowable speeds, temperature and vibration levels

- 3.2.1 The linear piston speed shall be limited to 4 m/sec for non-lubricated and 4.5 m/sec for lubricated compressors.
- 3.2.2 The maximum discharge gas temperature for each stage shall be limited to 150-degree C.
- 3.2.3 Compressor maximum vibrations at cylinders and at frame shall not exceed 10 mm /sec. And 5 mm/s respectively unfiltered peak velocity. The Bidder shall provide for all structural support within the package so that these levels can be achieved.

3.3 Piston Rod, Bearings and Cross Heads

- 3.3.1 The surface hardness of Rockwell C 50 minimum is required on piston rods in the areas that pass through the packing. Rolled threads shall be provided on the rods with thread relief area as polished.
- 3.3.2 Crosshead shall be manufacturer standard material and designs. Adequate openings for removal of the crossheads shall be provided.
- 3.3.3 Piston rod and cross head pin loading at any specified operating condition at the relief valve set pressure shall not exceed 80% of the maximum design rod load of the offered compressor. Rod loads shall have sufficient reversals in direction for all specified operating conditions including RV Settings and part load operation.
- 3.3.4 Frame rating as published in catalogues of the offered compressor model shall be min 1.1 times the required rating corresponding to max severe operating conditions taking into account temperature correction factor.

3.4 Packing Cases and Pressure Packing

- 3.4.1 All oil wiper intermediate gas cylinder pressure packing shall be a segmental ring with stainless steel garter springs. The pressure packing case shall be provided with a common vent and drain below the piston rod tube to the outside of the Package enclosure.
- 3.4.2 ERW / seamless steel tubing conforming to ASTM A-192 or series 300 SS tubing conforming to ASTM A-269 with minimum thickness as specified in Cl. 7.11 of API-11P shall be used for vent piping.
- 3.4.3 Packing vent piping inside of the distance piece shall be designed for the maximum operating pressure of the cylinder.
- 3.4.4 In case of Pressurized crank case type design, packing vent & drain are not applicable.

3.5 Compressor Frame Lubrication

- 3.5.1 Compressor frame lubrication shall be pressurized system, with a main oil pump driven directly by the compressor shaft.
- 3.5.2 If required the Bidder shall provide an air/electric motor driven pre-lubrication pump. Crankcase shall be fitted with lube oil temp & level indicator.
- 3.5.3 All lube oil piping after oil filter shall be 300 series stainless steel conforming to ASTM A269.

3.6 Distance Pieces

- 3.6.1 Distance piece as per API-11P with cylinder side compartment vented to safe location is specified.
- 3.6.2 Distance pieces shall be provided with gasket, solid covers and shall be suitable for a minimum differential compartment pressure of 1.75 kg/cm²g.



3.7 Cylinder and Packing Lubrication

- 3.7.1 Single plunger per point force feed mechanical lubricator / divider Block type shall provide lubrication to compressor cylinders.
- 3.7.2 Lubricators shall be driven by crankshaft and bidder shall highlight any pre lubrication requirements of the cylinders and the method of achieving the same.
- 3.7.3 Lubricators shall have a sight flow indicator for each lubricator point and a stainless-steel double ball check valve shall be provided at each lubrication point. Common sight glass is also acceptable. Divider block lubrication system to compressor cylinders shall also be accepted.
- 3.7.4 Digital no flow timer shall be provided to stop the compressor in case of loss of cylinder lubrication.
- 3.7.5 Lubricator reservoir capacity shall be adequate for 100 Hrs of normal flow, and shall be equipped with low level alarm.
- 3.7.6 Bidder along with the proposal shall furnish the recommended lubricating oil type, International Grades & Specification along with their quantity and frequency of change. The recommended oil shall be compatible with gaskets, O-rings, seals, packing, lubricator parts and other parts coming into contact.

3.8 Cooling System

3.8.1 Compressor Cylinder

Compressor cylinders may be air-cooled or water-cooled. The CW shall be cooled by an air-cooled heat exchanger.

3.8.2 Inter / After Gas Coolers

Air-cooled inter-stage and final stage discharge coolers shall be provided which shall limit the gas temperature after the cooler to 50 degree C (Or the discharge temperature after aftercooler = Ambient + 10°C). For calculating the surface area of the air cooler, the ambient air temperature of 42°C and 80% RH shall be considered. Cooler design shall be on the basis of 20% excess capacity than required corresponding to suction PR of 16 kg/cm² Gas sections of coolers shall be designed as per API-661 requirements; however, gas section shall be inspected by approved third party inspection agency and may not be "U" code stamped. Vibration switch shall be provided on the heat exchanger to trip the compressor on high vibration limit. Bidder shall indicate vibration level in the offer.

For cooling of the Heat Exchangers a cooling fan to be provided inside the enclosure(s).

The discharge temperature after the cooler is 42°C + 10°C = maximum 52 C

Cooling system shall be preferably installed on the same skid as the compressor due to space constraints. Bidder shall submit cooler sizing calculation for review.

3.9 Separators & Oil Removal System

- 3.9.1 Carbon Steel separators/KOD at auto and manual drain system shall be provided for the capacity as required.
- 3.9.2 All pressure vessels shall be designed as per ASME VIII Div 1 or equivalent.
- 3.9.3 Scrubber service class - B shall be used for Inter-stage / discharge scrubbers. Service Class - C shall be used for suction scrubber. (Refer API -11P)
- The offered scrubber and mist removal shall restrict the oil level to < 5 ppm in the discharge gas of compressor. SS mesh pad shall be used in the scrubbers.
 - All vessels including pulsation dampeners shall be fully (100 %) radiographed as per ASME VIII UW (a) or equivalent.
 - Minimum design temperature for separators shall be 71°C and minimum design pressure shall be maximum operating pressure plus 15% for inter-stages and plus



10% for final stage.

3.9.4 Gas recovery system: Bidder shall provide blow-down tank either horizontal or vertical to act as:

- A buffer tank during start-up.
- Gas flow dampener during compressor operation
 - Surge tank for depressurization of each of the compressor stage piston cylinders during shutdown.
 - Blow-down tank size should be to manufacturer's design standards. The gas recovery vessel shall be provided with pressure relief valve and necessary instrumentation to avoid cold flaring of gas. If bidder will not provide PRV then bidder shall have to ensure operation of compressor package in without any venting of gas at time of starting and compressor capacity must be ensured at the minimum inlet pressure.
- Capacity shall be suitable to prevent any venting.
 - Suction damper and gas recovery vessel shall preferably not be combined and one pressure regulator with isolation valve shall be provided to connect gas recovery vessel with compressor suction.
 - If suction dampener and gas recovery vessel are combined, pressure regulator after gas recovery vessel will not be allowed due to high pressure drop during compressor operation.
- One vent line from gas recovery vessel with double isolation valves shall be provided

3.9.5 All separators / KOD's shall be provided with 3 mm corrosion allowance.

3.9.6 Oil from all drains shall be collected into the oil recovery pot. Oil recovery pot shall be provided with double isolation manual valve and level gauge. Capacity shall be min 15 water liter.

3.9.7 Coalescent super fine filters (preferably two stages) with CE mark/ third party inspected for removal of liquid (e.g. water & oil) and solid particles down to 0.1 microns out of compressed natural gas shall be provided. Residual Oil Contents shall be less than 1 PPM. Manual drains with isolation valves with oil collecting pot shall be provided. The filter should be sized to flow for 200% of flow corresponding to flow at suction pressure of 19 kg/cm²g. However mechanical design shall be based on safety set pressure.

3.9.8 Pulsation, Vibration Control and Analog Study

- Suitable arrangement for interstage pulsation damping shall be provided in confirmation to API 618 and API 11P.
- Bidder shall get the acoustic and mechanical evaluation study carried out for one compressor package (from inlet flange to discharge on skid edge as per API-618 approach-3) by an agency or in house experts. The compressor Bidder shall be totally responsible for all the coordination with the agency carrying out the study

3.10 Prime mover (Electric Motor)

The motor shall be flame proof/ explosion proof and conform to IS: 2148 suitable for zone 1 group II area as per IS/IEC. The Motor shall be of standard frame size as per IS/IEC and rated for continuous duty with high efficiency and shall be designed for soft starter starting. The Motor shall be provided with class 'F' insulation, however, temperature rise shall be limited to the temperature specified for class 'B' insulation as per IS and shall be suitable for voltage variation of 415V± 10%. The bidder shall indicate the guaranteed total power requirement in KW. The motor rating shall be 110% of the greatest BKW required by the compressor.

Electrical panel for motor starter (Soft Starter) to be provided with both induced draught and forced draught ventilation and must be compact in size.

3.10.1 Motor Specification (To be provided separately for 1200 scmh)

Electric Motor

- a) Type of drive totally enclosed fan ventilated (TEFV) high efficiency as per IECMA standard-



**CITY GAS DISTRIBUTION PROJECT
ANNUAL RATE CONTRACT FOR PROCUREMENT OF 1200
SCMH MOTOR DRIVEN CNG COMPRESSOR**

19-2000

- | | |
|---------------------------|---------------------------------------|
| b) Protection | Flame proof & weather proof enclosure |
| c) Insulation | Class F with class B temperature rise |
| d) Mounting | Horizontal Foot Mounting |
| e) Specification standard | By Bidder |
| Supply | |
| f) Voltage(assumed) | 415+/- 10% volt, 3 phases,50+ 5%Hz |
| g) Synchronous speed | By bidder |
| h) Motor rating | By Bidder |
| i) Motor Efficiency | By Bidder |
| j) Power factor | By Bidder |
| k) Speed of motor | By Bidder |
| Nos. of hot starts of | |
| l) motor | 4 per hours |
| m) Coupling Type | By Bidder |
| n) Torque speed cure | By Bidder |

m) Starting torque speed, thermal withstand curve load, current speed curve, Efficiency power factor vs load curve byBidder

Motor Accessories

- a) Compressor grooved flywheel (if any)
 - b) Motor grooved drive pulley (if any)
 - c) Drive VEE belts (if any)
 - d) Flexible coupling for direct drive
 - e) Drive guard
- Adjustable motor slide rails for belts tensioning to be used (if any)

Note:

- 1) Motor shall be three phase, AC, asynchronous, flameproof, high efficiency (IE# or better, as per IEC60034-30), Ex'd' rated, continuous duty, service factor 1.1, on IEC standard type. Designing shall be done on basis of 50 degrees package ambient temperature. Motor shall be suitable for Soft starter. Service factor shall not play any role in finalizing the rating of motor.
- 2) Main Motor Starter: Variable Frequency Drive (Heavy Duty) with input line and DC choke, along with other safeties.
- 3) Considering all de-rating factors as applicable, rating of soft starter (at 50 degree Celsius) shall match or be greater than the selected main motor rating.
- 4) Soft starter panel, LCP or any other power/ control panel need to be appropriately forced cooled to maintain the temperature favorable for switch gear employed in panel.
- 5) Appropriate cable (wrt: size, material, and shielding) to be used for soft starter drive.
- 6) Routing of soft starter and power cable shall be separated from control supply/ instrument cables.

3.10.2 Motors shall be capable of starting and accelerating the load with the applicable method of starting without exceeding permissible winding temperature, when the supply voltage is 75% of the rated motor voltage.

3.10.3 Motors shall be designed for restart under full load, after momentary loss of voltage and with possibility of



restoration in few cycles. Supply voltage being 100% out of phase with motor residual voltage, motors shall be capable of withstanding transient torque's associated under such reaccelerating conditions.

Oil Filter

The ingress of oil into CNG adversely affects vehicle emission and storage system; hence in case of lubricated cylinders vendor shall supply oil separators after cooler at each stage with automatic and manual drain. The maximum permissible oil content in CNG is 5 PPM.

Contractor to supply a proven, maintenance free oil removal system after after-cooler to remove oil from compressed gas. The offered oil mist removal system shall restrict the oil to less than 5PPM in discharge of compressor.

a. Electrical System

- b. All electrical equipment of compressor package shall be installed in accordance with NFPA 70, NEC for Class 1, Division 1, Group D, and IS 5571 and shall have approval of a recognized certifying authority.
- c. OWNER shall provide $415 \pm 10\%$ volts, 3 phase and $50 \pm 3\%$ Hz electrical connection at CNG station electrical panel only. Vendor shall distribute electrical power to all equipment and control system by providing cables and suitable switch-gear distribution panel.
- d. The electrical power supply distribution panel, switch gear panel and starter shall be in flame proof construction, not applicable for soft starter. Certificate from recognized agency to the effect that equipment supplied and or installed conform to above area classification. All devices shall meet the requirement for the specified area classification in which they are installed, including instrumentation leads.
- e. All cables from Electrical room to compressor package shall be in bidder's scope
- f. Heavy duty on-load phase changeover should be provided for H.E motor.
- g. Semiconductor fuses to be provided, where applicable.
- h. All illumination fittings should be single phase AC supply based.
- i. All wire/ cable to be used in compressor and panel shall be of copper conductor and FRLS type through proper cable tray /conduit etc.
- j. Compressor Motor and hence soft start should always start on NO-LOAD for all start method (AUTO or MANUAL mode), selected for operation of compressor, no matter whatever may be the last stopping mode of the compressor viz, programmed or un-programmed. Loading in motor in no manner shall be more than the value as defined by motor manufacturer in motor characteristic curves.
- k. Sufficient space to be provided for Motor JB for cable glanding work.
- l. Chain pulley to be provided in package for easy extraction of motor from package
- m. Multifunction meter to be provided for metering of package total energy and other parameters (viz; KVAH, KWH, Voltage, current, PF, Frequency, MDI (KVA), MD (KWH)).
- n. Bidder to ensure that spares and service support of all switchgears, soft starter, instruments, or meter etc used in package/ panel, shall be available in Indian market.
- o. The power factor (PF) of the whole electrical system should not be below 0.95. Motor feeder shall be provided with energy meter, heavy duty switch, HRC link type with single phase presenter fuses, contractors (AC-3 Duty), bi-metal relay switch fuse unit, voltmeter, push buttons, earth leakage relays, indication lamps for start/stop/trip/ etc. Ammeters shall be provided for all motors above 3.7. KW rating. Stop push buttons shall be lockable and have stay put except in case of critical devices such as lube oil pumps etc.
- p. Cables used inside the package must be frls type. Sufficient distance to be maintain b/w cables and gas/oil tubings inside the package



- q. Local flameproof enclosure inside compressor to have provision of extra holes along with dead end plug to accommodate control cables for any future modification
- r. Phase sequence preventer (Current based) shall be provided

3.11 INSTRUMENTATION & CONTROLS

- 3.11.1 All the Instruments and Control Shall Be Suitable for Area Class I, Group D, Division1
- 3.11.2 All package mounted transmitters & temperature elements, flow transmitter shall be intrinsic safe as per IEC 79-11 and solenoid valves, switches and related junction boxes shall be flame proof 'd' as per IEC 79-1. Other special equipment / instrument, where intrinsic safety is not feasible or available, shall be flame proof/explosion proof as per IEC 79-1.
- 3.11.3 PG shall be Direct-mounting type having element of bourdon tube and dial size of 63/100 mm. It shall have shatterproof glass. Connection shall be 1/2" NPT (M) from bottom. Enclosure shall be weatherproof to IP65. Protection shall be 130% over range. Accuracy shall be $\pm 1\%$ of FSD. PG shall have blown out disc facility. For higher pressure applications (above 60 Barg), it shall be solid front type. Pressure gauge dial shall be white, non-rusting plastic with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment. Pressure gauge sensing element shall be of SS 316 and moving elements of SS 304, as a minimum.
- 3.11.4 The temperature gauge shall be generally gas field in steel field type /bimetallic type. Capillary tubing shall be min. SS304 with SS flexible armoring. The gauge shall have an accuracy of +1% FSD and 100mm dial size. The range shall be 1.5 times of operating temperature. Skin type temperature gauges shall not be used.
- 3.11.5 Pressure Transmitter and Temperature Transmitters shall be used for CNG Gas application with 4-20 mA output signals to PLC. Ex proof enclosure, The units of measurement for pressure shall be Kg/cm² (g)/Barg and temperature shall be degree C. Pressure and temperature switches are not acceptable.
- 3.11.6 RTDs are 4 wire type and element shall be Pt100 as per DIN 43760 & accuracy class A and thermowell's immersion length shall be suitable for the line size. All RTDs shall have duplex elements. RTDs sheath OD shall be 8 mm and material SS 316. Cable entry shall be 1/2" NPT (F). Enclosure shall be WP to IP-65. All RTD shall be supplied with flange or socket welded type thermowell. Thermowell shall be SS316, drilled bar stock type. 50% insertion inside the pipe from top shall be considered for calculating wake frequency calculation. This calculation shall be submitted along with data sheet for approval.
- 3.11.7 Coriolis type mass flow meter with element, transmitter and integrated display shall be provided at inlet and outlet of compressor. All the electronic shall be Ex proof or intrinsically safe. Accuracy shall be $\pm 0.5\%$. Refer data sheet enclosed with tender document.
- 3.11.8 Calibration certificates required for all instruments such as Mass Flow Meter, Pressure transmitters, Pressure gauges, Temperature gauges, Temperature transmitters, Gas detectors, Flame detectors etc.
- 3.11.9 Refer data sheet of gas detectors and flame detectors enclosed with this document. Gas detectors and flame detectors should be mounted with the canopy.

3.12 PLC CABINET

PLC cabinet shall be ex proof, Zone 1 & 2, gas group IIA & IIB, weatherproof min IP 65. Dia cast aluminum alloy LM 6 MOC with Inside & outside epoxy powder coating, with shade RAL 7032, gasket neoprene rubber with single door, glass arrangement for HMI view. Panel shall be provided is Ex proof cable gland. 10% spare gland entry of each size with SS plug.

Panel shall be complete with start, stop push buttons, alarm acknowledge, alarm rest & test button for checking healthiness of annunciation system, HMI, power on, fault indication lamps, fault reset button. All necessary timers and intrinsically safe relays to control the system on an automatic starting and stopping basis shall be provided. The compressor package control system shall be designed for unattended operation in automatic mode and in case of any fault it will go in a safe mode.

Redundant 230 V AC to 24 V DC power supply unit shall be provided with diode circuit for auto switch over. Healthiness of both the PSUs shall be provided in front of cabinet and same shall be repeated in



PLC for failure of alarm.

In addition to inbuilt in PLC, surge protection device for 24 V DC, 230 V AC UPS power supply, 230 V AC non-UPS power supply at inlet shall be provided in cabinet.

Compressor package shall be provided with a PLC based local control with HMI for local operation & monitoring, which shall be mounted on the package enclosure. All the interlock, monitoring and controlling of the CNG compressor package shall be done through PLC based control system.

3.13 PLC SPECIFICATION

PLC hardware shall be in accordance with IEC-61131. PLC shall be 32 bit microprocessor, min 8 MB RAM, and support to protocols DNP 3.0 over TCP/IP, DNP 3.0 Over modbus, Modbus (TCP/IP).etc as min

PLC shall be of modular in construction, rack for mounting cards, CPU, Input output cards, Power supply card, communication card. PLC CPU shall be redundant (1 W+1S) with auto switch over without manual intervene. Failure alarm of CPU shall be provided in HMI and same shall be repeated in PLC for remote monitoring.

PLC shall be suitable for controlling of compressor parameters as indicated in instrumentation and all other parameters that are recommended by the compressor manufacturer for 24x7 operation. PLC shall be suitable interfacing port for Laptop for programing, configuration and diagnosis. Type of communication with laptop shall support upto 30 mtrs distance from compressor to safe area.

A dedicated Modbus (RS 485) slave communication port shall be provided for Remote terminal unit (RTU) interface. A separate Modbus RS 485/ TCP/IP communication ports shall be provided for GPRS modem for communication with SCADA system.

All the parameters shall be time stamped in PLC. It shall be possible to synchronize PLC clock with GPS system.

PLC shall be 20% spare each type of input output channels for future use. All these IOs shall be wired upto the spare terminal block inside the PLC cabinet. Diagnosis feature shall be available in CPU and I /O used in PLC.

The PLC/RTU shall comprise the following subsystems:

- Redundant Central processor with system software.
- Power supply unit
- Analogue input
- Contact (digital) input
- Contact (digital) output
- Modbus Serial ports configurable (RS 232/485)
- Ethernet port
- Diagnostic port

The Digital Output shall be configured for pulse duration. No separate program or logic will be acceptable at PLC end. On restart/ power failure, PLC shall not reset the output circuit, shall not generate false control signal and shall necessarily cancel all pending control signal.

Configurator software licenses shall be preferred in software (software key) form instead of hardware (dongle). Multiuser software licenses shall be provided.

Suitable bypass for interlocks shall be provided for start-up.

Configuration and diagnostic tool should be able to connect to remotely over TCP/IP.



Successful bidder to include in scope live demonstration of remote monitoring of all PLC logged parameters in one machine at his works. OWNER may ask for the same. However, this may be required to be demonstrated at site.

The PLC System offered shall be supplied with monitor and memory card for Processing of live data and stored data.

Compressor package shall be provided with the following indicators:

- 3.13.1 Pressure transmitter and pressure gauge at suction, discharge, cascade bank distribution header.
- 3.13.2 Pressure transmitter at high bank line
- 3.13.3 Pressure gauge & temperature gauge at each stage of compressor
- 3.13.4 Temperature transmitter at discharge.
- 3.13.5 MFM at suction & discharge and vent line
- 3.13.6 Oil pressure indicator on each pressure lubrication system
- 3.13.7 Oil levels indicator, field mounted
- 3.13.8 Hour meter
- 3.13.9 Hydraulic oil cooler inlet & outlet temperature on local gauge panel (if required)
- 3.13.10 Hydraulic oil pressures each stage on local gauge panel (if required) The Compressor package shall be provided with the following trip devices:
- 3.13.11 Low oil level protection devices
- 3.13.12 High oil temperature devices
- 3.13.13 Low suction pressure protection devices
- 3.13.14 High discharge temperature protection device
- 3.13.15 Coolant flow low devices
- 3.13.16 Flame detection
- 3.13.17 Gas detection
- 3.13.18 Emergency stop devices
- 3.13.19 Fail safe/ wire break alarm for safe operation
- 3.13.20 Interlocking provision in PLC program for tripping of machine

The compressor package shall be furnished with the following trip logic that shall stop the compressor and suction of compressor shall be isolated:

- a) On low oil level
- b) On high oil temperature
- c) On low suction gas pressure
- d) On high discharge pressure
- e) On high discharge gas temperature
- f) On coolant flow low
- g) On fire detection
- h) On gas detection
- i) On pressing manual stop button at local control panel
- j) On pressing emergency stop devices

3.14 DOCUMENTS TO BE PROVIDED WITH PACKAGE



Vendor shall submit documents during engineering stage for review & approval to client/consultant.

Specification /data sheet with statutory approval certificate, W&M certificate, PESO certificate of all the instruments as per P&ID, Instrument index, Input output list, Power CONSUMPTION CALCULATION, Cause & effect, Cables specification, Cable schedule with termination details, Operation & control philosophy, PLC specification & architecture. Operation and Maintenance Manual (In English) – 02 Copies, Calibration certificates of all instruments & devices

P&ID with tag numbers for each item, line size, valve size, type of connection, instrument symbol connectivity with PLC, interlock number.

