



## **CENTRAL U.P. GAS LIMITED**

{A Joint Venture of GAIL & BHARAT PETROLEUM CORPORATION LIMITED  
(BPCL)}  
Uttar Pradesh (U.P.), India

# **TENDER DOCUMENT FOR PROCUREMENT OF 1200 SCMH GAS ENGINE DRIVEN RECIPROCATING CNG COMPRESSORS**

**OPEN DOMESTIC COMPETITIVE BIDDING**

**Tender No.: 05/51/Q7UC/CUGL/031-02**  
(E-Tender No.-55156)  
**VOLUME – II OF II**



**PREPARED AND ISSUED BY  
MECON LIMITED**  
(A Govt. of India Undertaking)  
Delhi, India



**1200 SCMH ONLINE  
GAS ENGINE DRIVEN  
CNG COMPRESSORS**



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**VOLUME – II OF II**

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**SECTION – I**

**Material Requisition**



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**MATERIAL REQUISITION  
(MEC/CG/CUGL/GED/MR-R3)**

**Project : City Gas Distribution Project at Kanpur, Bareilly & Jhansi District.**  
**Client : CENTRAL UP GAS LTD**  
**Items : Gas Engine Driven 1200 SCMH Reciprocating CNG Compressors**



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Item Sl. No.	Description of Items	UOM	QTY
<b>1.0</b>	<b>GAS ENGINE DRIVEN 1200 SCMH RECIPROCATING CNG COMPRESSORS AND ITS ASSOCIATED AUXILIARIES (SUPPLY)</b>		
1.1	<p>Design, Engineering, Manufacturing, Supply including packaging and forwarding, insurance, custom clearance, handling ,loading &amp; unloading at port and delivery at CUGL store/site, re-transportation of the package from the store to the actual site/ station of Skid mounted Gas Engine driven 1200 SCMH Reciprocating CNG Compressor (Online)Package with explosion proof electric &amp; control panel having suction pressure of 16 kg/cm2(g), inlet line pressure range of 14 – 49 kg/cm2(g) (performance range 14 to 19 kg/cm2(g) with discharge pressure 255 kg/cm2(g) with 9 bank Priority panel along with all special tools and tackles required for erection and commissioning. The package shall be inclusive of:</p> <p>a) String test of complete compressor package along with Gas Engine and accessories at packager’s factory. b) Design, Engineering, Manufacturing, Supply including packaging and forwarding, insurance, custom clearance, handling, loading and unloading of air compressor of suitable capacity, discharge pressure approx 16 kg/cm2g, 1000 water litre capacity air receiver for instrumentation air, air dryer along with all accessories and auxiliaries.</p> <p>CUGL Stores/Sites (Tentative Locations): <b>Kanpur, Bareilly &amp; Jhansi</b></p>	Nos.	12
<b>2.0</b>	<b>INSTALLATION, COMMISSIONING &amp; TESTING</b>		
2.1	Installation, commissioning & Field performance test of Compressor Package including all accessories/ equipment(s) i.e. air compressor, CO <sub>2</sub> flooding system, cabling etc. system at CUGL site.	Nos.	12
<b>3.0</b>	<b>SERVICES FOR OPERATIONS &amp; COMPREHENSIVE MAINTENANCE</b>		
3.1	<b>ITEMS FOR OPERATIONS</b>		
3.1.1	Operation charges for 1 <sup>st</sup> year i.e. During Warranty period per shift of 8hrs (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140



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3.1.2	Operation charges for 2 <sup>nd</sup> year per shift of 8hrs (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140
3.1.3	Operation charges for 3 <sup>rd</sup> year per shift of 8hrs (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140
3.1.4	Operation charges for 4 <sup>th</sup> year per shift of 8hrs (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140
3.1.5	Operation charges for 5 <sup>th</sup> year per shift of 8hrs (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140
3.1.