Bill of Material with Tag No & Technical Specifications

Wiring Diagram of Electrical & PLC Panel

Specifications of Electric Motor & Characteristic Curves

Foundation and GAD Drawings

Capacity vs. Suction Pressure curve

Capacity vs. Energy Consumption curve

List of spares for four years of operation and maintenance. The list of spares should include ordering specification and manufacturer's catalogues. Bidders to keep inventory of spares in the centralized stores as finalized by the owner. The availability of the spares will be checked by the owner on required basis.

3.15 SKID AND ENCLOSURE

Each compressor module shall be housed within a purpose-built SS 304 acoustic enclosure or in case of mild steel the surface shall be treated with anti-rust coatings followed by UV resistant epoxy paint for durability and rust protection. The units shall incorporate a rigid framework with a combination of fixed and removable panels. Filling of Class A melamine self-extinguishing polyurethane (PU) foam specifying the maximum burn extent, with UL certification or better shall be used in acoustic enclosure.

The enclosure shall be assembled onto the package base plate at the supplier's works to give a fully transportable unit.

Enclosures shall be designed to include cooling air inlet and outlet louvers together with a forced ventilation system to prevent the possibility of gas build up inside the enclosure. Suitable interlocks shall be built in for clearing entrapped gases (if any) within the enclosures before the startup of the electric motor / compressor. Packages design should be such that its vent should not go upward (package vent in vertical direction not required) i.e. opening of package vent should be in horizontal directional with duct arrangement.

The maximum temperature within the enclosure shall be limited to ambient +10°C. Adequate ventilation fans shall be provided to meet the above and also to account heat dissipation of the coolers/ all other components.

Enclosures shall be engineered to give a noise level of maximum 75 dBA measured at 1 meter as standard, utilizing Melamine filled self-extinguishing, low smoke Polyurethane (PU) foam. Specifying maximum burn extent with UL certification covering aluminum or steel with perforated steel inner face. Materials shall be non-combustible to deter spread of flame requirements.

The enclosure shall be designed for ease of access to the equipment within and has suitable entry doors.

To prevent the discharge of gas into the enclosure, all safety relief valves within to be connected to a manifold. From this connection a single pipe passes through the enclosure roof to a vent stack to allow satisfactory dispersion of gas at a height of minimum 3m above ground level.

A viewing window at operating level to be fitted to allow monitoring of gauges, etc. without entering the enclosure.

External emergency stop push-button shall be fitted to wall of enclosure close to main access door. Total 5 Nos. of Emergency shut off push buttons with hooter. One to be provided local at package mounted area, one in panel room and one in customer interface room (control / sales room). Bidder to



assume that the sales / control room and compressor area, each, will be max 75 Mtrs. away from the compressor. Bidders to include the cables along with cable trays / flexible PVC ducts for Emergency stop push buttons and have to install the same at the site. Cables shall be PVC insulated with steel armored and of 1.1 KV grade. Any unutilized cables shall be returned to OWNER with no extra cost.

Enclosure shall have gas detection & Fire detection system consisting of 2 nos. Infrared type LEL detectors and 2 nos. flame detectors (UV type) shall be provided. The detectors shall be re- calibrated at site during commissioning. Also, the performance of the detectors shall be demonstrated at the time of commissioning.

Adequate fixed flameproof lighting (minimum at 2 locations) shall be provided inside the enclosure.

Bidder shall optimize the compressor package for minimum possible space requirements considering space constraints of sites where the compressors are proposed for installation.

Suitable gradient shall be provided on the enclosure roof for rain drainage and to avoid water pockets. Enclosures shall be designed with proper rain protection in the ducting or any other cut out to protect the inside equipment from rain water.

For handling of all heavy parts for maintenance purpose suitable lifting arrangement shall be provided i.e. beam fitted with chain hoist arrangement/chain pulley arrangement etc. The chain hoist arrangement i.e. chain pulley block shall be removable type, which can be disassembled and shifted onto the other machines. It shall be provided for each tendered quantity of compressors. Eye bolt arrangement shall be provided on heavier components like electric motor, cylinder crankcase, and wherever felt necessary for lifting during maintenance.

The bidder shall also provide 2 nos. monkey ladder for safe climbing on the top of the canopy along with hand railing on the top for ease of maintenance and operation. Platform provided above on top of the canopy must have sufficient space in order to attend any breakdown of cascade.

Jack arrangement required for alignment of the motor.

All FLP lighting inside enclosure should have LED lamp.

The bidder shall be providing a degree of protection equivalent to IP54 as defined in AS 1939. All the pressure temperature & level indicators shall be visible from outside of enclosure.

The package shall be protected by automatically operated CO2 flooding system designed as per NFPA-12, which should have minimum following features as stated in respective clause of technical specification.

Constructional details

1. The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and a long service life for the bearings. The accepted values of peak-to-peak vibration amplitudes for a motor at rated voltage and speed on a machined surface bedplate with the motor levelled and with a half-key or coupling fitted shall not exceed those given in IS:12075.
2. Windings -insulation and bracing.
3. Motors shall be provided with Class 'F' insulation with temperature rise limited to Class 'B'. The permissible temperature rise above the specified ambient temperature by thermometer method shall be limited to these specified in the applicable Indian standards for class 'B' insulation.
4. The windings shall be treated so as to resist the action of corrosive agents or substances (solids, liquids or gases) as may be present in the atmosphere of chemical, petrochemical and natural gas plants which may tend to adversely affect the insulation. Sulphur vapour may be present in the atmosphere. The windings shall be tropicalized. The windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactory in humid and corrosive atmosphere.
5. The windings shall be adequately braced to prevent any relative movement during operation and, in this respect, particular attention is drawn to the stator windings of full voltage started squirrel cage motors insulation shall be provided between coils of different phases which lie together.



6. In case of motors driving equipment with pulsating loads, special attention shall be paid to the joints of rotor bars and end rings to avoid failure due to induced fatigue stress.
7. Phase connections.
 - (a) The windings shall preferably be connected in delta. However, for motors rated 1.5KW and below, star connection may be accepted.
 - b) If star-delta starting is required, this will be specified in the data sheet and the motor windings shall be fully insulated for delta connection. However, main motor must configured through soft starter starting only.
8. Winding terminations
 - (a) The ends of the windings shall be brought out into a terminal box. They shall be terminated by means of terminals mounted on an insulating base made of non-hygroscopic and non-flammable material.
 - (b) The terminals shall be adequately designed and thoroughly insulated from the frame using material resistant to tracking.
9. Terminal box and cable entries
 - (a) The terminal box shall be of sturdy construction and large enough to facilitate easy connection of the cables.
 - (b) An adequately sized earth terminal shall be provided in the motor terminal box for termination of the fourth core of cables.
 - (c) The terminal box shall be provided with bolted terminals, Cu cable lugs and entries for suitable cable glands corresponding to the number and size of specified cables. If specified in the requisition, nickel-plated brass (or aluminum if specifically required) double compression type cable glands and pin type lugs shall be supplied along with the motor for the mentioned cable sizes.
 - (d) Equipment and accessories provided should conform to the area classification and the environmental conditions specified in the motor data sheet.
 - (e) The terminal box shall be capable of withstanding the full internal short-circuit conditions without danger to personnel or plant from the emission of hot gases or flame or due to excessive distortion or damage to the terminal enclosure.
10. Phase marking
 - (a) Appropriate phase markings as per IS: 4728 shall be provided inside the terminal box. The Markings shall be non-removable and indelible.

Other Details:

Motor shall be TEFC squirrel cage type in standard frame size as per IS/IEC rated for continuous duty with high efficiency and designed for soft starting. Motor shall be suitable for starting under specified load conditions with 75% of rated voltage at the terminals. Motor torque shall be compatible with the speed torque curve of the compressor. Motor winding shall be Class F insulated with temperature rise limited to Class B. Minimum degree of protection of enclosure shall be IP55 as per IS. Motor for use of hazardous shall have flameproof protection ex (d) as per area classification. The main motor starter should be soft starter and all accessories motor above 5.5kW should have start-delta except main compressor motor. Adequate space shall be provided along/ around the motor for maintenance purpose.

The motor name-plate rating (exclusive of service factor) shall be minimum 110% of the greatest kW/ HP required under any of the specification operating conditions. All motor shall be tested in accordance with IS/IEC.

Each motor shall be compulsorily be protected with thermal magnetic over-current relay.

Electric power supply distribution panel switchgear panel and starter panels shall be skid mounted construction, weather and vermin proof suitable for installation in the compressor package. There shall be FLP push button panel available at the compressor skid. The switchgear shall have 1 incomer and adequate no. of outgoing feeders. The incomer shall be provided with suitable rated switch fuse unit,



ammeter, voltmeter with selector switch, energy meter, pf meter, etc. Motor feeder shall be provided with heavy duty switch. HRC link type fuses, contractors (Ac 3 duty) bimetallic relays, single phase prevented, ammeter, pushbutton, earth leakage relay and indication lamp for start/stop/trip etc. Adequate nos. Of MCB feeders for control and lighting shall be provided. Supplier shall furnish single line diagram of panel with the bid. The switch for changeover of phase shall be provided inside the panel. Multi-functional digital energy meter preferably HPL socomac CT2emfA1- basic version with maximum demand in kVA and kW with suitable fuse protection required within the panel.

There shall be separate panel for main incoming switch (MCCB) and starter for main motor.

There shall be minimum clearance of 30mm between the 2-power contactor.

The compressor panel shall have phase reversal relay to detect electric supply phase sequence and trip the compressor on wrong phase sequence.

Supplier shall make provision for earthing of the complete package as required as per IS

All electrical shall comply with latest IS/ IEC. Epoxy base paint shall be applied on all electrical equipment's.

Supplier's scope shall include obtaining statutory approvals for all complete package, wherever necessary.

Bidder to note that all control electronics/ electrical, instrumentation shall be capable of withstanding voltage fluctuation within +/- 15% of rated voltage (240 VAC). In case the card/components are not capable of withstanding above voltage fluctuation, the scope of supply of compressor package shall include an UPS/ voltage stabilizer (VS) / voltage conditioner (VC) so as to take care of voltage fluctuation.

In such condition each compressor packager shall be provided with individual UPS / VC / VS. along with necessary interconnecting cable. Bidder shall also be responsible for lying of such cable, installation and commissioning of UPS.

Pre-lubricated sealed bearing for all motors may be considered provided a full guarantee is given for 4-5 years of trouble, free service without necessity of lubrication.

Various Data's Curves & Design calculation for selection of Driver i.e. Electrical Motor to be submitted by bidder. Superimposed Torque-Speed characteristics of motor & compressor. Starting time calculation at 100%, 80% & 58% of rated voltage.

Motor casing and type of enclosure

1. Motors for use in safe areas shall be normal industrial types meeting the specified ambient conditions and operating requirements. The minimum degree of motor enclosures, including terminal boxes and bearing housing, shall be IP-44 as per IS: 4691 for motors meant for indoor use and IP-55 for outdoor duty motors.
2. Motors for use in hazardous area (Zone 1 or Zone 2) shall have type of protection Ex (d) or ex (p) or Ex (e) or ex (n) as specified in the data sheet and shall meet the requirements of applicable Indian standards. The minimum degree of motor enclosure, including terminal boxes and bearing housings, shall be IP-55 as per IS: 4691 for all motors, used in hazardous areas.
3. Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. In case of manufacturer's view that the motors for outdoor duty should have a canopy at any particular site, the same shall be deemed to be included in manufacturer's scope of supply. Motor casing shall be provided with a suitable drain for removal any of condensed moisture.
4. All internal and external metallic parts which can come into contact with cooling air, (piping, air supply and discharge conduit, protective grills, air deflectors, filters and supports) shall be of corrosion- resistant



material or appropriately treated to resist the corrosive agents which may be present in the atmosphere. Screws and bolts shall be hot-dip galvanized or zinc passivated to protect against corrosion.

Bearings and lubrication

1. Motors shall have grease-lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum operating life of 40,000 hours. Unless otherwise specified the bearing shall be adequate to absorb axial thrust in either direction produced by the motor itself or due to shaft expansion. Vertical motors shall be provided with thrust bearings suitable for the load imposed by the driven equipment. In cases such as pumps for hot liquids, the driven machine operates at high temperatures and the bearings, particularly of vertical motors, which are exposed to high temperature, shall be cooled by an impeller fan mounted on the shaft. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven object by conduction or convection.
2. Bearings shall be capable of grease injection from outside without removal of covers with motors in the running condition. The bearing boxes shall be provided with required seals, to prevent loss of grease or entry of dust or moisture, where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices which ensure passage of grease through the bearing. Pre-lubricated sealed bearings will be considered provided a full guarantee can be given for 4 to 5 years' trouble-free service without the necessity of re-lubrication.

COOLING SYSTEM

1. All motors shall be self-ventilated, fan cooled. The fans shall be of bronze, brass, aluminum, mild steel, stainless steel or of plastic. Plastic fans shall be "antistatic" type. i.e. they shall not permit the accumulation of electric charge on the fan surface. In all cases fans shall be corrosion-resistant or appropriately protected against corrosion. They shall be suitable for rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.
2. Motors for installation in dusty atmospheres or in the presence of sand, fuel or other solid particles in suspension in the air, shall be fitted with filters for the cooling air. The filters shall be easily accessible for inspection and removable for cleaning and re-use.
3. The material of the filter and support trays shall be rustproof or protected against oxidation or corrosion.

Other requirements

1. Motors shall be provided with a single shaft extension with keyway and full key.
2. All motors above 25Kg of weight shall be provided with lifting hooks of adequate capacity to facilitate safe lifting.
3. Two earth terminals located preferably on diametrically opposite points shall be provided for each motor. Necessary nuts and spring washers shall be provided for earth connection.
4. A warning with indelible red inscription shall be provided on the motor to indicate that isolation of the power line alone is not sufficient and that the heater supply should also be isolated before carrying out any work on the motor.
5. Fixing bolts: All motors shall be supplied with fixing bolts.
6. Special tools and spanners
 - (a) Each motor shall be provided with a set of spanners and special tools, required for dismantling and maintenance of the motor.
 - (b) Triangular spanners required for explosion-proof or increased safety motors are considered as special tools.



7. A name plate as required under specification IS: 325 shall be provided on each motor in addition to the motor rating plate. A separate motor plant equipment number plate shall be fixed in readily visible position. This number is indicated on the attached data sheets. Additional information as stipulated in applicable Indian standards shall be included in the nameplate for motors meant for use in hazardous atmospheres.
8. The permissible noise level shall not exceed the stipulations laid down in IS: 12065.
9. Motor vibrations shall be within the limits of IS: 12075 unless otherwise specified for the driven equipment.
10. Internal and external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with anti-acid paint that will resist the particular ambient condition. All external surfaces shall be given a coat of epoxy-based paint.

3.16 Enclosure of CNG Compressor Package

- 3.16.1 The maximum allowed temperature within the enclosure shall be 10°C above ambient temperature. Adequate ventilation fans shall be provided to meet the above and also to account for heat dissipation of the coolers. Interlock shall be provided to start the exhaust fan to vent out any entrapped gases in the enclosure before starting the main compressor. In case the ventilation fan is mounted inside the canopy then no separate ventilation fan required provided this meet the required temperature.
- 3.16.2 The compressor package shall consist of separate enclosures for Compressor and electric motor. The equipment shall be mounted on one common skid. The Enclosure to restrict maximum noise level to 72 dB (A) ± 3 dB (A) at 1 meter from the enclosure.
- 3.16.3 Enclosures shall be provided with a degree of protection equivalent to IP 54 as defined in AS 1939, shall be flame proof and provided with ventilation system.
- 3.16.4 The enclosures shall have doors for normal access and removable wall panels for ease of maintenance.
- 3.16.5 All the pressure, temperature, lube oil pressure, coolant temperature, coolant level indicators shall be visible from outside of enclosures.
- 3.16.6 Enclosures shall have internal flame proof lighting arrangement.
- 3.16.7 For handling of all heavy parts for maintenance purpose lifting arrangement i.e. beam fitted with chain hoist shall be provided in enclosure.
- 3.16.8 The Compressor shall be located inside an acoustic enclosure. All Coolers, knock out Drums, Scrubbers, Cooling System, lubrication system along with interconnecting piping shall be inside an enclosure. Enough headroom shall be made available for easy access and maintenance of all equipment. The piping layout with respect to the compressor, intercoolers, KOD and auxiliaries' location shall be subject to Purchaser's approval during detailed engineering stage.
 - Components such as pressure gauges, temperature, pressure switches, filter automatic ball valves, safety valves etc., which require in-situ adjustment, maintenance and reading, shall be easily accessible.
 - Conduits and tubing shall be arranged in orderly and systematic manner and shall be routed neatly to enter the back of display or monitoring panels
 - Routine service items such as, but not limited to, crank case oil filters, inter stage gas filters, inlet and outlets gas filters and drive belt shall be located to facilitate easy one-man servicing.
 - One person should be able to access crank case oil inlet and drains to allow addition or drainage of oil without removing panels or adjacent components and without the need of the pump.
 - Items which must be operated & monitored during operation shall be readily accessible without opening the door.
 - Suitable gradients shall be provided on the enclosure roof for rain drainage and to avoid water pockets.
 - Communication/Control cables shall be routed through Cable Trays/conduits



3.17 Piping

- 3.17.1 All gas piping shall be designed, fabricated & tested in accordance with ANSI B 31.3.
- 3.17.2 Gas piping shall be seamless carbon steel manufacturing in accordance with ASTM A-53 Gr. B or ASTM A - 106 Grade B. All Gas piping shall be flanged connections. Pipe wall minimum thickness shall be in accordance with Table 4 of ISO 13631:2002.
- 3.17.3 All rigid piping, tubing & other components of compressor package shall be designed for full range of pressure & temp and loading to which they may be subjected with a factor of Safety of at least 4 based on minimum specified tensile strength at specified ambient temperature.
- 3.17.4 All rigid piping shall be continuous between their respective components & free of connections except welded joints. All high-pressure joints shall be welded unless otherwise not feasible.
- 3.17.5 The instrument air tubing material shall be SS316 as per ASTM A269.
- 3.17.6 All high-pressure double ferrule fitting and 2/3 way valves shall be of S.S. material only. Material of tube shall also be SS316 as per ASTM A269 Sandvik/Tubacex/Parker make.
- 3.17.7 Bidder shall furnish a temporary start up conical strainer fitted with adequate size mesh.
- 3.17.8 All lube oil piping downstream of filter shall be series 300 Stainless Steel. Pressurized lubricating oil lines downstream of the filter (with the exception of cast-in-frame lines or passages) shall be made of austenitic stainless steel. For either tubing or piping, bends shall be used to minimize the number of fittings wherever possible. Steel fittings shall be furnished with stainless steel tubing. Pressure piping downstream of oil filters shall be free of internal obstructions or pockets (such as those created by socket weld fittings) that could accumulate dirt at pipe joints. Non-consumable back-up rings and sleeve-type joints shall not be used. Other piping fittings shall be of the socket-weld or butt-weld type. When butt welds are necessary, such precautions as internal grinding of joints and use of gas tungsten-arc welding for the first weld pass shall be taken to prevent weld splatter inside the lines. After fabrication, oil lines shall be thoroughly cleaned and preserved. In addition, carbon steel piping shall be pickled and passivated.
- 3.17.9 External drain & vent piping shall be Carbon Steel and not less than 1" nominal size. However, all the internal drains shall be SS 316 tube as per ASTM A269. However, all the internal drains shall be SS 300 series material.
- 3.17.10 Mercaptan/ THT dosing is envisaged hence all materials coming in contact with gas shall be compatible to such gas with Mercaptan/ THT dosing and be of compressor manufacture's standard. The use of SA 515 material is prohibited.
- 3.17.11 All piping after coalescent filter at compressor discharge shall be of SS 316.
- 3.17.12 The instrument air header up to compressor enclosure and CO2 piping shall be seamless CS
- 3.17.13 All low pressure and high-pressure gas piping joints fabricated at site / shop shall be 100% radiographed after welding.
- 3.17.14 Design of piping systems shall achieve the following:
- Proper support and protection to prevent damage from vibration or from shipment, operation and maintenance;
 - minimize loads on the nozzles of cylinders and pulsation suppression devices;
 - avoidance of pipe work bending forces and/or introduction of adequate flexibility to minimize stress;
 - good accessibility for operation, maintenance and cleaning;
 - installation in a neat and orderly arrangement adapted to the contour of the machine and not obstructing access openings;
 - elimination of air pockets;
 - complete drainage through low points without piping disassembly;
 - elimination of low points in the inlet process piping including recycle/by-pass piping that could trap liquid;



- use of pipe clamps on all gas piping and on all piping DN 50 (2 in) and larger;
- supports shall not be welded directly to gas piping.
- Following certificates have to be submitted for piping fabricated at Site / shop
- A- Electrode qualification test procedure
- B- Proposed Welding procedure specification with impact test
- C- Electrode qualification test results.
- D- Procedure qualification test results and final WPS.
- E- Welder's qualification test.

3.18 Coupling

The first preference is for directly coupled driver-compressor arrangement.

4. ELECTRICS & INSTRUMENTATION CONTROL:

4.1 Starter/Control Panel/ Control philosophy

4.1.1 Doors shall be interlocked isolator. Panel shall be complete with start and stop push buttons, hours run meter, power on and fault indication lamps, fault reset button. All necessary timers and intrinsically safe relays to control the system on an automatic starting and stopping basis shall be provided. The compressor package control system shall be designed for unattended operation in automatic mode and in case of any fault it will go in a safe mode.

4.1.2 CONTROL PHILOSOPHY

A. The compressor package control system shall be designed for unattended operation in automatic mode and in case of any fault it will go in a safe mode.

Compressor Package shall be provided with a PLC based LCP which shall be mounted on the package enclosure, which shall be weatherproof to IP65 and shall be housed inside flameproof IIA/IIB (Ex'd'). PLC should be integral with the package with necessary Hazardous Area Certificate (HAC) compliance. HMI shall be of touch screen type. All operational buttons shall be on touch screen except the Emergency stop button. Touch screen display system shall be weather proof to IP65. PLC shall incorporate all process parameters (specified elsewhere) and status of compressor, motor & priority panels and shall be modular in construction with 100% redundancy with respect to CPU, Power supply, Interface. PLC components/system shall be tropicalized, MIL standard adopted with complete wiring and necessary terminals. Wiring to be colour coded with cross ferruling in position.

PLC shall be capable of carrying out on line routines for at least ten separate loops without affecting the scan, cycle & up dating time etc.

PLC shall be capable of, All the process parameters as per P&ID, Compressor Control & Emergency Shut down, Fire and gas detection and monitoring, Graphics, Data acquisition, monitoring & logging, viewing, modifying set point and range of all process parameters for which transmitters are provided, Record the last 20 Alarms of abnormal operations on separate page.

PLC shall be capable for display of flow meter data (i.e. Gas Suction, Gas Discharge, Package/vent loss), & KWH meter, P.F , various trips/abnormal conditions, compressor running hour etc. in following manner:

- a) Shift wise (for 3 shift operation i.e. 06:00-14:00, 14:00-22:00 & 22:00-06:00) - shall be available for atleast last 96 hours
- b) Daily basis- shall be available for atleast last 31 days
- c) Fortnightly basis- shall be available for atleast last 3 fortnights
- d) Monthly basis- shall be available for atleast last 2 months

PLC shall be configured as a remote terminal unit of supervisory computer and data acquisition system complete with dial up connectivity. One card for transferring and accessing data from minimum twenty devices with RS 485 port shall be provided. PLC SCADA connectivity is required as per the attached specification at Table 17.3



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SCMH MOTOR DRIVEN CNG COMPRESSOR**

PLC would be provided with integral keyboard and display for configuring, programming and to view process & machine parameters. Suitable communication port shall be provided to download programs etc from PLC through a Laptop.

All source & object codes including logic flow chart, ladder diagram etc are to be furnished by the Packager and PLC shall be capable of incorporating function Block diagram, sequence function chart, ladder diagram and structural text as per IEC 61131. All PLC programming shall be provided by the bidder in soft version.

There shall be three independent ports available in the PLC with all the parameters available on each individual port.

Out of three ports from first port there shall be an arrangement to retrieve the data in external storage device such as memory card/ pen drive. Data may be required in suitable format as per AGL Engineer In-charge discretion. This will include critical temperature, pressure, flow, running hour etc information. Depending upon the parameters, calculation of Gas loss/Energy Loss, Efficiency, normalized efficiency etc. is also required.

Second port shall be for remote monitoring of the parameters. Besides PLC display, all the parameters which are measured, should be monitored on a HMI/MMI for remote monitoring as well as of remote operation. Data should be stored at 2 places simultaneously in case of failure of one device, data can be retrieved from second device. Trends, alarms, events should be logged for at least 3 months on day/hour/minute basis.

Third port shall be available for any third-party interface which shall be OPC compliant for networking or SCADA. The recorded data or part of the data may be required to transmit to remote locations over open/secured network through internet/ Ethernet using local cable/ data card/ simcard (GPS/GPRS/CDMA). Modem / router or any other medium to transmit the data should be available. Vendor shall provide protocol details to AGL and also provide necessary support for third party interface for remote data connectivity or SCADA connectivity.

Redundancy in PLC is required. PLC shall incorporate all process parameters (specified elsewhere) and status of compressor, motor & priority panels and shall be modular in construction with 100% redundancy with respect to CPU, Power supply, Interface. PLC components/system shall be tropicalized, MIL standard adopted with complete wiring and necessary terminals. Wiring to be color coded with cross ferruling in position. PLC shall be capable of carrying out on line routines for at least ten separate loops without affecting the scan, cycle & up dating time etc. PLC shall be configured as a remote terminal unit of supervisory computer and data acquisition system complete with dial up connectivity. One card for transferring and accessing data from minimum twenty devices with RS 485 port shall be provided. In case of failure of master / active controller/CPU, standby controller/CPU should take over the control in bump less manner. All values & data should be available through both the controllers immediately, i.e. there should be no data loss.

Successful bidder to include in scope live demonstration of remote monitoring of all PLC logged parameters in one machine at his works. AGL may ask for the same. However, this may be required to be demonstrated at site.

There shall be an interlocking provision in PLC program for tripping of machine due to communication break or power failure of flow meters.

Fail safe / Wire break alarm for safe operation. Machine should trip in case the loop is broken for GD/FD/PT/TT.

Each cable shall be neatly tagged & dressed of each for instrument. There shall be identification tags for individual instruments.

In PLC pressure process values should be taken from pressure transmitters/RTD and should be independent from pressure gauges installed on local gauge panel. Temperature process values should be taken from temperature transmitters and should be independent from temperature gauges installed on local gauge panel.

- B. The compressor package control system shall be so designed that the first item to go into alarm condition shall lock out to indicate the cause of the trip though the cause of the trip may have disappeared. The lock out condition shall be manually reset. A change over set of contacts shall be provided for Owner's use to give a remote indication of alarm and trip.



- C. In auto mode, compressor shall start automatically in case high bank storage pressure falls below 220 kg/cm² and stop as soon as pressure of stationery cascade reaches 255 kg/cm².
- D. The priority fill system (In bidder's scope) shall ensure the filling of vehicle, storage cascade and mobile cascade in correct order.
- E. Control system shall be designed such that in case of any fault, discrepancy or abnormality, it will go in safe mode. All controls shall be made in fail-safe mode & failure of any control shall not lead to operation of equipment/ system in unsafe condition.
- F. In case of fault, a warning hooter shall operate, the sound of which should be audible at distance of at least 15 meters. Further the fault alarm and emergency stop PB shall be duplicated in the CNG station control room. Acknowledgement/resetting of fault shall be possible only from compressor panel. Emergency stop PBs shall be mushroom head turn lockable type.
- G. Once the fault is acknowledged or the motor and/or compressor are under normal maintenance, the valves of priority panel shall take the position so that gas available in the stationary CNG storage cascade can be dispensed.
- H. The pressure in each bank shall be monitored from downstream of priority panel.
- I. Bidder shall provide emergency shut down (ESD) system in the control room as well as locally mounted on the compressor panel and one no. on the enclosure. Total 3 nos. of ESD switches to be provided as a minimum.
- J. Fail-safe system shall be designed and incorporated to isolate cascade storage from dispenser, stop compressor, isolate the compressor suction line and cut off supply to motor on activation of ESD switch.
ESD switch shall have to be manually reset to restart the compressor package again.
- K. Bidder shall provide Application program for PLC, HMI (Human Machine Interface) on LCP (one set) along with all interfacing adaptors and cables. Bidder shall also provide one set of source & object codes for PLC, HMI on LCP (in both forms, hard & soft).
- L. All pressure and temperature at compressor inlet, outlet, at each stage before and after cooling, all related pressure temperature, all cooling water temperature at inlet and outlet to be available on the PLC.
- M. PLC shall have historical as well as event recording system for at least last 200 events as per attached section: General specification for instrumentation.
- N. The pressure in each bank shall be monitored from downstream of priority panel.
- Pressures in each bank of stationary storage cascades.
- Pressure at outlet for dispenser.
- Pressure at outlet for mobile cascades.
- Control Air Pressure
- Indicators, Alarms and Trips as per Equipment Data Sheets
- Pre alarm to be incorporated in the software before machine trips in predefined values of Pressure & temperatures.
- O. Calibration certificates of all instruments such as Pressure, Temperature, flow meter, vibration, KWH meter, SRV, GD FD etc shall be valid at the time of string test, compressor commissioning and Performance Guarantee testing.
- P. Vendor shall ensure to calibrate the instruments during O&M period and calibration shall be valid upto three months from expiry of O&M period.
- Q. Vendor has to calibrate Pressure & Temperature instruments within 1 month of compressor commissioning or before Performance Guarantee testing.
- R. Training to Client's team at site - functional & operational with PLC & instrumentation system. Training program and the procedure shall be provided for training at site.



4.2 The priority fill systems: the priority panel shall ensure the filling of vehicle, storage cascades & LCV in correct sequence. The priority fill system shall ensure 200-kg/cm²g pressure in CNG dispenser outlet port. Design of priority fill system shall be aimed to achieve maximum flow rate through combined flow from compressor and cascade arrangement. All priorities shall be with full bore ball valves having high CV. Bidder shall indicate flow rate achievable through proposed priority fill system design. All tubing and valves shall be ¾" size for 1200 SM³/h compressor. One isolation valve at outlet of each line shall be provided. After isolation valve tube dia for bus dispenser and bus cascades shall be 1" OD. Sheeting work of priority panel shall be SS construction. All the pneumatic tubing for Solenoid of priority shall be of SS 304 only.

The priority fill panel shall be designed to deliver the CNG and priorities shall be as follows:

4.2.1 TYPE – 1 FOR MOTHER STATION: 9

LINE: A: When compressor is running

- 1 Priority no one: Car dispenser Low bank
- 2 Priority no two: Car dispenser Medium bank
- 3 Priority no three: Car dispenser High bank
- 4 Priority no four: Bus dispenser (Single bank filling)
- 5 Priority no five: High bank of storage cascade
- 6 Priority no six: Medium bank of storage cascade
- 7 Priority no seven: Low bank of storage cascade
- 8 Priority no eight: Bus cascade (Single bank filling)
- 9 Priority no Nine: Mobile cascade mounted on Light commercial vehicle (single bank filling).

B: When compressor is not running:

When the compressor is not running, the valves of priority panel shall take the position so that gas available in the stationary car cascade and bus cascade can be dispensed. The priority of dispensing from car cascade shall be as follows;

Priority no One: Low bank of storage cascade
Priority no Two: Medium bank of storage cascade
Priority no Three: High bank of storage cascade

4.3 Human machine interface (HMI)

HMI shall be provided with touch screen and operating system software, (with minimum all the features of operator panel MP277B/ TP1200 Comfort min. 10" graphic display of Siemens/Schneider), software's for interlocking, monitoring and control. All operational buttons shall be on touch screen except the Emergency stop button. Touch screen display system shall be weather proof to IP65. This should be provided in the flame proof panel with HMI mounted on the door of the panel. The HMI screen shall be back side of the toughened glass. During running of the compressor the HMI should be assessable through the external push button provided on the panel. All the parameters on the PLC shall be available on the HMI. Bidder shall provide one set of source & object codes for PLC, HMI on LCP (in both forms, hard & soft).

4.4 Emergency Shut Down

Bidder shall provide emergency shutdown (ESD) system in the control room as well as locally mounted near the Compressor. Fail-safe system shall be designed and incorporated to isolate cascade storage from dispenser, stop compressor, and isolate the compressor suction and discharge lines. ESD switch shall have to be manually reset to restart the compressor package again. ESD shall activate either on pressing emergency push button (red button) or on fire detection. Red ESD button (5 nos) shall be located near dispenser, control room, control panel and at two sides of compressor.

Separate ESD push button shall be provided in LCP other than the packaged emergency push button.. On pressing the button it shall immediately cut off the fuel supply and ground the ignition system for immediate stop of the machine. A spare contact from the emergency push button shall be connected in PLC to initiate other auxiliaries shut down and indicate alarm as "hard ware emergency push button press".



4.5 Electric Motor arrangement:

4.5.1 Electric Motor for Air Compressor

4.5.1.1 Type of drive totally enclosed fan ventilated (TEFV) high efficiency as per IEEMA standard-19-2000

- | | | | |
|----------|------------------------------|-------------------------------------------|------------|
| 4.5.1.2 | Protection | By bidder | |
| 4.5.1.3 | Insulation | Class "F" with Class "B" temperature rise | |
| 4.5.1.4 | Mounting | Horizontal foot mounting | |
| 4.5.1.5 | Specification Standard | By Bidder | |
| 4.5.1.6 | Supply Voltage (assumed) | 415 + 10% volt, 3 phases, 50 + 5%Hz | |
| 4.5.1.7 | Synchronous Speed | By Bidder | |
| 4.5.1.8 | Motor rating | By Bidder | |
| 4.5.1.9 | Motor efficiency | % | |
| 4.5.1.10 | Power factor | By Bidder | |
| 4.5.1.11 | Speed of motors | By Bidder | |
| 4.5.1.12 | Nos. of Hot Starts of Motors | | 4 per hour |
| 4.5.1.13 | Coupling type | By Bidder | |

4.5.2 Motor accessories

- 4.5.2.1 Compressor grooved flywheel
- 4.5.2.2 Motor grooved drive pulley
- 4.5.2.3 Drive V- belts
- 4.5.2.4 Flexible coupling for direct drive
- 4.5.2.5 Drive guard
- 4.5.2.6 Adjustable motor slide rails for V- belt tensioning
- 4.5.2.7 Starter

4.6 Preferred makes of electrical equipment shall be as follows:

a)	FLP motors	ABB/ Compton Greaves/ Kirloskar /Siemens/Bharat bijlee/Weg/Marelli/LHP
b)	FLP Switchgear	Baliga/FCG/FPE/Flexpro/Sudhir/L&T(Lauritz Knudsen)/Schneider/Havells
c)	Switches/Fuses/Contactors	L&T/GEC/Siemens/Schneider
d)	PLC	Rockwell Automation/GE Fanuc/Siemens/Allen Bradley/L&T/ (Schneider)/Emerson/Honeywell
e)	IR Gas detectors	General monitors/ Crow con /Honeywell/Sieger / Detronics/ Khrome Schroder / Net safety/ESP Safety Pvt.Ltd / M/s Oldham
f)	UV flame detectors	General monitors/ Crow con /Honeywell/Sieger / Detronics/ Khrome Schroder / Net safety/ESP SafetyPvt.Ltd / M/s Oldham
g)	Mass flow meter	Micromotion CNG 50, E&H
h)	Pressure Transmitter	Druck/Wika/Honeywell/ABB/Rosmount/MSI/Fisher/ Yokogawa
i)	Pressure Regulator & Slam Shut Valve	M/s Pietro Fiorentini S.P.A. (Italy)/M/s Emerson Process Management/M/s RMG-Regel Messtechnik (Germany)/ M/s Mokveld Valves BV (Netherlands)/ Tartarini/ Fisher /M/s Gorter Controls (Netherlands)/M/s Dresser/ Nirmal /M/s Vanaz
j)	Pressure Safety Valve	M/s BHEL, OFE & OE Group (New Delhi)/ M/s Keystone Valves (India) Pvt. Ltd. Baroda/M/s Sebin Sarasin Valves India (P) Ltd. (New Delhi/ Halol-Gujarat)/ M/s Tyco Sanmar Ltd.(New Delhi) / M/s Parcol SPA, Italy/ M/s Nuopignone, Italy/ M/s Sarasin, France/ M/s Tai Milano SPA, Italy/ M/s Fisher Rosemount (Now M/s Emerson Process) Singapore/ Mercer USA/ Fainger-Leser
k)	Pressure Gauges & Temperatures Gauges	M/s AN Instruments Pvt. Ltd., New Delhi/ M/s General Instruments Ltd., Mumbai/ M/s WIKA/ WAREE/ BAUMER / M/s Altop
l)	RTD's	M/s General Instruments LTD. Mumbai/M/s Nagman Sensors (Pvt.) Ltd./M/s Pyro Electric, Goa,M/s Waaree / M/s Wika / M/s Altop
m)	SS Tube	M/s Tubacex / M/s Parker (USA)/ M/s Sandvik, Sweden/ M/S Ratnamani/ Jindal/ MSL
n)	SS Tube Fittings/ On Off valve/non – return valve for CNG application	M/s Swagelok (USA) / M/s Parker (USA)/ SSP/HOKE/HAMLET
o)	Plug Valve for air water	M/s Nordstrom Valves Inc. USA/M/s Serck Audco Valves, UK /M/s Breda Energia Sesto industria Spa Italy/ M/s Sumitomo Corporation, New Delhi/ M/s Fisher Xomox Sanmar India Ltd., New Delhi/ M/s Larsen & Toubro Ltd. (Audco India Limited Chennai)/M/s Microfinish/M/s Virgo/M/s BDK/M/s Petro valves
p)	Solenoid Valve	M/s ASCO/ M/s Rotex/ M/s parker Hanifen/ M/s Swagelok



**CITY GAS DISTRIBUTION PROJECT
ANNUAL RATE CONTRACT FOR PROCUREMENT OF 1200
SCMH GED AND MOTOR DRIVEN CNG COMPRESSOR**

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q)	Cables and wires	INCAB/ Universal / ASEAN/CCI/FORT Closter/ Finolex/KEI, Associated cables Pvt Ltd./Polycab
r)	Barrier/ Isolators/Surge protector	MTL/Phoenix/ P&F/L&T/C&S/ABB/Siemens/Schneider
s)	Air exchanger	GEI Ham on Ind Ltd, GEA India , Patel Air tem p, Process equipments Karad / M/s KPCL , M/s CP.
t)	Vibration Switch	Robertshaw Control, Murphy
u)	MCCB	Siemens/ Legrand/Schnieder/C&S
v)	SMPS	Telemecanique(Schnieder)/ Siemens/Phoenix/ABB
w)	Pressure switch	Orion/Switzer/Danfoss/Wika/IFM/Honeywell/Schneider /Siemens
x)	Soft Starter	Siemens/ABB/Rockwell/Schneider/FUJI

Please note that the above listed makes shall be preferable from vendors/suppliers however, for procuring bought out items from vendors other than those listed above, the same may be acceptable subject to prior approval of Consultant/owner to the following: -

Note - 1:

4.6.1 The vendor/ supplier of bought out item(s) is a regular and reputed manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing/ supply range. Further, the bidder has to certify that the item(s) has/have been regularly used by them in all the packages for the last two years and they are working satisfactorily.

4.6.2 The vendor/ supplier should not be in the Holiday list of Client / Any

other PSU.Notes:

- 1) Successful bidders shall take prior approval of the make for the items not covered above for which complete technical credentials of the proposed vendors shall be required to be submitted for evaluation by purchaser/consultant.
- 2) Some items indicate only Indian makes. Successful Foreign bidders may take prior approval of any other make also for which complete technical credentials of the proposed vendors shall be required to be submitted for evaluation by Purchaser/ Consultant.

Note - 2:

For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from reputed vendors/ suppliers who have earlier supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range.

The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder; these documents shall be required to be submitted by them within 30 days from date of Placement of Order.

4.7 INSTRUMENT ATION

4.7.1 All Instruments shall be suitable for an area classification of "Class 1, Group D, Division1 as per NEC" OR "Zone 1, Group IIA /IIB as per IS/ IEC".



- 4.7.2 All package mounted transmitters & temperature element shall be intrinsic safe "ib" as per IEC 79-11 and solenoid valves, switches and related junction boxes shall be flame proof "D" as per IEC 79-1. Other special equipment's/instruments, where intrinsic safety is not feasible or available, shall be flame proof as per IEC 79-1. Flameproof temperature elements shall also be accepted.
- 4.7.3 The compressor package instrumentation & control is to be configured for manual as well fully automatic control system including starting, shutdown as applicable for unattended operation. Control system shall be PLC based of a reputed make and proven type.
- 4.7.4 Electrical instrumentation shall be certified by a recognized authority such as BASEEFA, PTB, LCIE, CESI, INIEX, CMRS or any agency approved by Indian Government.
- 4.7.5 All the instrumentation shall be capable of operating for full range of operation.
- 4.7.6 Separate junction boxes shall be provided for each type of signal i.e., analog, digital, solenoids, RTD thermocouple and power supply.
- 4.7.7 RTD shall be 3 wire PT-100 and duplex type, thermocouple shall be K type and solenoid valve shall be 24 V DC operated.
- 4.7.8 Power cable, analog signal cable, digital signal cable shall be separately laid and properly tagged.
- 4.7.9 All pressure gauges and pressure transmitters shall be provided with isolation valves and have accuracy of + or - 1% of FSD and + or - 0.25% of FSD respectively.
- 4.7.10 Pressure transmitters shall be fixed range type with 2 wire 4 to 20 mA suitable for CNG applications except at suction and discharge which is 2 wire smart type 4 to 20 m A transmitter with integral display and IP 67 certified & ex-proof.
- 4.7.11 The temperature gauge shall be generally gel filled type, weatherproof & with capillary extension. Capillary tubing shall be min Carbon Steel with CS flexible armoring. The gauge shall have accuracy of + or - 1% FSD. The range shall be 1.5 times of operating temperature. The RTD shall be Duplex type PT-100 and thermocouple shall be Duplex type.
- 4.7.12 Units of measurement shall be:

GAS FLOW : SM³H & kg/hr

TEMPERATURE: °C

PRESSURE: kg/cm²

- 4.7.13 Two nos. Of RS 485/RS232 Serial Communication or TCP/IP Ports shall be provided for Hooking Up the PLC to SCADA & Laptop PC at PLC end in Future. Necessary adopter if required shall be under scope of vendor. Also, Vendor shall include one set of all licensed relevant Software (Windows XP/ Windows 2000 or latest based system configuration software and application program) for accessing the PLC, HMI and mass flow meter through owner supplied Laptop PC or laptop supplied by the bidder. All the parameters, Alarms, set-points, control R/W commands rights available on the PLC through SCADA system are required. The detail requirement of SCADA will be communicated to successful vendor during detailed engineering. For selection of equipment, compatibility of SCADA system vendor shall consider the Modbus RTU protocol, FCC-68 RJ 45 or separate TB connection, type RS 232 communication standard, Baud rate upto 19.2 K with configurable software.
- 4.7.14 Following points to be noted regarding Mass Flow meter – Coriolis type.
- Each Mass Flow meter shall include a sensor with integral transmitter i.e. meter electronics certified intrinsically safe/explosion proof by statutory authority suitable for the required hazardous area as per IS-2148 /IEC-79. Also, the offered sensor and the transmitter shall be weather proof to IP 65 as per IS-2147/IEC-529. Statutory authority for local installation is CCOE.
 - For online Calibration of MFM; Vendor to provide suitable arrangement to connect Master Mass flow meter (Prover) with Compressor Suction & Compressor Discharge flow meter for calibration purpose.
 - Offered mass flow meter shall be necessary for Custody Transfer application but not exceeding 0.5% of



span. Type of approval certificate from W&M India is required.

- Calibration for the offered mass flow meter from the authority of country of origin and should be valid at the time of supply. If the validity expired then the same shall be calibrated from FCRI. The display shall be in Kg/hr for cumulative flow and M3/hr for volumetric flow.
 - Flying lead type electrical termination is not acceptable. All electrical connections shall be ½" NPTF. Cable glands shall be provided for electrical power, signal and control connections. Cable glands shall be double compression type and certified weatherproof and explosion proof for the required area classification as per IS-2147 and IS-2148.
 - Offered Mass flow meter shall be completely free from corrosion of measuring tube due to alternating stresses continuously occurring in the tube. Also measuring tube shall be completely free from erosion, which may result due to fluid velocity.
 - The design of meter electronics shall be in compliance with the electromagnetic compatibility requirements as per IEC-801.
 - Meter Electronics shall include all the associated pre-amplifiers converters line riser etc and shall have enough diagnostic facility to correct live zero, variation, meter factor etc with help of Laptop. Output of the mass flow meter RS 485 type/ RS 232 to PLC shall be utilized. Mass flow meter shall be powered by 24 V DC only.
 - Installation details like straight run requirements, recommendation for horizontal /vertical installation, minimum distance between upstream and downstream pipe bends from Mass flow meter to be provided.
 - Bidder shall calibrate each mass flow meter at his shop or any recognized test house (for India from FCRI) with the fluid (Use design process conditions) for which it is to be used as per clause no.9 of MPMS (Draft standard Nov. 2000). In case it is not possible to calibrate the Mass Flow meter with actual fluid Vendor must indicate.
- a) Fluid used for calibration
- b) Correction factor/Adjustment required for actual process fluid. In any case, inaccuracy when extended to actual process shall not exceed the specified limits (as per manufacturer's standard).

The calibration certificate should be valid for at the time of supply. The validity of calibration will be considered one year from the date of calibration. If the same is expired then the recalibration has to be done from FCRI as per the latest NABL/IS standards with the fluid.

LL Vendor shall submit the following test certificates and test reports for purchaser's review:-

- a) Material test certificate with detailed chemical analysis from foundry (MIL Certificate).
- b) Certificate of radiography / x-ray for any welded joint.
- c) Hydrostatic test report with pressure of 1.5 times the design pressure.
- d) Calibration report including calibration factors for each Mass flow meter certificate from statutory body for offered sensor and transmitter for required area classification.
- e) W&M India certificates.

4.7.15 CERTIFICATION:

The requirement of statutory approvals for usage of equipment/instruments/system in electrically hazardous areas shall be as follows:

- a) The vendor shall be responsible for obtaining all statutory approvals, as applicable for all instruments and control systems.
- b) Equipment's/instruments/ systems located in electrically hazardous areas shall be certified for use by statutory authorities for their use in the area of their installation. In general, the following verification shall be provided by the vendor.
- Bidder shall provide certificates (from BASEEFA FM, UL, PTB, LCIE etc.) from country of origin for all intrinsically safe/flameproof protected by other methods equipment/instrument/systems, which are manufactured outside India. If required, bidder shall provide necessary certification/ approvals/authentication, for all such intrinsically safe/flameproof equipment/instrument/systems, by the Indian authority—Chief Controller of Explosive (CCOE), Nagpur, India.



- For all flame proof equipment manufactured within India, the testing shall be carried out by any of the approved testing houses- Central Mining Research Institute (CMRI)/ERTL etc. The item shall in addition bear the valid certification from CCOE and also the manufacturer shall hold a valid Bureau of Indian Standards (BIS) license.
- For all intrinsically safe equipment manufactured within India the testing shall be carried out by any of the approved testing houses – Central Mining Research Institute (CMRI)/ERTL etc. The item shall in addition bear the valid certification from CCOE.

4.8 CABLING (all suitable for hazardous area applications)

- 4.8.1 Control Cable inside the compressor package shall be of 1.5 Sq. mm and for outside compressor package shall be 2.5mm.
- 4.8.2 Cables shall be 1100-volt grade, stranded copper conductor, PVC insulated, PVC sheathed, round wire armoured, FRLS cables.
- 4.8.3 Cables shall be terminated using double compression type metallic frame proof glands and copper lugs.
- 4.8.4 Spare cores to be kept in each control cable.
- 4.8.5 All JB's shall have flame proof metallic enclosure.
- 4.8.6 All the signal cables shall be screened armored cables.
- 4.8.7 All the control and power cables shall be armored cables.
- 4.8.8 All the communication cables shall be screened and shall be terminated to JB through threaded GI conduits only.

4.9 Earthing of equipment:

- 4.9.1 Bidders shall make provisions for earthing of the complete package as required as per IS (Earth pits are not in Bidder's scope). All electrics shall comply with latest IS/IEC. Epoxy based paints shall be applied on all electrical equipments. Bidder's scope shall include obtaining statutory approvals for the complete package, wherever necessary.
- 4.9.2 Metallic part of all equipment not intended to be alive shall be connected to earth as per provisions of IS: 3043/IEC recommendation. Grounding of all electronics shall be separately connected to earth using insulated copper wire. Grounding of electronic equipment shall not be connected to earthing for electrics or equip-potential bonding

Any conflict between the above scope / specification / requirements. most stringent will be followed as per the instruction of EIC.

5.0 INSPECTION AND TESTING

5.1 General

- a) Inspection and Test Requirements have been spelled out in respective Equipment Data Sheets and this Technical Specification.
- b) Bidder shall keep following data available for at least 5 years for examination by purchaser.
 - All necessary certification of materials, such as mill test reports.
 - Purchaser specification for all items on bills of materials.
 - Test data to verify that requirement of the specification has been met
 - Result of quality control test.
 - Pressure retaining parts including auxiliaries shall be hydrostatically tested with water at following minimum test pressure for a minimum period of 1 hour.
 - Cylinder: 1-1/2 times maximum allowable working pressure.
 - Cylinder cooling jacket & packing case 1-1/2 times coolant pressure but not less than 8 barg effective.
- c) Bidder shall confirm compliance to all inspection and testing requirements stipulated therein and include the inspection charges in the lump sum cost.



- d) Owner/consultant shall witness tests as per data sheet and this specification. The Bidder shall notify the timing of such inspection and testing at least 15 days in advance to PURCHASER/CONSULTANT. PURCHASER/ CONSULTANT shall depute their representative for witnessing the tests.
- e) Bidder shall submit detailed Test Procedure for Approval of the Purchaser two months in advance of the actual date of conducting each test.
- f) Inspection testing for foreign bidder: Cost of third party inspection including fees payable and arranging the same shall be borne by bidder. Approved 3rd party inspection agencies are EIL, BVQ, DNV, MECON, Lloyd's reg , TUV India Pvt Ltd., TUV SUV South Asia,AB-Vincotee,SGS,American bureau services,Velosi certification services/International certification services limited, Certification Engineers International Ltd,Bureau Veritas (India) Pvt. Ltd , Dr.Amin Controllers Pvt. Ltd , RINA
- g) Inspection testing for Indian bidder: Owner/Consultant shall carry out Inspection and testing as per QAP, inspection charges shall be considered @0.5% of the ex-works price excluding duty and taxes of the equipment for price evaluation purpose only. Domestic bidder shall also arrange 3rd party for inspection as indicated in QAP and expenses on third party inspection including fees payable and arranging the same shall be borne by bidder. Approved 3rd party inspection agencies are EIL, BVQ, DNV, MECON, Lloyd's reg , TUV India Pvt Ltd., TUV SUV South Asia,AB-Vincotee, SGS, American bureau services, Velosi certification services/International certification services limited , Certification Engineers International Ltd, Bureau Veritas (India) Pvt. Ltd , Dr.Amin Controllers Pvt. Ltd , RINA.

5.2 Mechanical running test (MRT)

5.2.1 The MRT for each compressors shall be carried out by tenderer with job or shop driver including complete job driving system i.e., job driven V-belt, job pulleys etc., for 4 hours continuously at shop of compressor manufacturer. The compressor need not be pressure loaded for MRT test. During this test following shall be recorded at agreed intervals.

- Vibration levels measured on cylinders and frame
- Bearing temperature
- Oil cooler inlet and outlet temp
- Sound level

Subsequent to satisfactory run the compressor shall be examined as per standard procedure & following shall be examined as minimum:

Strip test is limited to open Crank Case cover, X-Hd guide & Dist. pc. Cover and opening of bore & other parts, piston, one valve per cylinder. Visual examination of position rod If any of part found damaged, all similar components shall be stripped for inspection. The MRT test shall be repeated after replacement of such parts. All the interlocking and performance of the instrumentation system will be verified during the MRT.

5.3 Motor Performance

1. Tests on the completely assembled motor shall be carried out in the presence of CLIENT/CONSULTANT or his representative. The results shall be tabulated and signed by both contractor and owner or their representatives. Though the motors shall be accepted on the basis of the satisfactory results of the tests at the works, it shall not absolve the contractor from liability regarding the proper functioning of motor coupled to the driven equipment at site.
2. General Inspection
 - (a) Check for installation according to drawings.
 - (b) Check equipment for clean and dry conditions, proper lubrication of bearings, earthing and terminations.
3. The motors shall be tested in accordance with IS:325 and IS:4029. Type tests including any specific test to ascertain compliance with these specifications shall be carried out if necessary, on one sample from each kW rating and frame size. Routine tests shall be carried out on all motors which are as follows:
 - (a) Insulation resistance test.



- (b) High voltage test.
- (c) No load running of motor and reading of current in three phases and voltage.
- (d) Locked rotor test at a suitable voltage.
- (e) Reduced voltage running up test.
- (f) Temperature rises test.

5.4 Mechanical String Test

Mechanical String Test of complete package for 4 hrs shall be performed at packager's shop before dispatch in presence of Purchaser/Consultant. This test can be clubbed up with the Mechanical Run Test of compressor as specified above, provided the job driver, lube Oil system is used for the test. All parameters including discharge pressure shall be demonstrated. String test at unload condition is not acceptable.

5.4.1 Compressor capacity during string test for 1200 SCMh Gas Driven Compressor

The string test for this compressor shall be performed at suction pressure 16 to 19 kg/cm² for 4 hrs continuously and the capacity shall be recorded. In case the capacity is found to be not meeting the requirement, the compressor shall not be accepted.

5.5 Package Performance Test (PT)

Bidder shall assemble the complete package including auxiliary systems, instrumentation, safety devices within the enclosure at his shop and dispatch. Duration of PG test shall be min 4 hours continuously. Complete package including electric motor shall be performance tested as a module along with electric motor driven air compressor. Bidder shall demonstrate all controls, shutdown, trips & alarms etc. Pressure and temperature of gas shall be considered at purchaser's boundary limit and supplier shall install necessary pressure and temp measuring devices. Necessary spool piece shall be provided in discharge tubing of the compressor. All instrument duly calibrated, tools & tackles, any modification required for conducting PT shall be in the scope of supplier.

5.5.1 The PT shall be conducted only after 30 days' running of the machine after successful commissioning or after 30 days from the date of commercial operation, but not later than 90 days from the date of commercial operation of the machine. **The delay in conducting PT beyond 90 days shall be liable for PRS unless such delays are solely attributable to the owner (ie, due to inadequate availability of CNG vehicles for conducting PT).**

5.5.2 The test shall be the basis of assigning penalties on the Bidder, acceptance/rejection of the package thereon. Bidder shall submit the detail test procedure for the same, which shall be approved by PURCHASER/CONSULTANT. The test package shall be witnessed by PURCHASER/CONSULTANT.

5.5.3 Bidder to note that prime mover speed correction shall not be allowed below guaranteed speed. **Temperature and pressure will be considered at purchaser's boundary limit.** Bidder shall submit exhaust gas certificate at the time of performance test of Compressor Package.

6.0 PRICE LOADING AND COMPENSATION FOR UNDER PERFORMANCE (FOR EMD COMPRESSORS)

6.1 Compressor Capacity:

Bidder shall guarantee 1200 SCMh capacity of compressor with given gas composition, at suction pressure of 16 kg/cm² (g) and at suction temperature of 30 degree C, discharge pressure of 250 kg/cm² (g) & Relative Density of 0.59565 with no negative tolerance for errors in instruments and measurements.

Since the compressor suction pressure varies from 16 kg/cm² (g) to 19 kg/cm² (g) the compressor shall be suitable to deliver flow corresponding to 16 and 19 kg/cm² (g).

In both the above cases the driver shall be selected corresponding to max capacity. Mechanically the compressor shall be suitable to operate from min to max suction pressure without throttle and suction valve



full open condition. Compressor shall also be Tested at 16 and 19 Kg/cm²(g) and reading shall be recorded without which the compressor will not be accepted. Bidder to note that the suction pressure and temperature shall be measured at vendor's boundary limit and not at compressor cylinder.

Bidder shall guarantee compressor capacity in SCM/hr as per MR for design case gas composition, suction pressure and suction temperature as specified against guaranteed condition with discharge pressure of 255 kg/cm²g with the no tolerance for errors in instruments and measurements. Mechanically the compressor shall be suitable to operate from min to max suction pressure without throttle and suction valve full open condition.

- a) The guaranteed parameter shall be adjusted on account of variation in gas composition and prevailing ambient condition during testing.
- b) Necessary calculations shall have to be furnished by Bidder, which shall be considered as final and no deviation shall be permitted afterwards.
- c) In case of any inconsistency in manufacture and/or operation of supplied compressor package, Bidder shall at his own risk and cost, eliminate the defects to the satisfaction of owner.

6.2 Loading & Penalty Criteria:

This section describes the Price Loading & Compensation methodology basis (declared as well as calculated), which the CNG compressor package is expected to fulfil and the penalty for shortfall in guaranteed parameters.

Bidder shall indicate the power consumption and/or BHP as guaranteed value (will be represented as "G" in all subsequent use) in the offer. Bidder shall also indicate the venting losses due to leakages from packings in percentage of total throughput of the package. Bidder to submit Motor parameters in specified format.

The offers shall be loaded for the electricity consumption as given under the loading per package, the differential cost shall be evaluated as follows:

Total Cost of Bid evaluation

The L-1 bidder will be selected based on the bidder whose total cost during Bid evaluation comes lowest.

Total cost of the package for evaluation purpose (A + B + C)

Where,

A= Quoted cost of each package including cost of erection, commissioning, and special tools and commissioning spares.

B= Differential operating cost as derived basis declared parameters (Loading Cost)

C= Cost of Annual Maintenance for 5 years (1st Year during warranty + 4 Years post warranty) from date of successful commissioning.

6.2.1 Loading during bid evaluation

a) For Energy Consumption:

The compressor package shall be designed in such a way that Energy Consumption of Package (KWH/Kg) should be minimum for production of CNG.

Bidder shall indicate actual energy consumption for their compressor package. This quoted figure will be used for evaluation and total quoted price for all compressors towards supply, special tools & tackles, erection and commissioning will be loaded as per following formulas:

$$F = (G - L) \times H \times \text{Nop} \times N$$

Where,

F = Loading amount in Rupees

G = Guaranteed Energy consumption in Kwh/Hr for every 873 Kg (1200SCMH) of CNG Compressed for



bidder under evaluation.

L = Lowest Guaranteed Energy Consumption Kwh/Hr for every 873 Kg (1200SCMH) of CNG Compressed (amongst technically accepted bidder)

H = Cost of Energy INR 11 / Kwh

Nop = 13000 Hrs *

N = Number of compressors

* This has been considered on expected running hours for next 15 years and NPV of Investment

6.2.2 PENALTY during Performance test

i) For Energy Consumption

During compressor package performance test, in case the compressors package fails to meet the guaranteed values, the compensation (calculated as per formula given under here) shall be claimable by the owner and the same shall be recovered by the owner from any payment due to the supplier. In case such claims are not fully recovered, then supplier will pay the balance amount to the owner.

During shop performance test of compressor package, in case the energy consumed in terms of Kw/hr, to achieve the guaranteed compressor capacity, is found more than 10% of the guaranteed value, the entire package shall stand rejected. However, for every extra Kw/hr consumed over and above the guaranteed value up to a maximum of 10%, the Bidder shall compensate the owner for extra energy consumption, as established during PAT.

During Performance Acceptance Test (PAT) at site, if the energy consumption is found less than Guaranteed Consumption then no penalty will be imposed. In case, actual consumption is found more than guaranteed consumption, penalty shall be imposed as per following formula for each compressor:

$$P = 2 \times (O - G) \times H \times Nop \times N$$

Where,

P = Penalty amount in Rupees

O = Energy consumption rate in KWH established during PAT for every 873 Kg (1200SCMH) of CNG Produced

G = Guaranteed Consumption of Energy quoted by supplier for every 873 Kg (1200SCMH) of CNG produced

H = Cost of Energy INR 11/Kwh

Nop = 13000 Hrs *

N = Number of compressors

* This has been considered on expected running hours for next 15 years and NPV of Investment.

The Energy consumption rate "G" shall be established by owner representative in presence of bidder representative and consultant.

ii) For Package Gas Loss:

Bidders are to ensure that the package loss should not exceed 0.5% of the capacity of the machine. If package loss is quoted more than 1 % of of the capacity of the machine, then bid shall be rejected. In case the above loss exceeds 0.5% of the capacity of the machine (established in PT), the purchaser shall be compensated at Retail Selling Price of CNG Rs./- per kg for 5 years for the gas leakage quantity. The amount will be deducted from O&M monthly running bill.

It is bidder's responsibility to demonstrate during PT that the gas leakage is within the limit of 0.5% of the capacity of the machine. All the provisions such as Flow Meter (for low flow application) at common vent line suitable for the application required for this shall be provided by bidder at his own cost.



iii) **For Capacity Loss of Compression:**

Over and above the penalty due to energy consumption, If during PG test, the compressor capacity is found to be less than tender requirement penalty for the reduction in capacity shall be imposed on the bidder on pro-rata basis based on the FOT/FOB cost of compressor (supply cost only) without any upper limit. Further the methodology for capacity and energy consumption (with sample calculation), if operating parameters are different than indicated for design case, it shall be compensated appropriately.

6.2.3 PENALTY during Operation & Maintenance period

i) For Energy Consumption

During Operation & Maintenance period, energy consumption shall be monitored based on the energy consumption quoted as guaranteed consumption. This shall be calculated on monthly basis. If the monthly actual energy consumption is found less than guaranteed monthly consumption, then no penalty will be imposed. In case, actual monthly consumption is found more than guaranteed monthly consumption, penalty shall be imposed as per following formula for each compressor:

$$M = (Q1 - G1) \times H$$

Where,

F = Monthly Penalty amount in Rupees

Q1 = Monthly Actual Energy consumption for every 873 Kg (1200SCMH) of CNG produced.

G1 = Guaranteed Consumption quoted by supplier or Energy Consumption established during PAT, whichever is higher for 873 kg (1200 SCMH) of CNG produced.

H= Cost of Energy INR 11/Kwh

b) For Package Gas Loss:

During Operation & Maintenance period, Package Gas Loss shall be monitored based on the Package Gas Loss quoted as Guarantee Gas Loss. If the monthly Package Gas Loss is found less than guaranteed monthly Package Gas Loss then no penalty will be imposed. In case, actual monthly Package Gas Loss is found more than guaranteed monthly package loss, penalty shall be imposed as per following formula for each compressor:

$$R = (G2 - Q) \times H \times (RD \times \text{Air density} \times 1200)$$

Where,

R = Monthly Penalty amount in Rupees

G2 = Monthly Vent/ Leakage Loss in % {(Compressor Suction – Compressor Discharge) * 100/ Compressor Suction} for every 873 Kg (1200 SCMH) of CNG produced.

Q = Guaranteed package loss in % quoted by supplier for every 873 Kg (1200 SCMH) of CNG produced.

H= Cost of NG per Kg = At average retail selling price of CNG at that particular period

RD= 0.59565

Air Density = 1.22541

Note :- Gas loss will be calculated on monthly basis and no incentive will be given for Gas gain or previous month gain will not be used to offset gas loss.

c) For Capacity Loss of Compression:

Over and above the penalty due to energy consumption, the compressor capacity is found to be less than tender requirement penalty for the reduction in capacity shall be imposed on the bidder on pro-rata basis based on following formulae: -

Penalty amount = (Actual compression capacity – Guaranteed Compression capacity) * Guaranteed Energy consumption quoted by bidder* Unit rate of electricity

$$F = ((A/B) - (A/C)) * D * E$$

A = Total quantity of Gas in KG at compressor inlet

B = Actual Flow rate of compressor in KG/Hr

C = Guaranteed Flow rate of Compressor in Kg/Hr



D = Guaranteed Power consumption in KWH
E = Electricity per unit cost (Rs. 11/KWH)

7.0 PAINTING AND PROTECTION

Packing shall be sufficiently robust to withstand rough handling during ocean shipment & inland journey. Sling points shall be clearly indicated on crates.

Painting of Internal process piping should be as per international colour coding standard, e.g- Gas line- Yellow, Water line- green, Airline-Blue, Fire suppressing system – Red etc. The paint shall be chosen, primed and applied to have a service life of ten years the exterior of equipment and enclosure is required to be corrosion free for ten years.

7.1 SURFACE PREPARATION

- (a) Rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained.
- (b) The first coat of primer must be applied by brush on dry surface. This should be done immediately after cleaning.
- (c) Surface shall be inspected by Purchaser/ third party before application of primer.

7.2 PAINTING (PRIMER & FINISH COAT)

Following primer and finish coats to be applied on the canopy and all structural parts as a minimum: -

a) Primer

Two component epoxy zinc phosphate primer with minimum volume solids of 59% an initial cure of 75 minutes at 25 deg C and a weight of around 2.52 Kg/Litre

No. of Coats : 1
DFT :75 (micron) μ each

b) Primer

Two component intermediate coat with epoxy high build MIO (micaceous iron oxide) of minimum volume solids of 80%, an initial cure of 60 minutes at 25 deg. C and a weight of around 2.1 kg /liter.

No. of Coats: 1
DFT:100 (micron) μ each

c) Finish Coat: Acrylic Polyurethane paint

No. of Coats: 2
DFT: 50 (micron) μ each
Total DFT100

Total DFT after application of primer and paint shall be 275 μ (micron) minimum.

7.3 The vendor to ensure that exterior steel surface of equipment and piping painted shall have a fade free life without oxidation of paint surface for atleast 5 years in an environment of bright sunlight with an intense UV content.

7.4 The headers of air-cooled exchanger shall be zinc sprayed.

7.5 Packing shall be sufficiently robust to withstand rough handling during ocean shipment & in-land journey.



Slings shall be clearly indicated on crates.

8.0 ERECTION, TESTING AND COMMISSIONING AT SITE

- 8.1 The bidder shall be responsible for erection, commissioning, performance acceptance test and noise level test of all packages at site. Commissioning of various equipment and systems shall be carried out by the bidder as per the accepted procedures and as per the instruction of the manufactures of the equipment. The units will be considered commissioned only after the successful performance tests are carried out by the bidder.

The bidder shall ensure integrity of compressor package and safety of electrical supply system available at back end while testing package, at site. Also, bidder shall arrange its own control/ single phase (UPS supply) for testing and commissioning of package.

- 8.2 Bidder shall be liable to pay all local taxes, levies applicable and comply with rules, laws prevailing in concerned state.

9.0 FIELD TRIAL RUN

Bidder shall conduct a field trial run of each compressor package for minimum 72 hours cumulative or 6 hours continuous duration near the guaranteed points in which satisfactory operation of complete package together with all accessories/auxiliaries' controls shall be established for specified operating conditions prior to the start of one year operation and maintenance period as defined in the contract. During the field trial run the bidder will be allowed a maximum of THREE attempts to complete the above specified test. The Equipment shall be considered commissioned after the successful completion of Field Trial Run. All punch points raised by OWNER should be completed before performing the FTR. The bidder shall record data of field trial run.

OR

Due to non-availability of the commercial load at CNG station, package will be treated as commissioned after filling of CNG cascades to installed at station.

10.0 SPARE PARTS, SPECIAL TOOLS AND TACKLES

- 10.1 All spare parts as required, special tools & tackles with toolbox for erection and commissioning and one year operation and maintenance of compressor package shall be supplied by the packager and shall form his scope of supply.
- 10.2 A brand new separate set of min 15 nos special tools and tackles (such as tool for extraction of fly wheel, key to hold crank shaft for loosing & tightening mech seal/bush , special key to install and uninstall bush for mech seal, piston nut wrench, valve installation tool, rod nut wrench, valve adjusting wrench, etc) as required for Normal maintenance beyond the contractual operation & maintenance period shall be supplied by the packager, which shall form the property of PURCHASER. Special tools & tackles used by bidder in during O&M period shall not be considered as new. Supply shall be before one month of completion of O&M period

11.0 DATA AND DRAWING

- a. Drawings and Data shall be furnished in conformity with the Bidder Data Requirements Forms attached with Enquiry Specifications.
- b. Bidder shall furnish all the information at the time of bidding as specified in the relevant Vendor Data Requirement (VDR) forms
- c. The data requirement after placement of Telex of intent is indicated in the Bidder Data requirement Forms for the respective equipment, including the number of weeks within which this data is to be provided. Bidder shall confirm that all data as required shall be furnished by him and shall indicate the Bidder's promised data in the columns provided.
- d. After the placement of TOI, a conference (kick off meeting) will be held at such date and at such place, as



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may be mutually agreed upon between the Bidder and the Purchaser. The intent of this conference shall be to discuss / clarify various requirements and finalize the modus operandi for execution of the contract within the scheduled delivery period.

- e. Bidder shall furnish the Drawings/Documents for Purchaser's Review / approval as per the Bidder Data Requirement (as specified in the Specifications/ Bidder data requirement forms). The review comments for major and critical drawings (such as system P&ID's, operation philosophy, General Arrangement Drawings, Foundation Drawings, Performance characteristics, Pulsation and Vibration Study Reports Tensional Analyses etc.) shall be discussed across the table at such date and place as may be mutually agreed between the Purchaser and the Bidder.

DRAWINGS AND DATA REQUIRED FROM BIDDER
(All drawings & Documentation shall be in English Language only and shall be submitted in three sets)

DESCRIPTION		Required with bidder	Certified information Required after Purchaser order		
			Points for review	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)		(2)	(3)	(4)	(5)
A	GENERAL				
A.1	Schedule for furnishing the vendor data				
A.2	A specific statement that CNG compressor package is in strict accordance with data sheet, technical specification & applicable standards listed with details & reasons for each deviation.	Yes	Yes		
A.3	General arrangement (GA) indicating battery limit for electric and piping connection & schematic diagram.	Yes	Yes		
A.4	A statement on oil consumption and minimum allowable oil temp.	Yes		Yes	
A.5	Flange details of piping connection with connection at battery limit. Foundation plan drawings along with load details of compressor package, Air compressor, dryer, receiver, Duplex filter, CO2 flooding system & PRV+SSV	Yes		Yes	
A.6	Duly filled in experience record program	Yes		Yes	
A.7	Tentative load data for foundation design.	Yes		Yes	
A.8	List of sub-vendor with address/ phone/ fax no. For all bought out items including electrical & instrumentation items.		Yes		
A.9	Leaflet, catalogues for all items.	Yes	Yes		
A.10	O&M manual		Yes	Yes	
B	Compressor				
B.1	Data sheet duly filled in.	Yes		Yes	



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B.2	Catalogue of compressor	Yes		Yes	
B.3	Typical cross sectional drg. And literature to fully describe the details of offering.	Yes		Yes	
	- Compressor	Yes		Yes	
	-Suction	Yes		Yes	
	-Discharge valve	Yes		Yes	
	-piston rod gland packing & piston rings.	Yes		Yes	
B.4	V-belt & pulley with selection chart & calculation			Yes	

B.5	Cooler data/ drg with thermal & mech. Design calculation	Yes	Yes		
B.6	Design calculation, GA drgs for pulsation dampner.	Yes	Yes		
B.7	Gas hydraulic oil, lube oil piping & instrument diagram.	Yes	Yes		
B.8	Torque angle diagram, piston rod load VS crank angle.	Yes	Yes		
B.9	Torque speed characteristic. Starting torque of motor and compressor to be superimposed over each other.	Yes	Yes		
B.10	Acoustic/ mechanical evaluation report.	Yes			
B.11	Itemized price list of spares	Yes	Yes		
B.12	Itemized list with price of spares for erection/ commissioning.	Yes	Yes		
B.13	Item list of spares for one year warrantee period	Yes	Yes		
B.14	Drg. For Testing arrangement & test procedure to be adopted.	Yes	Yes		
B.15	Quality Assurance Plan (QAP) and Quality Procedure.		Yes		
B.16	Certificate for following.		Yes		
	a) Hydraulic testing		Yes		
	b) Non destructive testing		Yes		
	c) Material composition & physical properties.		Yes		
	d) Leak proofness list of frame.		Yes		
	e)Lube pump,frame oil pump, hyd. Oil pump		Yes		
B.17	Design /Actual assembly clearance chart	Yes	Yes		

B.18	Test records of following		Yes		
	a) Mechanical running		Yes		
	b) Performance test		Yes		
	a) Noise level test		Yes		
B.19	List of special tools & tackles for installation & maintenance	Yes	Yes		
B.20	Filled in air cooler data sheet	Yes	Yes		
C	Electric equipment & motors	Yes	Yes		
C.1	Performance curves of motor	Yes	Yes		
C.2	Technical literature/catalogue, selection	Yes		Yes	
C.3	Filled in data sheet of motor and Gas and UV detection system.	Yes	Yes		
C.4	Control schematics of motors	Yes	Yes		
C.5	Performance curves for auxiliaries like	Yes	Yes		
C.6	Typical component cross sectional	Yes	Yes		
C.7	Test procedure of motor		Yes		
C.8	Minutes of offering		Yes		
C.9	Manufacturer's test report of motors.		Yes		
C.10	Stage inspection and test report		Yes		
C.11	Final acceptance testing and performance		Yes		
C.12	Schematic diagram with start up & shut		Yes		
C.13	Inter connection & logic diagram		Yes		
D	INSTRUMENTATION AND				
D.1	Drawing & document index		Yes		



D.2	Instruments and electric motor data sheets	Yes	Yes		
D.3	Start up and shut down write up	Yes	Yes		
D.4	Start up & shut down interlock diagram	Yes	Yes		
D.5	Alarm & shut down list with set point	Yes	Yes		
D.6	Control panel layout		Yes		
D.7	Termination diagram, panel writing detail		Yes		
D.8	Loop schematic		Yes		
D.9	Inter connecting diagram		Yes		
D.10	Cable schematic		Yes		
D.11	Bill of material		Yes		
D.12	Inspection & test procedure		Yes		
D.13	Test/ Inspection certificate		Yes		
D.14	List of relief valves with settings		Yes		
D.15	P&ID of priority panel.	Yes	Yes		
D.16	Electrical Load summary	Yes			
D.17	Power required from UPS supply (230 V	Yes			
D.18	Power required form Non UPS supply	Yes			
D.19	Compressor speed-Torque Characteristic	Yes			
	curve of motor and Compressor under Star-Delta starting at rated inlet pressure.				

Note:

- 1) The above documents shall be given by bidder after placement of order and approval of drawings/ document a explained above.
 - a) 1 CD- of all documents/drawing in editable form;
 - b) 6 sets of prints;
 - c) One set of transparency
 - d) One no licensed CD software for compressor PLC

For Consultant: 1 CD – of all documents/drawing in editable form; b) 2 sets of prints

The drawing submitted with bid will not be considered a final. Successful Bidder shall submit final drawing as per scope defined in tender for approval

12.0 OPERATION & MAINTENANCE SERVICES

The date of successful performance test (PT) at site (which shall be conducted within 90 days from the date of successful commissioning of the machine) will be considered as date of start of the annual maintenance contract.

However, bidder shall be paid only 50% of O&M charge for operation and maintenance of the compressor from the date of commercial operation upto the date of performance test as part payment against O&M till the capacity and other guaranteed parameters of the package is established through PT. The balance 50% of O&M charge (from the date of commercial operation upto the date of PG test) shall be released to the bidder subsequent to successful PT (ie, after establishing all the guaranteed parameters as per tender). In case the PT is not successful the balance 50% shall be forfeited in addition to provision of CI 7.2.2 and 7.2.3 of this section. The bidder must follow the 'OPERATION & MAINTENANCE REQUIREMENT' as stated below but not limited to and ensure to provide trouble free services to the satisfaction of the owner

12.1 Accommodation/transportation/medical

The bidder shall make his own arrangement for the accommodation of his personnel at respective locations and subsequent transportation arrangement for them from their place of residence to work place or any other place as required and company shall have no obligation in this respect. The company shall not be responsible for providing any medical assistance to the bidder personnel.



12.2 Discipline:

The bidder shall be responsible for the discipline and good behavior of all his personnel deployed in the services contracted out and should any complaint be received against any of his employee, he shall arrange to replace such persons within 24 hours of notice issued by the Engineer-in-Charge. The decision of the Engineer-in-Charge in this matter shall be final and binding on the Bidder.

12.3 Gate pass/identity card

The contract shall arrange to supply / renew identity card to his workforce at his own cost, if so required by the Purchaser for security or for any other reasons. Those Bidder's personnel shall be required to carry their respective identity cards while on duty and produce on demand.

12.4 Right to get services carried out through other agencies.

Nothing contained herein shall restrict Purchaser from accepting similar service from other agencies, at its discretion and at the risk and cost of the Bidder, if the bidder fails to provide the said services any time.

12.5 Sub-letting of contract

Sub-letting of contract: The bidder may sub let/ assign the installation and O&M services to an agency having experience of CNG compressor installation and O&M for min two years. However, complete responsibility including composite bank guarantee shall be furnished by the bidder/supplier. **Bank guarantee for O&M shall start from the date of commercial operation by the purchaser which will be 10% of total cost of O&M services.**

12.6 Compliance of laws

The bidder deploying 20(twenty) or more workmen as contract labour shall have to obtain license from appropriate licensing authority, if required. The bidder (which shall include the Contracting firm / company) shall be solely liable to obtain and to abide by all necessary licenses from the concerned authorities as provided under the various labour laws legislation's including labour license from the competent authority under the Contract Labour ("Regulation & Abolition") Act or similar act applicable to land of law.

The Bidder shall be responsible for necessary contributions towards PF, Family Pension, ESIC or any other statutory payments to Government Agencies if applicable under the laws in respect of the contract and personnel deployed by the bidder for rendering services to PURCHASER and shall deposit the required amount with the concerned statutory authorities on or before due dates.

The bidder shall not engage /deploy any person of less than 18 years under this contract and the persons to be deployed should be physically and mentally fit.

The installations where job is to be carried out are live and have hydrocarbon environment. Bidder shall comply with all safety and security rules and regulations and other rules laid down by PURCHASER for its operation. It shall be the duty/responsibility of the bidder to ensure the compliance of fire, safety, security and other operational rules and regulations by his personnel. Disregard to these rules by the Bidder's personnel will lead to the termination of the contract in all respects and shall face penal/legal consequences.

The bidder shall arrange for insurance of all this workers engaged on the job as per the relevant Acts, rules and regulations, etc. In case by virtue of provisions of worker's compensation Act, or any other law in force. PURCHASER has to pay compensation for a workman employed by the bidder due to any cause whatsoever the amount so paid shall be recovered from the dues payable to the bidder and /or security deposit.

12.7 The officer in charge shall have power to

- i) Issue the bidder from time to time during the running of the contract such further instructions as shall be necessary for the purpose of proper and adequate execution of the contract and the bidder shall carry out and bound by the same.



- ii) During the currency of this contract, PURCHASER can increase and/or decrease the number of the services / technicians to meet contractual requirements.
- iii) Order the bidder to remove or replace any workman whom the company considers incompetent or unsuitable and opinion of the company representative as to the competence of any workman engaged by the bidder shall be final and binding on the Bidder.

12.8 Repatriation and termination

PURCHASER shall reserves the right at any time during the currency of the contract, to terminate it by giving 30 days notice to Bidder, and upon expiry of such notice period the bidder shall vacate the site/office occupied by him immediately.

12.9 Indemnity agreement

Bidder shall exclusively be liable for non-compliance of the provision of any act, laws, rules and regulations having bearing over engagement of workers directly or indirectly for execution of work and the bidder hereby undertake to indemnify the company against all actions, suits, proceedings, claims, damages and losses, etc. which may arise under minimum wages act, payment of wages act, workman compensation act, personnel injury (compensation insurance) act ESI Act, Fatal Accident Act, Industrial Dispute Act, Shops and Establishment Act, Employees Provident Fund Act, Family Pension and deposit Linked Insurance Scheme or any other act or statutes not herein specifically mentioned but having direct or indirect application for the persons engaged under this contract. (A certificate to this effect shall be submitted by the bidder immediately on receipt of LOA).

12.10 Compensation for non-fulfillment of obligation under Annual Maintenance Contract (AMC)

During the AMC in warranty period of 1 year and post warranty period of further 4 year, the bidder must ensure that the compressor is available for 365 days a year for performing the required services as defined in the tender document. Refer: **SCOPE OF WORK FOR AMC OF GED AND EMD CNG COMPRESSOR.**

12.11 Bidder's responsibility

The bidder shall depute his Supervisor for supervision of the services to receive instructions from Engineer-in-Charge or his representative.

12.12 Employment liability of Bidder

The bidder shall ensure and will be solely responsible for payment of wages and other dues latest by 7th of the following month to the personnel deployed by him in the presence of the Company's representative.

The Bidder shall ensure the continuous availability of operators in accordance with the prescribed shift pattern. The Bidder is required to deploy necessary relievers in compliance with all applicable labour laws, statutory provisions, and regulations governing working hours, weekly offs, leaves, and manpower welfare.

Although the Schedule of Rates (SOR) specifies quotations on a per-shift basis (maximum of three shifts), it is the responsibility of the Bidder to include within the quoted SOR rates all costs associated with providing relievers or additional manpower required to maintain uninterrupted operations and statutory compliance. No additional claims on account of reliever manpower, leave reserves, or statutory manpower requirements shall be entertained beyond the SOR quote.

The Bidder shall be fully accountable for adherence to all applicable labour legislation, including but not limited to the Minimum Wages Act, Contract Labour (Regulation & Abolition) Act, Shops and Establishments Act, Industrial Disputes Act, and any other relevant laws, rules, or notifications.

The bidder shall be directly responsible and indemnify the company against all charges, claims, dues etc. arising out of disputes relating to the dues and employment of personnel deployed by him

The bidder shall indemnify the company against all losses or damages caused to it on account of acts of the personnel deployed by the Bidder. The bidder shall ensure regular and effective supervision of the personnel deployed by him.

The bidder shall be liable for making good all damages/losses arising out of loss or theft of each handled, leakage, pilferage of any office, furniture equipment fitting and fixtures what-so-ever as may be caused directly or indirectly by the engaged persons through him/work carried out by them.



12.13

General

- i) The operation and maintenance services shall be provided in terms of shift pattern on the round the clock basis as mentioned in the tender document. The operation and maintenance services shall be provided in terms of shift pattern on the round the clock basis as mentioned in the tender document. In case of Compressor operations are less than or equal to 2 shift operations then recovery for the O&M charges equivalent to the applicable minimum wages for skilled category shall be applicable. Recovery will be made on monthly basis from O&M running Invoices.
- ii) The bidder shall deploy adequate number of technicians / supervisors / Engineers / helpers as well as tools & equipment for smooth and proper operation & maintenance of the compressors supplied in terms of the contract. In case required to meet operational requirements, the bidder shall augment the same as per direction of Engineer –in- Charge.
- iii) The bidder is required to carry out all services as mentioned in the Scope of Services and Schedule of Rates on all the 365 days including Sunday and all Holiday & around the clock.
- iv) The bidder shall allow weekly rest and daily working hours to his workmen as per the relevant Act/Law/and Rule made there under. However, no work shall be left incomplete /unattended on any holiday/weekly rest. Technician/operators provided shall have minimum qualification of ITI. Contract in person or his authorized representative shall provide the services on daily basis to interact with Engineer-in-charge and deployed workman.
- v) The work force deployed by the bidder for O&M services at CNG installation shall be of sound relevant technical professional expertise which is otherwise also essential from the safety point of view of the personnel of the bidder as well as for the installation.
- vi) Bidder has to ensure the safety of man and machine all the times. Damages of equipment due to negligence will be recovered as per the decision of Engineer in-Charge, which will be final.
- vii) Regarding work completion, the decision of the Engineer-in-Charge will be final and binding.
- viii) The bidder shall make his own arrangements to provide all facilities like boarding and transport etc. to his workmen.
- ix) All personnel of the bidder entering on work premises shall be properly and neatly dressed and shall wear uniform, badges while working on premises of the company including work sites.
- x) Bidder shall maintain proper record of his working employee's attendance and payment made to them.
- xi) The Bidder's representative/supervisor shall report daily to the Shift-in-Charge for day to day working.
- xii) All the safety rules and regulations prevailing and applicable from time to time at the installations as directed by PURCHASER will be strictly adhered to by the Bidder.
- xiii) The rates quoted by the Bidder must be inclusive of all the taxes, duties, services tax, work contract tax and any other levies, Bidder's share of P.F. and insurance charges, Bidder's profit and any other expenditure etc.
- xiv) It will be the responsibility of the bidder to pay as per the minimum wages of the appropriate government applicable under the Minimum Wage Act.
- xv) The services shall be provided in terms of shift pattern on the round the clock basis. The bidder is responsible to provide effective and efficient services in all shifts and assure that there is no disruption in the services for want of any resources.
- xvi) The bidder shall establish a central control room to operate 24 hours, seven days a week where complaint regarding non-performance of the compressors in terms of the contract can be lodged. Further, the bidder shall deploy adequate number of technicians/ supervisors / engineers at various site offices in consultation with Engineer-in-Charge to provide trouble free operation & maintenance of the compressors.



- xvii) All arrangements for communication from control room to the contract person working on job under the services shall be the responsibility of the Bidder, viz pagers/ walky-talky.
- xviii) All the jobs mentioned under scope of services shall be carried out as per sound engineering practices, work procedure documentation, recommendation of the manufacturer and as per the guidelines/direction of engineer-in-charge of authorised representative.
- xix) The bidder shall carry out retesting of pressure vessels periodically i.e every year or earlier as per Gas Cylinder rules 2004/ Static and Mobile Pressure Vessels Rules.

12.14 Operation and Maintenance of compressor packages during one year warranty Period and further 4 year of post warranty period.

12.14.1 Scope of supply during one year warranty period:

All spares, consumables, lubricants, lubricating oil, coolant, sealant etc. required for carrying out the Operation and maintenance of the complete compressor package during the warranty period, including periodic, breakdown maintenance for continuous and uninterrupted operation of the compressor packages shall be in scope of the Bidder and shall be kept in stock. If any equipment got fire or broken due to accident the same shall be replaced or rectified by the bidder. Electricity shall be supplied free of cost to the Bidder.

12.14.2 Scope of supply during post warranty period:

All spares, consumables, lubricants, lubricating oil, coolant, sealant etc. required for carrying out the Operation and maintenance of the complete compressor package during the post warranty period, including periodic, breakdown maintenance for continuous and uninterrupted operation of the compressor packages shall be in scope of the Bidder and shall be kept in stock. If any equipment got fire or broken due to accident the same shall be replaced or rectified by the bidder. Electricity shall be supplied free of cost to the Bidder.

12.14.3 Scope of services:

The Bidder shall have to keep all the spares, consumables, lubricants, coolant, etc required for carrying out periodic, breakdown, emergency maintenance etc of the package so as to minimize the down time of the compressor. Non-availability of compressor package for non-availability of spares shall be liable for compensation.

12.14.4 All tools, tackles and fixtures required for carrying out the above maintenance of the compressor shall be in scope of the Bidder. The scope will also include handling equipment like crane, forklift, chain pulley block, etc required during the any maintenance activity.

12.14.5 Any expert services required from principal company or OEM shall be arranged by the bidder or his agent at his own cost. All arrangements like phone, fax, computer, Internet etc required for correspondences with above personnel shall be arranged by the Bidder.

12.14.6 The periodic maintenance required to be done as per OEM recommendation shall be taken up promptly. The Bidder shall provide the detailed preventative maintenance schedule along with

- a) Estimated down time required for each type of maintenance schedule.
- b) List of spares and their quantities required for each type of maintenance schedule per compressor.
- c) Type and number of man days required for each type of maintenance schedule per compressor.

The bidder shall plan such maintenance during non-peak hours and in consultation with the Engineer In Charge (EIC) of PURCHASER. Any maintenance that needs to be taken up shall be well planned in advance with due approval of the EIC.

12.14.7 The Bidder shall use only OEM's certified spares during maintenance. In case, the schedule maintenance of the OEM recommends checking and replacing parts like valve spring, valve plates, piston rings etc. after certain time interval, same shall be replaced or used further only on approval from the PURCHASER representative. However any untoward consequences for non-replacement of such parts shall be the



responsibility of the Bidder.

12.14.8 All routine and periodic checks / inspections required to be done as per OEM recommendation shall be done by the Bidder. Instruments required for above inspection like venire caliper, micrometre screw gauge, fill gauges, bore gauge etc shall be in scope of the Bidder and these instruments shall be calibrated every year.

12.14.9 All parts replaced by the Bidder during the above contract period shall be properly packed and handed over to PURCHASER, on replacement.

12.14.10 The bidder shall submit a copy of the daily / weekly / fortnightly / monthly / bimonthly / quarterly and yearly performance report to the EIC in both soft and hard form. All stationery including the printed material shall be in scope of the Bidder.

12.14.11 All the maintenance / inspection job carried out by the Bidder shall be recorded and the report of the same shall be jointly signed by PURCHASER representative.

12.14.12 The EIC will be final authority to take decision with regards to maintenance or replacement of parts or any disagreement between the Bidder and PURCHASER, during the execution of the contract.

12.14.13 The Bidder shall carryout calibration of gas detectors and flame detectors every six months or earlier as per requirement or instruction of EIC of PURCHASER. Also yearly calibration of all instruments such as pressure gauges, transmitters, switches, mass flow meters etc shall be in the scope of the Bidder. In addition to the above all safety relief valves shall also be tested and calibrated every year.

12.14.14 Calibration shall be done from government-approved laboratories and shall be carried out at least 15 days prior to the calibration due date.

12.14.15 The Bidder shall keep 1 set of safety relief valves in spare for the purpose of calibration.

12.14.16 The Bidder shall carry out retesting of pressure vessels periodically as per Gas Cylinder rules 1981 or Static & Mobile Pressure Vessels Rules.

The periodic maintenance required to be done as per OEM recommendation shall be taken up promptly. The Bidder shall plan such maintenances during non peak hours and in consultancy with the Engineer in Charge (EIC) of PURCHASER. Any maintenance that needs to be taken up shall be well planned in advance with due approval of the EIC. The scope shall include preparation of maintenance schedule for carrying out the maintenance during the contract period.

12.14.17 In case, the schedule maintenance of the OEM manual recommends checking and replacing parts like valve spring, valve plates, piston rings etc. after certain time interval, same shall be replaced in the presence of PURCHASER representative.

If top overhauling and major overhauling of the compressor and prime mover is required as per compressor and prime mover manufacturer's O&M manual recommendation, the same shall be in supplier's scope.

12.14.18 Insurance of free issue items upto 15 days beyond commercial operation by purchaser or two months from the date of supply of equipment at site whichever comes earlier will be in the scope of supplier. The risks that are to be covered under the insurance shall include, but not be limited to the loss or damage in handling, transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, war risk etc.



13.0 GUARENTEED PARAMETERS OF COMPRESSOR

13.1 SUCTION PRESSURE 19 Kg/cm² (g): COMPRESSOR CAPACITY BY BIDDER

Sr.No	DESCRIPTION	BY BIDDER
1	Compressor capacity in SM3/Hr at suction pr 19 kg/cm ² discharge pr 255 kg/cm ² and gas inlet temp 30 degree C.(No -ve tolerance)	
2	Compressor BKW excluding (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) at guaranteed condition in KW (No +v e tolerance)	
3	Auxiliaries load (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) in KW (No +ve tolerance)	
4	Power consumption of package in KWH for 1200 SCMh delivery (basis for loading and penalty)	
5	Gas Loss % of production, including loss from SRV, due to oil top ups and idling (basis for loading & penalty)	
5	Site rated BKW of electric motor (No -ve tolerance)	
7	Over all transmission efficiency %	
8	Noise level 72 dBA ± 3 dBA @ 1 meter from enclosure	

13.2 SUCTION PR 17.5 KG/CM²(g), COMPRESSOR CAPACITY BY BIDDER

Sr.No	DESCRIPTION	BY BIDDER
1	Compressor capacity in SM3/Hr at suction pr 17.5 kg/cm ² discharge pr 255 kg/cm ² and gas inlet temp 30 degree C.(No -ve tolerance)	
2	Compressor BKW excluding (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) at guaranteed condition in KW (No +v e tolerance)	
3	Auxiliaries load (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) in KW (No +v e tolerance)	
4	Power consumption of package in KWH for 1200 SCMh delivery (basis for loading and penalty)	
5	Gas Loss % of production, including loss from SRV, due to oil top ups and idling (basis for loading & penalty)	
5	Site rated BKW of electric motor (No -ve tolerance)	
7	Over all transmission efficiency %	
8	Noise level 72 dBA ± 3 dBA @ 1 meter from enclosure	



13.3 SUCTION PR 16.0 KG/CM²(g), COMPRESSOR CAPACITY BY BIDDER

Sr.No	DESCRIPTION	BY BIDDER
1	Compressor capacity in SM ³ /Hr at suction pr 16 kg/cm ² discharge pr 255 kg/cm ² and gas inlet temp 30 degree C.(No -ve tolerance)	
2	Compressor BkW excluding (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) at guaranteed condition in KW (No +ve tolerance)	
3	Auxiliaries load (motor cooling fan, after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable) in KW (No +ve tolerance)	
4	Power consumption of package in KWH for 1200 SCM ³ delivery (basis for loading and penalty)	
5	Gas Loss % of production, including loss from SRV, due to oil top ups and idling (basis for loading & penalty)	
5	Site rated BkW of electric motor (No -ve tolerance)	
7	Over all transmission efficiency %	
8	Noise level 72 dBA ± 3 dBA @ 1 meter from enclosure	

14.0 GAS COMPOSITION: The gas composition at Indore is as shown below:

Component	Range mole %	
Methane	84.5	98.77
Ethane	0.69	9.00
Propane	0.03	4.00
Butane	0.00	2.00
Pentane	0.00	0.35
Hexane	0.00	0.15
Heptane	0.00	-
CO ₂	0.00	4.50
Nitrogen	0.05	1.25
Total	100	100

NOTES:

- O₂ not more than 0.5% mole. Total non hydrocarbon-Not more than 2.0%.
- Total S including H₂S not more than 10PPM by weight.
- H₂S not more than 4 PPM by volume.
- Moisture content in the range 112 to 114 Kg/MMSCM.
- Relative Density of 0.59565 (design case).
- Temp of gas shall be 20 to 40 °C.

CLIMATE

- Height above Mean sea level: 560m
- Max. site temp.: 45°C
- Minimum site temp.: 40°C
- Max. RH: 81% in the month of August.
- Min. RH : 36% in the month of March.



15.0 DATASHEET OF COMPRESSOR AND ELCTRIC MOTOR

15.1 DATASHEET OF COMPRESSOR.

1	GENERAL: <input checked="" type="checkbox"/> Means required <input type="checkbox"/> Means bidder shall indicate; if not indicated shall be in bidders scope		
2	PROJECT: City Gas Distribution		
3	OWNER : AGL		
4	SERVICE: PROCUREMENT OF CNG COMPRESSORS		
	SITE:	INDORE	UJJAIN
			GWALIOR
	NO.REQD: 03 NO.		
5	COMPRESSOR CAPACITY:1200	DRIVER: ELECTRIC MOTOR	
6	NOTE: <input checked="" type="checkbox"/> SCOPE OPTION/ INFORMATION SPECIFIED BY PURCHASER INFORMATION REQUIRED FROM VENDEOR.		
7	<input type="checkbox"/> MANUFACTURER:	<input checked="" type="checkbox"/> MODEL NO.:	
8	<input type="checkbox"/> PLACE OF MANUFACTURE:		
9	<input type="checkbox"/> NO OF STAGES: THREE	<input checked="" type="checkbox"/> CYLINDER ARRANGMENT:	
10	CYLINDER LUBRICATION: <input type="checkbox"/> LUBRICATED <input type="checkbox"/> MINIMUM LUBRICATED <input type="checkbox"/> NON		
11	DRIVER TYPE: ELECTRIC MOTOR		
12	<input type="checkbox"/> DRIVE: <input type="checkbox"/> V-BELTS (ANTI-STATIC TYPE) <input type="checkbox"/> DIRECT WITH COUPLING		
13	<input type="checkbox"/> DIRECTION OF ROTATION (FACING DRIVEN END) : <input type="checkbox"/> CLOCKWISE <input type="checkbox"/> COUNTER		
14	SCOPE INSTALLATION DATA		
15	SITE DATA:		
16	AMBIENT TEMP (O C):	MAX : MIN:	
17	RELATIVE HUMIDITY (%) MAX:		
	ALTITUDE (M):		
18	EARTH QUAKE ZONE V (MAX)	W IND VELOCITY (KM/HR) 160	
19	INSTALLATION: <input checked="" type="checkbox"/> OUTDOOR		
20	<input checked="" type="checkbox"/> MOUNTED ON A COMMON SKID ALONGWITH DRIVER, ENCLOSED INSIDE A ACOUSTIC ENCLOURE		
21	<input checked="" type="checkbox"/> ELECTRICAL AREA HAZARD:		
22	CLASS/ZONE: CLASS I ZONE I DIVISION: I GAS GROUP:D, GROUP IIA, IIB		
23	APPLICABLE CODES AND STANDARDS		
24	COMPRESSOR: Preferably API 618 API 11P 2 nd EDN	PIPING: ASME/ANSI B 31.3	
25	PRESSURE VESSELS: ASME SEC-VIII, DIV-1.	GAS COOLER: Preferable API 661	
26	OILM COOLER: TEMA 'C'	SOUND :72 DBA ±3 @ 1M FROM	
27	AUX. ELECT. MOTORS: N O U R		
28	CONTROL PANEL & INSTRUMENTATION REFER: TECHNICAL SPECIFICATION		
29	UTILITIES DATA		
30	<input type="checkbox"/> Cooling water (Not Available)		
31	<input type="checkbox"/> Type:	<input type="checkbox"/> Supply temperature (oC) :	<input type="checkbox"/> Max
32	<input type="checkbox"/> Fouling Factor:	<input type="checkbox"/> Supply pressure (Kg/cm 2G):	<input type="checkbox"/> Min
33	<input type="checkbox"/> Design pressure (Kg/cm 2)	<input type="checkbox"/> Design temperature (oC):	



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34	□Water Flow Rates (m ³ /hr)					
35	□Electricity					
36	Auxiliary Motors:	V	Ph	Hz		
37	Oil Heaters:	V	Ph	Hz		
38	Solenoid Valves:	A.C/D.C	V	Ph		
39	Instruments:	A.C/D.C	V	Ph	Hz	
40	Local Panel INDI/Alarm /Ann:	A.C/ D.C	V	Ph	Hz	
41	Local Panel Trip Circuit:	A.C/D.C	V	Ph	Hz	
42	UPS: KVA	V	Ph	Hz		
43	□Total Utility Consumption					
44	□Cooling water (Make UP) (m ³ /hr)					
45	□Power (Auxiliaries) (kw)					
46	□Power (Heater) (kW)					
47	REMARKS:					
48	Vendor/ Bidder should estimate the requirement for all the Utilities and indicate the same in tabular form.					
49	□CONSTRUCITON / DESIGN REATURES					
50	Nomenclature	Unit	Stage # 1	Stage # 2	Stage # 3	
51	Cylinders					

52	No of Cylinders-					
53	Single Acting (SA)/ Double Acting (DA)					
54	Cylinder Bore / Stroke	mm/mm				
55	Rotational Speed	RPM				
56	Linear Average Piston Speed	M/sec				
57	Piston	M ³ /hr				
58	Cylinder Liner (Yes/No)					
59	Type of Cylinder Liner: Dry/Wet-					
60	Clearance pockets Yes/ No					
61	Max. Allow. Working Pressure, cylinder	Kg/cm ² a				
62	Max. /Min Allow. Working Temp., cylinder	oC				
63	M.A.W.P, Cylinder @ Amb. Temp.	Kg/cm ² a				
64	Safety Valve set Pressure, Cylinder	Kg/cm ² a				
65	Helium Test Pressure, Cylinder	Kg/cm ² a				
66	Hydrostatic Test pressure, cylinder	Kg/cm ² a				

67	Cylinder Jacket cooling Type As reqd.						
68	Cooling Media, cylinder Jackets Water/Air						

69	Max. Allow. Working Pressure, Cyl. Jacket	Kg/cm2a					
70	Hydrostatic Test Pressure, Cyl. Jacket	Kg/cm2a					
71	Suction Nozzle Size/rating/position						
72	Discharge Nozzle Size/Rating/Position						
73	Suction valve Number						
74	Average gas Velocity	M/sec					
75	Discharge valve Number						
76	Average gas Velocity	M/sec					

77	Type of Suction valve-						
78	Type of Discharge valve-						
79	Suction valve unloaders Yes/No						
80	Clearance Pockets Unloaders Type						
81	Piston Rod Diam	MM					
82	rod Reversal at Crosshead Pin (min.)	Deg.					
83	Piston Rod Run Out Operating						
84	Max. Allow. Rod Load Comp.	Kg					
85	Tension	Kg					
86	Rod Load Comp.	Kg					
87	Tension	Kg					
88	Rod Load at R.V Set	Kg					
89	Distance piece/packing						
90	Type of packing						

91	Packing vent connected to ##						
92	Packing cooling						
93	Type of Distance piece						
94	Cyl. Side Compartment Purged						

95	Frame Side Compartment Pressurized						
96	Distance Piece purge gas	Mm H2O					
97	Distance Piece purge	Nm3/hr					
98	Distance Piece vent to		Safe Height	Safe Height	Safe Height		
99	Distance piece Hydrostatic Test Pressure	Kg/cm2G					
100	## Packaging should be connected to vent header Ref 7.19.4 of API-11						
101	Frame						
102	Replaceable Crosshead Shoes Yes/ No						
103	Crosshead Guide Integral / Separate						

104	Maximum Frame Rating	KW					
105	Speed- Maximum / Minimum	Rpm					
106	Lubrication Systems						
107	Type of Lube System			Piping material			
108				Carbon steel			
109	Main Oil Pump Driven By:			Stainless Steel (all piping & valves Trims)			
110	Standby Oil Pump, Driven By:			Auxiliary oil tank			
111	Hand operated Prelube /Priming pump:			Oil Grade:			
112	Suction Strainer			Lube Oil Consumption			
113	Pressure Control Valve			Main Pump	Make:	Model:	
114	Size of Filter:				Type:	Material:	
115	Oil Heater (If required)						
116	Electric Heater with thermostat (Kw)						
117	Thermostatic Valve						
118	Type of Cylinder Lubrication			Lubricator Equipped with:			
119	Lubricator Type: Manzel of Equivalent.			Level sight glass			
120	Single plunger per feed			Oil heater electric with thermostat			
121	Divider blocks type.			Electric Heater (Kw) (If required)			
122	Lubricator Driven by:			Auxiliary Oil Tank (If required)			

123	Compressor Shaft	Oil Grade:
124	Lube Oil Electric Motor KW	Oil System capacity: (min 30 Hrs.)
125	Compressor Shaft	Oil Grade:
126	Lube oil Electric Motor KW	Oil System Capacity: (min 30 Hrs.)
127	All tubing and valves in SS	Oil consumption Rate
128	Double ball check valve on each lubrication point	
129	□ Cooling System	
130	□ Static filled coolant system for	
131	All stage cylinders	
132	Including expansion chamber, vents, drains, level gauge, piping, etc.	
133	Add piping prefabricated material	

134	□ Atmospheric thermosyphon cooling system for	
135	All stage cylinders	
136	Including expansion tank, vents, drains, coolers and level & temp. indicators, piping, etc.	
137	All piping prefabricated material	
138	□ Forced cooling water system	
139	All stage cylinders	
140	□ Packings	□ Oil Coolers □ Gas coolers
141	□ Including drains, vents, flow & temp. indicators, regulating & isolation valves complete piping to provide one	
142	□ Common inlet and one common outlet connections for Purchaser's interface terminated by a flanged block valve	
143	□ Block valve	
144	□ Each isolatable circuit to be provided with thermal relief valve.	
145	All piping pre fabricated. □ Material	
146	□ Self contained, forced circulation, closed circuit cooling water system (if reqd.)	
147	All stage cylinders □	
148	□ Packings	□ Oil Coolers □ Gas coolers

149	□ Including drains, vents, flow & temp. indicators, temp. control valve, regulating & isolation valves, complete piping	
150	□ Main circulating pumps with drivers & suction strainers	□ single coolers
151	□ Reservoir (make up)	□ Heater (if required)
152	Pumps, reservoirs, coolers etc. to be mounted on a common skid as to make a separate	
153	Material of piping	
154	Type of coolant	
155	Jacket cooling	
156	Gas piping system	
157	Vendor's supply includes:	
	□ Separator	
158	□ Pulsation suppressing equipment as per 'next' page	
159	□ Suction filter	
160	□ Temporary strainer on compressor suction	
161	□ Type of strainer	
162	□ Relief valves : on compressor □ suction □ inter-stage □ on compressor discharge	
163	□ Check valve on discharge line (compressor valve design and suction line)	

164	□ Process gas coolers complete with manual drain valve
165	□ Separators complete with manual / automatic drain valves
166	□ Process gas piping
167	□ Supply starts at inlet flange of CNG package
168	□ Terminates after priority panel with isolation valve
169	□ Materials

170	□ By-Pass line piping
171	□ Between
172	□ Gas cooler
173	□ Interconnecting piping between packing vents, PSV relief terminating to vent recovery system
174	□ Interconnecting piping between distance piece terminating to vent recovery system up to package BL
175	□ Interconnecting piping between drains terminating as a single point
176	□ Interconnecting piping between instrument air terminating

177	□ Pulsation suppression equipment					
178	Stage #	Stage #1	Stage #2	Stage #3		
179	Suction					
180	Puls. Equipment required Yes / No	YES				
181	Inlet pressure					
182	Residual Peak to Peak Pulsation % CI 3.9.2.7	As per API 618 (Approach – 3)				
183	Inlet Nozzle Size / Rating / Position					
184	Discharge Nozzle size / rating / Position					
185	Design Pressure					
186	Design temperature °C					
187	Volume					
188	Material : vessels	SA 516 Gr.60	SA516 Gr.60	SA516 Gr.60		
189	Internals					



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190	Corrosion allowance	3	3	3		
191	Hydrostatic test pressure kg/cm ² ,g	1.3XMAW P	1.3XMAWP	1.3XMAW P		
192	Discharge					
193	Puls. Equipm ent supplied	YES	YES	YES		
194	Inlet pressure					
195	Residual peak to peak pulsation %			As per API 618, CI 3.9.2.7		
196	Inlet nozzle size / rating / position					
197	Discharge Nozzle size / rating / Position					
198	Design Pressur e Kg/cm ² a					
199	Design temperatur e					
200	Volume					
201	Material : vessels	SA 516 Gr.60	SA516 Gr.60	SA516 Gr.60		
202	Internals					
203	Corrosion allowance	3	3	3		
204	Hydrostatic test pressure	1.3XMAW P	1.3XMAWP	1.3XMAW P		
205	Design Code : ASME SECT. VIII DIV 1					
206	Analog piping study / acoustic simulation, as per approach 3, Cl. 3.9.2.6 API618, 4 th edition					
207	Upstream / downstream inter-stage					
208	Performed by : <input checked="" type="checkbox"/> Vendor <input checked="" type="checkbox"/> Any other agency having similar experience					
209	Piping mechanical analysis					
210	Performed by : <input checked="" type="checkbox"/> Vendor <input checked="" type="checkbox"/> Any other agency having similar experience					
211	Automatic drain valves for each stage suction KOD					
212	Capacity control					
213	Start / Stop based on discharge receiver pressure : Fully automatic					
214	Unloading for start up / shut down : automatic through <input checked="" type="checkbox"/> Valve unloader <input checked="" type="checkbox"/> Recycle					
215	Interlock against loaded start					
216	Automatic control based on					
217	<input checked="" type="checkbox"/> Suction pressure <input checked="" type="checkbox"/> Discharge pressure <input checked="" type="checkbox"/> Flow manual signal					
218	<input checked="" type="checkbox"/> Type of actuator <input checked="" type="checkbox"/> Actuation fluid to load <input checked="" type="checkbox"/> Actuation fluid to unload					
219	On power/actuation fluid failure : compressor to <input checked="" type="checkbox"/> load <input checked="" type="checkbox"/> unload					
220	<input checked="" type="checkbox"/> Continuously <input checked="" type="checkbox"/> Maximum hrs.					
221	<input checked="" type="checkbox"/> Continuously <input checked="" type="checkbox"/> Maximum hrs.					
222	At all other capacity, compressor should run continuously					
223	Vendor's scope should include :					



224	☞ Pilot devices (pressure / temperature / flow devices, controllers & switches)				
225	Intermediate devices (solenoid valves / pneumatic relay / valves)				
226	Actuators				
227	Recycle valves				
228	Control logic & system for complete capacity control				
229	Inter connecting tubing, piping, cabling & wiring				
230	Protection against extended unloaded operation (trip)				
231	Valve unloaders are required as such compressor should start / stop at specified receiver pressures.				
232	Purchaser's interface				
233	Type of interface (single point)	Size	Rating	Face	Position / Location
234	Main gas piping inlet				
235	Main gas piping outlet				
236	Relief valves discharge				
237	Distance piece vent				
238	Packing vent				
239	C.W .Inlet				
240	C.W .Outlet				
241	N ₂ Inlet supply				
242	N ₂ Vent (Safe location)				
243	Drains				
244	Materials				

245	Cylinder materials				
246	Stage	1 Stage	2 Stage	3 Stage	
247	Cylinder				
248	Liner				
249	Piston				
250	Piston rings	PTFE	PTFE	PTFE	
251	Rider Rings	PTFE	PTFE	PTFE	
252	Piston rod				
253	Packing rings				
254	Valve seats				
255	Valve stops				
256	Valve rings / plates				
257	Valve springs				
258	Cylinder head				
259	Motion work materials :				
260		Material / ASTM Grades			
261	Top cover				
262	Crankcase				
263	Crankshaft				
264	Connecting rods				
265	Cross heads				
266	Cross head shoes				
267	Cross head guide				
268	Main bearings type				
269	Cross head pin bearings type				
270	Connecting rod bearings type				
271	Cross head pin type				
272	Notes : Bidder to indicate the material				
273	Each package should be provided with tow number drain lines, one from suction KOD and second drain as common drain line from intermediate and discharge KOD routed to drain vessels through gas recovery vessels				
274	Controls & Instrumentation				



275	AC power on/off switch with indication lamp		
276	• Control power on/off switch with indication lamp YES		
277	• Selector switch A/M station for L/O pump motor		
278	Selector switch A/M station for CW pump motor		
279	Emergency stop push button		
280	Start push button for air compressor motor		
281	Emergency stop push button for electric motor		
282	Lamp test push button		
283	Alarm / trip acknowledge / reset push button		
284	Frame oil heater ON (Indicating lamp)		
285	• Lubricator oil heater on (Indicating lamp)		
286	Interlock against loaded start		
287	Interlock against start without prelubrication		
288	Notes :		
289	Minimum required indications, alarms and trips are shown herewith. Bidder should provide any additional instrumentation for safe operation.		
290	Compressor should start stop at pre determined receiver pressure as specified. Bidder should include in his		
291	Scope includes the necessary hardware for the same.		
292	Inspection and tests		
293	Material composition and physical properties certificates required for :		
294	<input type="checkbox"/> Cylinder and liner	<input type="checkbox"/> Piston	
295	<input type="checkbox"/> Crankshaft	<input type="checkbox"/> Connecting rod	
296	<input type="checkbox"/> Pressure vessels	<input type="checkbox"/> Heat exchangers	
297	<input type="checkbox"/> X-ray examination for components : pressure vessels (certificates to be furnished)		
298		By bidder	Witnessed
299	Mech. Running test with shop driver (4 hours min.)		
300	Performance test at site as per IS 5456/PTC9/BS 726 (*).		
301	Partial stripping and internal inspection		
302	Functional / continuity tests – control panel		
303	Field trial run under vendor's supervision (package)		
304	Valve leak test		
305	Lube oil console run test		
306	Closed circuit C.W . System test		
307	During package performance test		
308	Test certificates required for :		
309	<input type="checkbox"/> Auxiliary motor & pumps	<input type="checkbox"/> Safety relief valves	
310	<input type="checkbox"/> Safety switches	<input type="checkbox"/> Solenoid valves	
311	Weights		
312	Overall supply (excluding driver and gear box, if any) kg. approx.		



313	Maximum erection weight kg. approx.
314	Maximum maintenance weight /kg. approx.
315	Gear box Kg. approx.
316	Driver Kg. approx.
317	Scope of supply
318	Compressor assembly complete with frame, cylinders, cross head etc.
319	Motion work lubrication system
320	<ul style="list-style-type: none">• Cylinder and packing lubrication system
321	<ul style="list-style-type: none">• Cooling system
322	<ul style="list-style-type: none">• Process Gas system
323	<ul style="list-style-type: none">• Local instrumentation
324	<ul style="list-style-type: none">• Local Gauge Board
325	<ul style="list-style-type: none">• Local Control Panel• PLC Panel• Man Machine Interface located in Control Room
326	<ul style="list-style-type: none">• Main driver (Electric motor)
327	<ul style="list-style-type: none">• Electric. pneumatic
328	<ul style="list-style-type: none">• Flywheel
329	<ul style="list-style-type: none">• Couplings
330	<ul style="list-style-type: none">• Driver Compressor
331	<ul style="list-style-type: none">• Guards for moving parts
332	<ul style="list-style-type: none">• Base plate Common for Compressor and Driver
333	<ul style="list-style-type: none">• Fabricated Steel skid Common for compressor, driver and accessories
334	<ul style="list-style-type: none">• Ladders and platforms
335	<ul style="list-style-type: none">• Special Tools - One Set for each package
336	<ul style="list-style-type: none">• Anchor Bolts for Complete Package
337	<ul style="list-style-type: none">• prefabricated for piping in Vendor's Scope
338	<ul style="list-style-type: none">• Piping supports and brackets• Supports For Cylinders & Auxiliaries, Prefabricated & fitted in the Package
339	<ul style="list-style-type: none">• Commissioning Spares, erection and commissioning spares
340	<ul style="list-style-type: none">• Train Torsion Analysis Study and Report
341	<ul style="list-style-type: none">• Acoustic Simulation Study & Report
342	<ul style="list-style-type: none">• Vendor data as specified
343	NOTE : Refer checklist for scope of supply



15.2 Data sheet- heat exchangers

1	GENERAL
2	PROJECT:
3	OWNER :M/S AGL SITE : Indore,Ujjain & Gwalior
4	Service : Intercooler / After cooler for Compressor Package
5	No. Reqd.: One for each unit
6	NOTE: ■ SCOPE OPTION / INFORMATION SPECIFIED BY PURCHASER □ INFORMATION REQUIRED FROM VENDOR.
7	□ Manufacturer : Type : □ Forced Draft □ Induced Draft
8	□ Bundle Size : m x m x m Bundles/Section □ Number of Units :
9	□ Bundles/Unit : In Parallel / Series □ Section Size :
10	□ Surface/Bundle : m ² Kg/cm ² e Tube : m ² □ Section/Unit :
11	□ Surface/Unit : m ² Kg/cm ² e Tube : m ² □ Plot Area/Unit :
12	PERFORMANCE (Of One Unit)
13	□ Heat Exchanged : kcal/hr MTD (Corrected) : 0C
14	□ Transfer Rate : kcal/hr m ² 0C (Finned Surface) (Kg/cm ² e Surface)
15	■ TUBE SIDE
16	■ Fluid Circulated GAS Gravity :
17	■ Total Entering Gas Kg/hr Enthalpy / Latent Heat kcal/kg
18	□ Operating Temperature In : Out : Fouling
19	□ Operating Pressure Passes / Bundle kg/cm ²
20	AIR SIDE
21	■ Temperature ■ In: 44 Out : ■ Altitude
22	□ Total Flow Unit Kg/hr Static
23	Power/Fan kW
24	□ Face Velocity m/sec Power/Unit kW
25	CONSTRUCTION (Each Bundle)



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15.3 DAT A SHEET- ELECTRIC MOTOR

ITEM NO.:					
QUANTITY:		As per requirement			
DESCRIPTION:					
A.	APPLICABLE SPECIFICATION AND STANDARDS	IS:325 / IEC / EQUIVALENT INTERNATIONAL STANDARDS			
B.	SERVICE CONDITIONS:				
	Max. Ambient Temp. (Deg. C)				
	Min. Ambient Temp. (Deg. C)				
	Design Ambient Temp. (Deg. C)				
	Altitude Above MSL (MTS)				
	Relative Humidity (Max.) (%)				
	Environment				
	Location (Indoor / Outdoor)				
	Area (Safe / Hazardous)				
C.	SYSTEM CHARACTERISTICS:				
	Systems Voltage with \pm %	415 V \pm 10%			
	Number of Phases	3			
	Rated Frequency with \pm %	50 Hz \pm 5%			
	Combined Variation	\pm 10%			
	Fault Level	25 KA			
	Space Heater Supply				
	Low Voltage Stator Winding Heating Supply	NA			
D.	Motor Rating / Details:				
	Rated Output	As per Vendor			
	Rotor Type	Squirrel Cage			
	Syn. Speed (RPM)	As per pump and fan vendor			
	Direction of Rotation	Bi-Directional			
	Insulation Class	'F', Temperature Rise Limited to 'B'			
	Duty	S1, Continuous			
	Winding Treatment	Moisture Protection Varnish			
	Insulation Process	Anti Corrosive Treatment			
	Starting Method	Soft Starter			
	Starting Current	Vendor to Furnish			
	Minimum Voltage Start at Terminal	80% of 415V			
	Starting Torque	Min. 200% of FLT			
	Pull Out Torque				
	No. of Hot Starts				
	No. of Cold Starts				
	Shaft Extension	Required			
	Type of Coupling				
	Earth Terminals	2 Nos. on Body & 2 Nos. on T. Box			
	Greasing Arrangement	Yes			
	Name Plate	Yes, as per IS:325			
	Starter Connection	Vendor to Furnish			
	Efficiency at				
	100% load				
	75% load				
	50% load				
E.	ENCLOSURE:				
	Degree of Protection	EExd IP55			
	Mounting Arrangement	As per requirement.			
	Type of Cooling	TEFC			
F.	TERMINAL BOX				
i)	Terminal Box (Main)	1 No.			
	Type				
	Fault Withstand				



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	No. of Terminals	6 Nos.
	Side of Terminal Box seen from the Driven End	RHS
ii)	Auxiliary Terminal Box	--
	1. Separate Terminal Box for	
	Space Heaters	YES
	Thermisters	--
G.	TESTS TO BE WITNESSED	
	Type Tests	CMRS test certificate to be furnished
	Routine Tests	As per IS:325
H.	ACCESSORIES	
	Anticondensation Heaters	Yes
	PTC Thermisters	NA
	Voltage Rating of Space Heaters	
	Foundation Bolt	Yes
	Cable Glands	Required
	Earthing Terminals	Body & T. Box
	Motor peak Amplitude Vibration at no Load at Bearing should not exceed	40 Microns for 1500 RPM 15 Microns for 3000 RPM
	Max. Motor Noise Level Measured at a Distance of 1.0 Mts. from Motor	
I.	CABLES	
	1. Type & Size	
	- Motor	Vender to furnish
	- Space Heater	
	- Thermister	NA
	2. Cable Lugs	
	- For Motor	Copper
	- Space Heater	Copper
	- Control Cables	NA
	3. Cable Glands – Type Material	
	- Motor	FLS-Double Compression, Ni-Cd Plated
	- Space Heater	FLS-Double Compression, Ni-Cd Plated
	- Control Cables	FLS – Double Compression Ni-Cd Plated
	J. PAINTING	
	TYPE	Epoxy
	SHADE (AS PER IS:5)	692 (Smoke Grey)

LIST OF MOTORS

S.No.	DESCRIPTION	KW	DUTY	QTY.

NOTE:- Motors are in hazardous area classification Zone 1 and Zone 2. Therefore, the Motors shall be flame proof. Vendor shall furnish the list of motor(s).



16.0 DATASHEET OF OTHER ITEMS

16.1 DATASHEET GAS DETECTION SYSTEM (IR TYPE)

1	TECHNICAL GENERAL			
2	PROJECT:			
3	OWNER: M/S AGL	SITE:		
4	EQUIPMENT: GAS DETECTOR			
5	NO.	GAS DETECTION TYPE:		
6	NOTE: <input checked="" type="checkbox"/> SCOPE OPTION / INFORMATION SPECIFIED BY PURCHASER <input type="checkbox"/> INFORMATION REQUIRED FROM VENDOR.			
7	<input type="checkbox"/> MANUFACTURER:	<input type="checkbox"/> MODEL NO.:		
	SIGNAL TRANSMISSION			
8	<input type="checkbox"/> ANALOG: TRANSMISSION BY 3CORE SHEILDED CABLE			
9	<input type="checkbox"/> MEASUREMENT CONTROL: 4mA to 20mA			
10	<input type="checkbox"/> SENSOR DRIFTS BELOW ZERO:			
11	<input type="checkbox"/> MEASURING RANGE EXCEEDED:			
12	<input type="checkbox"/> TRANSMITTER FAULT:			
13	<input type="checkbox"/> MAINTENACE SIGNAL:			
14	<input type="checkbox"/> HART COMPATIBLE:			
	<input checked="" type="checkbox"/> SITE / ENVIRONMENTAL DATA			
15	SITE DATA:			
16	AMBIENT TEMP. (POPC):	MAX:		
17		MIN:		
18	RELATIVE HUMIDITY (%):	MAX:		
	ALTITUDE (M):			
19	INSTALLATION: <input checked="" type="checkbox"/> INDOOR			
20	<input checked="" type="checkbox"/> ELECTRICAL AREA HAZARD:			
21	CLASS/ZONE: CLASS I ZONE I DIVISION: I GAS GROUP: D, GROUP IIA, IIB			
	<input checked="" type="checkbox"/> APPLICABLE CODES AND STANDARDS			
22	<input checked="" type="checkbox"/> GAS DETECTION APPROVALS: CENELEC	<input checked="" type="checkbox"/> UL, CSA: Class 1, Div 1, Groups		
	VOLTAGE OF SUPPLY			
23	OPERATING VOLTAGE 20 – 36 VDC, 24 VDC @ 150mA m	<input type="checkbox"/> COMM. FAULT		
24	<input type="checkbox"/> XIN-RUSH CURRENT: A.C/D.C			
25	<input type="checkbox"/> POWER INPUT A.C/D.C			
	<input checked="" type="checkbox"/> PHYSICAL SPECIFICATIONS			
26	<input type="checkbox"/> ENCLOSURE: Nema 4+7 (IP65)			
27	<input type="checkbox"/> SIZE			
28	<input type="checkbox"/> WEIGHT			
	<input checked="" type="checkbox"/> INSPECTION AND TESTS			
29	<input type="checkbox"/> Physical Tests on site:			
	REMARKS			



**CITY GAS DISTRIBUTION PROJECT
ANNUAL RATE CONTRACT FOR PROCUREMENT OF 1200
SCMH GED AND MOTOR DRIVEN CNG COMPRESSOR**



29	■ DIAMETER:	■ MOUNTING:
30	■ CABLE ENTRY:	■ WEIGHT:
SCOPE OF SUPPLY		
31	■ UV FIRE DETECTION SENSORS COMPLETE:	
32	■ DAT ASHEET COMPLETED	
33	REMARKS:	

16.3 PARAMETERS REQUIRED FOR SCADA (PRELIMINARY-DETAILS)

We want to monitor / control all parameters available on the PLC through SCADA system.

- I. Hardware Details: Connector Type, Communication Standard, Communication port Pin details,
- II. Communication Port Configuration: Baud Rate, data bits, stop bit, parity
- III. Polling Constraints: Minimum time period between two consecutive poll cycles.
- IV. Protocol Details: Protocol name and message structure for different read / write functions.
- V. Function codes for reading digital and Analog inputs
- VI. Function code for writing analog values in the IED registers
- VII. List of parameters available in the IED which can be accessed from the IED through serial port.
- VIII. Register address of each parameter in the IED.

A Sample of the details is given below for understanding:

PROTOCOL DETAILS:

Sr.No.	Description	Content/Details
1	Protocol	MODBUS RTU
2	Connection Type	FCC -68 RJ45
3	Communication standard	RS232D
4	Signals supplied	Tx, Rx, GND
5	Baud Rate(Speed)	300, 600,1200,4800,9600,19200
6	Format	Software configurable
7	Port Configuration	Speed : 19,200 bps Data Bits: 8 Bits Stop Bit : 1 Bit Parity : None
8	Min. Time period between consecutive Query	2 Sec.

PORT PIN Details:

Example: RS232 Pin Details:

- | | | |
|----|------|-------|
| | IED | SCADA |
| | RJ45 | |
| 1. | GND | |
| 2. | DTR | |
| 3. | RTS | |
| 4. | TX | RX |
| 5. | RX | TX |



Parameter	Register details			
	Engineering Range and Unit	GC Register	Register Format	
Density	Kg/m ³ (500-600)	8655-56	Float	
Pressure		8657-58	Float	
Temperature		8659-60	Float	
Mass Flow Rate		8661-62	Float	
Totalized mass flow		8663-64	Float	
Yesterday's Total Mass flow		8665-66	Float	
Today's Total Mass Flow		8667-68	Float	
Corrected volumetric Flow rate		8669-70	Float	
Yesterday's Total corrected Volumetric Flow		8671-72	Float	
Totalized Mass Flow at 6 AM (Snapshot of cumulative)		8673-74	Float	

17.0 OPERATING CONDITON & EXPERIENCE RECORD OF COMPRESSOR

17.1 SUCTION PRESSURE: 16 kg/cm²(g) COMPRESSOR

Sl no		Units	Stage 1	Stage 2	Stage 3 if
1					
2	<input type="checkbox"/> Corrosion Due to		NONE	NONE	NONE
3	Suction Condition				
4	■Pressure (@ Vendor's B/L)	Kg/cm ²	16		
5	■Temp. (+@ Vendor's B/L)	°C	30		
6	Discharge Conditions (Vendor's)				
7	■Pressure (@ Vendor's B/L)	Kg/c m ²			255
8	Pressure @ Cylinder Flg.	Kg/c m ²			
9	Temp., Adiabatic @ Cyl. Flange	°C	<150	<150	<150
10	Temp., Actual @ Cyl. Flange	°C			
11	Temp., After After Cooler	°C			<50
12	Cp/Cv Ration				
13	Compr. Factor (Z ₂) or (z avg)				
14	Operating Characteristics				
15	Capacity (Wet)	SM ³ /Hr			
16	Mfr's Rated Cap. (Design)	(No -ve tol)			
17	Actual Inlet Flow (wet)	SM ³ /Hr			
18	Specific Gravity				
19	V Belt/ coupling Losses	KW			
20	Volumetric Efficiency	%			
21	Valve Lift Suction/	mm /mm			
22	Valve Lift Area Suction/	mm ² /mm ²			
23	Valve Velocity	m/sec			
24	Compressor Speed	RPM			
25	Electric Motor Speed in	RPM			



26	Compressor Shaft Power	KW			
27	Compressor Shaft Power KW @ RV Set Pressure.	KW			
28	Transmission efficiency	%			
29	Energy Consumption	Kwh			
30	Driver Power	KW			
31	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
32	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
33	Specific gravity of gas				

17.2 SUCTION PRESSURE: 17.5 kg/cm² COMPRESSOR

SI no		Units	Stage 1	Stage 2	Stage 3 if applicable
1	<input checked="" type="checkbox"/> Gas Handled (See Analysis)				
2	<input type="checkbox"/> Corrosion Due to		NONE	NONE	NONE
3	Suction Condition				
4	<input checked="" type="checkbox"/> Pressure (@ Vendor's B/L)	Kg/cm ²	16		
5	<input checked="" type="checkbox"/> Temp. (+@ Vendor's B/L)	°C	30		
6	Discharge Conditions (Vendor's)				
7	Pressure (@ Vendor's B/L)	Kg/c m ²			255
8	Pressure @ Cylinder Flg.	Kg/c m ²			
9	Temp., Adiabatic @ Cyl. Flange	°C	<150	<150	<150
10	Temp., Actual @ Cyl. Flange	°C			
11	Temp., After After Cooler	°C			<50
12	Cp/Cv Ration				
13	Compr. Factor (Z ₂) or (z avg)				
14	Operating Characteristics				
15	Capacity (Wet)	SM ³ /Hr			
16	Mfr's Rated Cap. (Design)	(No -ve tol)			
17	Actual Inlet Flow (wet)	SM ³ /Hr			
18	Specific Gravity				
19	V Belt/ coupling Losses	KW			
20	Volumetric Efficiency	%			
21	Valve Lift Suction/	mm /mm			
22	Valve Lift Area Suction/	mm ² /mm ²			
23	Valve Velocity	m/sec			
24	Compressor Speed	RPM			
25	Electric Motor Speed in	RPM			
26	Compressor Shaft Power	KW			
27	Compressor Shaft Power KW @ RV Set Pressure.	KW			
28	Transmission efficiency	%			
29	Energy Consumption	Kwh			
30	Driver Power	KW			



31	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
32	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
33	Specific gravity of gas				

17.3 SUCTION PRESSURE: 19 kg/cm² COMPRESSOR

Sl no		Units	Stage 1	Stage 2	Stage 3 if applicable
1	<input checked="" type="checkbox"/> Gas Handled (See Analysis)				
2	<input type="checkbox"/> Corrosion Due to		NONE	NONE	NONE
3	Suction Condition				
4	<input checked="" type="checkbox"/> Pressure (@ Vendor's B/L)	Kg/cm ²	16		
5	<input checked="" type="checkbox"/> Temp. (+@ Vendor's B/L)	°C	30		
6	Discharge Conditions (Vendor's				
7	Pressure (@ Vendor's B/L)	Kg/c m ²			255
8	Pressure @ Cylinder Flg.	Kg/c m ²			
9	Temp., Adiabatic @ Cyl. Flange	°C	<150	<150	<150
10	Temp., Actual @ Cyl. Flange	°C			
11	Temp., After After Cooler	°C			<50
12	Cp/Cv Ration				
13	Compr. Factor (Z ₂) or (z avg)				
14	Operating Characteristics				
15	Capacity (Wet)	SM ³ /Hr			
16	Mfr's Rated Cap. (Design)	(No -ve tol)			
17	Actual Inlet Flow (wet)	SM ³ /Hr			
18	Specific Gravity				
19	V Belt/ coupling Losses	KW			
20	Volumetric Efficiency	%			
21	Valve Lift Suction/	mm /mm			
22	Valve Lift Area Suction/ Discharge	mm ² /mm ²			
23	Valve Velocity	m/sec			
24	Compressor Speed	RPM			
25	Electric Motor Speed in	RPM			
26	Compressor Shaft Power	KW			
27	Compressor Shaft Power KW @ RV Set Pressure.	KW			
28	Transmission efficiency	%			
29	Energy Consumption	Kcal/ Kwh			
30	Driver Power	KW			
31	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
32	Kcal required by Electric Motor per hour to drive fan and other auxiliaries.	KW			
33	Specific gravity of gas				



17.4 EXPERIENCE RECORD OF COMPRESSOR

Sl. No.	Description	INFORMAT ION OF TO OFFERED COMPRESSOR	INFORMAT ION FO EXISTING COMPRESSOR
	REQUIREMENT AS PER TNER		
1	a)Status of Bidder (Indicate packager or agent of packager)		
	b)In case Bidder is the agen submit the agreement of agen ship/ dealership with packager.		
2	COMPRESSOR		
	Name of compressor manufacturer		
	Place of compressor manufacturer		
	Compressor model		
	Anticipated Life in running hours		
	Compressor maximum frame BKW		
	Compressor operating RPM		
	Compressor max design RPM		
	Comp. Manufacturing code preferably API-11P 2 nd edition, API-618		
	Lubricated or non lubricated		
	Nos of stages		
	Max stage temperature deg cen (150 deg cen)		
	Compressor Operating RPM (max		
	Piston Rod Speed (4.5 m/s lub, 4m/s non lub)		
	Compressor maximum vibrations at cylinders and at frame shall not exceed 10 mm/sec. And 5 mm/s respectively		
	Material for all stages		
	Cylinder		
	Piston rings		
	Rider rings		
	Piston rod		
	Valve (Rings/ plates/ spring)		
3	PERFORMANCE OF COMPRESSOR		
CASE-L	Performance of compressor at 16 kg/cm ² suction pr, 255 kg/cm ² discharge pr and 30 deg c suction temperature		
CASE-G	Performance of compressor at 17.5 kg/cm ² suction pr, 255 kg/cm ² discharge pr and 30 deg c suction temperature		



CASE - H	Performance of compressor at 19 kg/cm ² suction pr, 255 kg/cm ² discharge pr and 30 deg c suction temp.		
-----------------	-------------------------------------------------------------------------------------------------------------------------------	--	--

	a) Capacity Sm ³ /h	CASE-L		
		CASE-L		
		CASE-G		
	b) BKW required by compressor including compressor lube oil pump BKW	CASE-H		
		CASE-L		
		CASE-G		
	c)BKW required by compressor including compressor's lube oil pump BKW at RV set pr	CASE-H		
		CASE-L		
		CASE-G		
	d2) Power required for all heat exchanger fans in Kw	CASE-L		
		CASE-G		
		CASE-H		
	e) Ventilation fans for enclosure No of fans.Type of fans(induced or forced draft)			
	Piston rod and cross head pin loading at any specified operating condition including the relief valve set condition shall not exceed 80% of the maximum design rod load of the offered compressor.			
	----Piston rod : max Design			
	----Piston rod: calculated at safety set pr condition			
	----Max cross head pin loading :			
	DeCross head pin loading: calculated at safety set pr condition			
	Guaranteed gas loss through rod seals; sm ³ /h			
	Electric Motor			
	Make and model			
	Power factor at 100% load			
	Efficiency at 100% load			
	KW Rating			
	Starting torque as % of full load			
	Type of Lubrication			

	Weight of motor (kg)		
	Starting time at 75%V (in sec)		
	Starting time at 100%V (in sec)		
5	PACKAGE		
	Name and Address of packager		
	Place of packaging (address)		
	Name of enclosure manufacturer		
	Place of enclosure manufacturer		
	Sound level at 1m distance from package in db (A) 70		
	Make & model LEL detector-4nos		
	Make & model fire detector-4 nos		
	CO ₂ Flooding system (2 cylinder each of 100 % capacity required)		
	Quantity of CO ₂ in each cylinder in		
	Volume of enclosure in m ³		
	Nos. of explosion proof tube light in enclosure min 3 nos		
	Coupling Direct/ V-belt		
	Separators between inter stage of compressor.		
6	Gas inlet train		
	W NRF, Flanged connection; outside canopy		
	Inlet relief valve		
	Inlet gas pressure gauge		
	Non return valve		
	Inlet filter of 5 micron size		
	Inlet twin filter		
	Temporary suction filter after main		
	Inlet manual isolation valve		
	Inlet automatic isolation valve		
7	Gas recovery system		
	Gas recovery system with p relief valve, pr regulator, pr gauge manual & automatic drainage system		
8	Gas delivery system		
	High pr piping with SS 316 tubing, compressor fittings, NRV.		
	Coalescent final separator.		
	Coalescent super fine filter with CE mark for removal of liquid (e.g water & oil) and solid particles down to 0.1 microns out of compressed natural gas.		
	Discharge isolation valve		
	PLC based Priority panel with SS 316		
	Double ferrule compression fillings, tubing, full bore valve ball.		

	Mass flow meter: Coriolis principle; interfaced with PLC head mounted local display to indicate flow rate (Kg/hr) cumulative gas compressed (in kg) etc.; inbuilt totaliser non-volatile & non-resettable type; suitable for hazardous area classification; One at compressor discharge One at compressor inlet		
	Final gas outlet connection from priority panel 3/4" (1" for bus) pipe OD SS double ferrule compression fittings.		
9	ESD system		
10	Volume bottles/dampers at each compressor stage of		
11	Drainage system:		
	Manual isolation valve		
	Automatic valves		
12	Heat exchanger		
	Code of construction preferably API 661, Coolers stamped as per API-		
13	Piping between stages shall be continuous with flange and welded connection or SS316 L tubing with ferrule fittings.		
14	Instrument air tubing shall be SS 316		
15	Area classification; "Class1, Group D, Division 1 as per NEC" OR "Zone 1, Group IIA/IIB as per IS/IEC		
16	The size of the complete package		
17	Chain pulley block and beam for chain pulley block		
18	Acoustic and pulsation study		
19	Separate Acoustic enclosure for motor and compressor.		
20	Confirm that instrumentation will be supplied as per tender.		
21	The offered compressors and electric motor and auxiliaries are new		
22	Human-machine interfacing unit		
23	String test at shop		
24	Field trial run at site		

24	Electrical power requirements (purchaser will give electric power for motor, air compressor, ventilation fans and compressor controls)		
	Confirm no deviation w.r.t. tender.		
	Other information of package:		
	a) Year and month of packaging the compressor package		
	b) Name and address of user with		
	c) Nos of hours the compressor have clocked on bid due date (Enclose certificate from user)		
	d) Documentary evidence that the Bidder/ manufacturer or packager having the capability and facilities (i.e. shop manpower, testing facility etc.)		
	e) Whether the bidder having office set up in India equipped with trained and experienced technical manpower for the operation and maintenance services. If not submit the agreement of O&M company having experience of motor driven compressor package		
25	Turn over of the Bidder manufacturer of packager during any of the last three financial years.		
Bidder can add another column to indicate the details of existing compressor at more than one site.			

18.0 LIST OF INSTRUMENTATION & CONTROL FOR COMPRESSOR

SI no.	Description	INDICATION		ANNUNCIATION & PRE ALARM		TRIP & ALARM	
		GUAGE - LOCAL	INDICATOR LOCAL PANEL (PLC)	LOW LOCAL DISPLAY	HIGH LOCAL PANEL DISPLAY (PLC)	LOW - N LOCAL PANEL-PLC-DISPLAY	HIGH LOCAL PANEL-PLC-DISPLAY
1	Oil Sump/Reservoir Level	■ Yes				■ yes	
2	Main L/O Pump Disch. Pr (Supply header)	■ yes	■ yes	■ yes		■ yes	
3	Oil Flow						

4	Oil Pressure at main Bearing						
5	Supply Header Temp.						
6	Oil cooler Oil Inlet Temp.						
7	Stand by pump start						
8	Compressor Main bearing metal Tem						
9	Cylinder & Packing Oil						
10	Lubricator Oil Level	■yes					
11	Lubricator oil Flow						
12	Lubricator Failure					■yes	
13	Aux. Oil						
14	Lub. Oil Supply Pr.						
15	Lub. Oil return						
16	Elec. Motor bearing metal temp.						
17	Coolant System						
18	Each cylinder CW						
19	Inter/After/Oil Cooler						
20	CW Supply header						
21	Sight Flow CW return each cylinder, Cooler & Header						
22	For Closed Circuit						
23	Coolant main pump disch. Pr.		■yes	■yes			
24	Coolant standby pump disch. Pr.						
25	Coolant standby pump start						
26	Coolant supply header						
27	Coolant supply header temp						
28	Coolant cooler Outlet temp.	■yes					
29	Coolant reservoir	■yes		■yes		■yes	
30	Cylinder Coolant Outlet temp.						
31	For Static/Thermo-siphon System						
32	Cylinder Coolant Outlet temp.						
33	Diff. Pr. Across packing coolant filter						
34	Process Gas System						
35	Temperature before twin filter at	■yes					
36	Pressure before twin filter at suction	■yes	■yes	■yes	■yes	■yes	■yes

37	2 nd and 3 rd stage Outlet	■yes	■yes		■yes		
38	Erash u estage Outlet temp.	■yes	■yes		■yes		■yes
39	After Cooler Gas Outlet temp.	■yes	■yes		■yes		■yes
40	1 st stage dish pressure	■yes	■yes	■yes	■yes	■yes	■yes
	low /high						
41	Cylinder packing vent pressure						
42	Final Disch pressure after	■yes	■yes	■yes	■yes	■yes	■yes
43	Blow Down vessel	■yes					
44	Piston piece diff. Purge pressure						
45	Distance piece diff. purge pressure						
46	Common process parameters						
47	Common machine parameters						
48	Blow down vessel pressure	■yes	■yes				■yes
49	Vibration on comp. heat exchanger fan main electric motor						■yes

*Pressure transmitter shall be of smart type with LCD display

SPECIFICATION FOR KWH METER

1	Meter type		3Phase 4 wire Static Energy meter				
2	Accuracy class		0.5 S as per IS14697				
3	Connection		Transformer Operated				
4	Rated Voltage		240V(P-N), 415V(P-P) ± 10%				
5	Rated Basic current		5A				
6	Rated maximum current		10A				
7	Rated Frequency		50 ± 5%HZ				
8	Power Factor range		Zero lag- Unity- Zero lead				
9	Standards compliance		IS 14697, IEC 62052-11, IEC 62053-21, IS 15959				
10	Calibration		Meter shall be calibrated at factory and no modifications should be permissible				
			a. Meter serial number				
			b. Date and time				
			c. Cumulative forwarded active energy				
11	Energy Audit Data		d. Cumulative reactive energy - Lag				
			e. Cumulative reactive energy - Lead				
			f. Cumulative forwarded apparent energy				

			g. Cumulative Maximum Demand in kW and kVA with date and time				
12	Metering philosophy		Metering should be 2 quadrant lag only and programmed accordingly				
			a. LCD test				
			b. Date				
			c. Time				
			d. Cumulative Active Energy				
			e. Cumulative Apparent Energy				
			f. Cumulative Reactive Energy – Lag				
			g. Cumulative Reactive Energy – Lead				
			h. Active Maximum demand with date and time				
			i. Apparent Maximum demand with date and time				
			j. Active load				
13	Auto/Manual Scroll mode		k. Reactive load				
			l. Apparent load				
			m. Phase wise power factor				
			n. Average power factor				
			o. R phase voltage				
			p. Y phase voltage				
			q. B phase voltage				
			r. R phase current (line)				
			s. Y phase current (line)				
			t. B phase current (line)				
			u. Instantaneous average power factor with sign for lag/lead				
			v. Frequency reading				
			Meter should store and display maximum demand in kW/kVA with date and time. Demand integration period should be 30 minutes. It is preferred that MD is computed using separate counter rather than by difference of initial and final energy counter.				
14	Maximum demand Registration						
15	Auto Reset of Maximum Demand		Meter should reset to zero and date should be customisable date				

19.0 QUALITY ASSURANCE PLAN

The supplier shall perform all test and inspection as per tender and as per this QAP

CUST OMER'S REF:					
REF:					
COMPRESSOR MODEL:					
		(1) INSPECTION-BY CUST OMER/ CONSULTANT/ THIRD PARTY			
		(2) CERTIFICATES/ DOCUMENTS REVIEW-BY CUSTOMER/ CONSULTANT/ THIRD PARTY			
		(3) INSPECTION - BY VENDOR			
		(4) CERTIFICATES/ DOCUMENTS TO BE SUBMITTED BY VENDOR/ SUB-VENDOR			
1		R	W	Y	HYDROTEST OF - CYLINDER, PRESS. VESSELS, HEAT EXCHANGERS
2		R	W	Y	HYDROTEST OF-CYLINDER HEADS
3	W	R	W	Y	LEAK PROOF TEST OF PRESSURIZED CRANK CASE (4 Hours with kerosene)
4		R	R	Y	ULTRASONIC TEST OF-CRANK SHAFT, CONNECTING ROD., PISTON ROD Refer Note: 1
5		R	R	Y	MAGNETIC PARTICLE TEST OF -CRANK SHAFT, CONNECTING ROD., PISTON ROD Refer Note: 1
6		R	R	Y	RADIO GRAPHY AS APPLICABLE-PRESSURE VESSELS, HEAT EXCHANGER, GAS PIPING
7		R	W	Y	BARRING OVER TO CHECK CYLINDER END CLEARANCE AND PISTON ROD RUNOUT

8	W	R	W	Y	NO LOAD MECHANICAL RUN TEST OF THE COMPR. WITH RATED (OR MORE) SPEED AND SHOP DRIVER (4 HRS. Minimum.)
9	W	R	W	Y	STRIP CHECK AND INTERNAL INSPECTION AFTER " NLMRT" OF ALL COMPRESSORS ; - Routine test certificate by vendors Refer Note:2
10		R	R	Y	Electric Motor Performance Test: At Sub-Vendors Works As Per ISO STD. Refer Note:3
11		R	R	Y	MAT ERIAL TEST CERTIFICATES FOR : CRANK SHAFT, CONNECT ING RODS, CYLINDER, LINER, PISTON (CO MPLIANCE CERT.), PRESSURE VESSELS, HEAT EXCHANGER
12		R	W	Y	CONOPY STRUCTURE PAINTING INSPECTION AT WORKS. SURFACE P R E P A R A T I O N TO BE INSPECTED AFTER CLEANING AND BEFORE APPLICATION OF FIRST COAT OF PRIMER.
13		R	W	Y	FUNCTIONAL/HV/CONTINUTY TEST/BILL OF MATERIAL FOR CONTROL PANEL (AT SUB VENDOR'S WORKS).
14	W	R	W	Y	MECHANICAL STRINGS TEST FOR 4 HOURS FOR CNG C O M P R E S S O R S PACKAGES WITH CONTROL PANEL.
15		R	R	Y	TEST CERTIFICAT E FOR - SAFETY SW ITCHES, TRAN SMIT T E R, SAFETY RELIEF VALVES, SOLENOID VALVES, CONTROL PANEL, POW ER/CONTROL & INSTRUMENT CABLES, FLAME PROOF LIGHTING FIXTURE, PANEL, JUNCTION BOXES ETC.- CALIBRATION CERTIFICATE FOR MEASURING INSTRUMENTS.
16	W	R	W	Y	FINAL MOCK-UP ASSEMBLY OF THE PACKAGE- AS PER GAFD, P&I DRAW INGS, WIRING DIAGRAM
17	W	R	W	Y	PERFOR MANCE TEST AT SITE AT GUARANTEED PARAMET ERS.
18	W	R	W	Y	FIELD TRIAL RUN AT SITE FOR EACH PACKAGE AFTER COMMISSIONING
19		R	W	Y	T EST CERTIFICATE FOR TILTERS, SS TUBES, FIT T I N G S, VALVES, CHAIN PULLEY BLOCK, ACCOSTIC MATERIAL
L E G E N D S : W = W I T N E S S . R = R E V I E W O F C O C U M E N T S , Y = D O C . S U B M I S S I O N B Y V E N D O R / S U B - V E N D O R					
NOTES:					
1	Crank shaft, Connecting rod : UT/MPT shall be connducted in either in forging OR in finish condition.				
2	Strip test is limited to open Crank case cover, X-Hd guide & Dist.pc. Cover and opening of bore & other parts, Piston, one valve per cylinder.				
3	Review of manufacturer's test reports/ certificates of all Electric Motors.				
4	Seller shall submit the list of approved Third Paty Inspection Agency (TPIA) for Purchaser's approval for inspection and testing of the package. The Inspection and Testing of the package by TPIA is in seller's scope.				

20.0 CHECK LIST OF SCOPE OF SUPPLY

Notes:

- (i) Bidder shall furnish all equipment, drivers, auxiliary systems, instruments and controls and safety devices as per the enquiry document. Anything required over and above what is specified, for safe and satisfactory operation of the equipment package shall be included by the Bidder in his scope.
- (ii) Bidder to write YES/NO against each item. Bidder is required to include complete scope, as such 'NO' is not warranted. However, in case for any of the items if vendor's reply is 'NO', vendor should give reasons for the same:
- (iii) Bidders' scope of supply shall include but not be limited to the following:

Sr.	Description No.	Specified by Purchaser (Yes/No)	Included by Bidder (Yes/No)	Remarks
1.0	Each Compressor package Complete with:			
1.1	Suction/discharge pulsation Dampers	Yes		
1.2	Process equipment such as Separator complete with supports, Manual drain with isolation valves, and automatic drain system for separators.	Yes		
1.3	Air cooled, lube oil cooling water, inter-stage and discharge gas coolers with air cooling arrangement	Yes		
1.4	Combined or separate closed cooling water system for compressor (As required)	Yes		
1.5	Lubricating oil system for compressor.	Yes		
1.6	Safety relief valves on each suction and discharge stage of the Compressor	Yes		
1.7	All interconnecting oil, gas, water, piping within the compressor package	Yes		
1.8	All valves, tubing, fittings as specified and required within the compressor package	Yes		
1.9	Fuel supply hardware complete with SS piping, control valves, regulators, Mass Flowmeter filter, vent/drain within the package suitable for the specified fuel gas	Yes		
1.10	Common skid for compressor and other auxiliary systems	Yes		
1.11	Acoustic enclosures for compressor for noise attenuation up to 72 dBA±3 @ 1 m distance fitted with LEL and fire detection and CO ₂ flooding system as specified.	Yes		

- 1.12** Instrumentation and control system as specified. **Yes**
- 1.13** Cabling with cable trays for all the electrical devices within the package. **Yes**
- 1.14** Supply of Gas mass flow meter with integral display for PG test purpose. One no **Yes**
- 1.15** Priority panel (as specified) at package discharge **Yes**
- 1.16** Compressor gas twin Y-type temporary Strainer, permanent inlet filter. **Yes**
- 1.17 Y-type strainers, valves, sight flow indicators, check valves, auto/manual drain traps as required for various compressor auxiliary systems. **Yes**
- 1.18** All couplings and guards **Yes**
- 1.19** Manual package isolating valves and Auto inlet isolation valve. **Yes**
- 1.20** Inlet pressure Regulators (Compressor Suction) **No**
- 1.21** Flywheels, barring device **Yes**
- 2 Spares and Tools / Tackles**
- 2.1** Mandatory Spares if specified in the TS" (Indicate separate price for item) **NO**
- 2.2 Erection and commissioning spares as recommended by Bidder including lube oil consumables etc. required for erection & of each compressor package. **Yes**
- 2.3 Two year normal operation maintenance spares over and the spares as required during one year warranty period normal operation and maintenance of each package by the Bidder **and No**
- 2.4 Quote for five year Normal & maintenance spares (excluding oil etc.) **No**
- 2.5 Special tools and tackles required

normal operation & maintenance of each equipment of compressor package as required and recommended by the Bidder

3 Inspection and Testing

3.1 As specified on the datasheets and tech. Spec.

4 Vendor data and drawings

4.1 All data & drawings as required per VDR format

5 Erection, commissioning and trial runs at site of the complete Package

6 Miscellaneous

- 6.1 Foundation and anchor bolts **Yes**
 6.2 Acoustical and mechanical analysis report & pulsation study (approach-3)
 6.3 Additional items not specified by Purchaser but recommended by Bidder for safe smooth and normal **Yes**

operation.
 (Bidder shall indicate separate list of such items in his proposal)

6.4 Optional price quoted for complete compressor package with Non-flameproof electric panel in lieu of flame proof electric panel. **Yes**

6.5 Data sheet of compressor, motor, LEL and UV Detection duly filled. **Yes**

6.6 Combined Speed-Torque

6.7	Electrical Load summary	Yes
6.8	Catalogues of electric motor, flameproof equipments and Instrumentation	Yes
6.9	Power required from UPS Supply 2 AC Single Phase	Yes
6.10	Power required from Non-UPS (S415pV _y TPN)	Yes
7	Operation maintenance contract including all consumables, man power etc.	Yes

SCOPE OF WORK

FOR

AMC OF EMD CNG COMPRESSOR

SCOPE OF WORK:

- 1.1 The job involves round the clock **Operation and Maintenance with spares** in shift pattern, of CNG Compressor Package supplied by Bidder for a Period of 5 year.

The operation and maintenance services shall be provided in terms of shift pattern on round the clock basis. This covers the routine servicing / maintenance works of Compressor as per the operation & maintenance Manual. Brief work to be carried out during O&M, but not limited to, is as follows:

- Check motion work oil and inspect crank case for contamination.
- Check oil filter and clean non-return valves.
- Check and clean oil strainer in motion work.
- Clean motion work.
- Check oil rise in cylinder
- Check oil consumption from records,
- Check the suction and discharge resp. stage pressure.
- Control condensate draining system, if required.
- Check vibration level of the Compressor.
- Tighten all cylinder head screw resp. bolts.
- Check condition and tension of V-belts.
- Check the functioning resp. tightness of safety & diaphragm valves.
- Check the concentric Valves of all stages, wherever necessary replace inner parts,
- Cleaning of V-belt grooves of flywheel and motor pulley.
- Cleaning of non-return valve of discharge line.
- Check condensate collection tank for contamination.
- To educate / train the operating & maintenance staff on preventive maintenance.
- To carry out repairs like arresting leakages, adjustments required etc. immediately to ensure availability of Compressor.
- To carry out Zero calibration of Mass Flow Meters at site.
- To carry out both air compressors maintenance, as per OEM guideline including consumables installed at CNG station sites.

1.2 **Calibration Schedule**

Instrument	Calibration / Year
PT, RTD, Press. Gauge, Temp. Gauge, SRV, Vibration Switch	Every 12 months
GD, FD, Mass flow meter-Zero Calibration	Every 06 months
CO2 Cylinder Weighing Machine and other instruments within the package.	Every 06 months
CO2 system health check-up, Cylinder Filling (If required)	Every 06 months
Pressure Vessel Thickness Test including Inlet Steel line piping (After IJ)	Every 1 year
Co2 Cylinder Hydro-test	Every 03 years

Another Section-

Penalty for breakdown time loss will be as per following:

- The penalty in case of breakdown for any reason would be as follows:
- 0-08 hours breakdown - Grace period and No penalty
- 08-12 hours breakdown - Rs. 5000/-
- 12-24 hours breakdown - Rs. 10000/-
- 24-48 hours breakdown - Rs. 20000/-
- 48-72 hours breakdown - Rs. 30000/-
- Beyond 72 Hours to upto 15 days: 50% of monthly maintenance charges (inc. GST) will be deducted.
- Beyond 15 days to upto 30 days : 100% of monthly maintenance charges(inc. GST)will be deducted.
- Vendor will make all efforts to maintain operation (availability) for duration of > 97.5%. In Case of monthly average availability is below 97.5%. Then penalty @ of Rs 10,000 per % or part thereof shall be applicable additional to hourly penalties subject to maximum cumulative penalty for a month i.e. 100 % of monthly maintenance charges for that particular month.
- Note: If there is carry over of breakdown from previous month to next month (for example if machine breaks down on last day of a month and is not operational till next month) then the penalty will be calculated on cumulative basis & the invoice for the final bill will be paid once the machine is operational.

1.3 Bidder's Responsibility-

- All spares, consumables, lubricants, lubricating oil, coolant, sealant etc. required for carrying out the Operation and Maintenance of the complete compressor package inclusive of air compressor (1 Nos), Dryer etc., including periodic, breakdown maintenance for continuous and uninterrupted operation of the compressor package, shall be in the scope of Bidder and shall be kept in stock. If any equipment got fire or broken due to accident the same shall be replaced or rectified by the Bidder.
- Bidder shall have to keep all the spares, consumables, lubricants, coolant, etc. required for carrying out periodic, breakdown, emergency maintenance etc. of the package so as to minimize the down time of the compressor. Non-availability of compressor package for non-availability of spares shall be liable for compensation. Bidder to submit the Spares stock list available with them in every month (by first week of the next consecutive month) during normal course of O&M to AGL.
- All tools, tackles and fixtures required for carrying out the above maintenance of the compressor shall be in the scope of Bidder. The scope will also include handling equipment like crane, forklift, chain pulley block, etc. required during any maintenance activity. Any other additional expense required at site during maintenance shall also be in Bidder's scope.
- The periodic maintenance required to be done as per OEM recommendations shall be taken up promptly. The Bidder shall provide the detailed preventative maintenance schedule along with
 - a) Estimated down time required for each type of maintenance schedule.
 - b) List of spares and their quantities required for each type of maintenance schedule per compressor.
 - c) Type and number of man days required for each type of maintenance schedule per compressor.
- Bidder shall use only OEM's certified spares during maintenance. In case, the schedule maintenance of the OEM manual recommends checking and replacing parts like valve spring, valve plates, piston rings etc. after certain time interval, same shall be replaced or used further only on approval from the AGL representative. However, any untoward consequences for non-replacement of such parts shall be the responsibility of the Bidder.

- Bidder shall submit a copy of the weekly / monthly and yearly performance report to the EIC in both soft and hard form. All stationery including the printed material shall be in scope of the Bidder
- All the maintenance / inspection job carried out by the Bidder shall be recorded and the report of the same shall be jointly signed by AGL representative.
- Calibration shall be done from government-approved laboratories (NABL accredited labs) and shall be carried out at least 15 days prior to the calibration due date and Calibration Reports shall be submitted. All the calibration compliances to be closed within 1 month of calibration at site.
 - In case of Mass Flow Meter malfunction, calibration of the same including repair/replacement is also in the scope of bidder without any additional cost. Provided replacement of MFM shall be of approved make listed above and must be calibrated in order to ensure reliability. Kindly note any arrangement/additional facility required for calibration of mass flow meter is also under scope of bidder. Bidder to ensure operation should not hamper in case MFM is sent for calibration or replacement by providing 1 spare MFM till rectification (repair/replacement/calibration) of damaged/malfunctioned MFM. AGL can ask bidder for calibration of MFM on suspicion of MFM not working properly and bidder has to abide by the same.
 - In case, the schedule maintenance of the OEM manual recommends checking and replacing parts like valve spring, valve plates, piston rings etc. after certain time interval, same shall replaced in the presence of AGL representative.
- Bidder shall provide Oil & consumables for compressor lubrication. Bidder to re-sale used oil for re-processing or disposal to authorized party and has to submit the report to AGL in form of FORM NO. 10 (Hazardous Manifest Declaration) timely.
- Bidder shall provide spares for maintenance of Compressor.
- Bidder shall deploy adequate number of technicians / supervisors / Engineers / helpers as well as tools & equipment for smooth and proper operation & maintenance of the Compressors package.
- To inspect and carry out checks on compressor as per Check sheet during O & M period.
- To maintain a log book for keeping all the day to day activities and compressor readings, for every site.
- To Check the Log Book / records, maintained and guide accordingly.
- To arrest the minor faults, leakages immediately. Any leakage which is after Suction Valve/Suction Filter will be in scope of Bidder.
- To correct failures arising due to workmanship defects under the scope of contract.
- To attend Emergency / breakdown calls on priority and provide workable solutions whenever Feasible.
- To adhere to safe working practice and take utmost care not to harm material and men around the equipment.
- To depute trained engineers / technicians from its network to carry out services
- To meet all statutory norms in terms of workmen involved in this contract.
- Bidder shall plan such maintenance during non-peak hours and in consultation with the Engineer In Charge (EIC) of AGL. Any maintenance that needs to be taken up shall be well planned in advance and submitted to EIC for approval.
- Bidder shall carry out scheduled maintenance (as per compressor running hour) as per OEM recommendation. Bidder to submit the OEM recommended hourly maintenance schedule to AGL along with parts list (hourly maintenance schedule-wise) to be over-hauled or to be replaced entirely during maintenance.
- Bidder shall deliver Old/ replaced spare part to AGL warehouse/Stores after the preventive/breakdown maintenance. The material return voucher of the same jointly signed by the AGL representative and Bidder representative shall be submitted along with the monthly bill.

Bidder will not be responsible for:

Any consequential damages, losses to any Individual or the property of the Customer; Expenses of whatsoever nature incurred by customer directly or indirectly due to non-availability of the Compressor during

the period of contract. In all events, the liability of the contractor is restricted to operation & preventive / breakdown maintenance only.

AGL's Responsibility:

- To inform in advance all concerned end users about non-availability of Compressor during the Scheduled maintenance or repair activity on the Compressor.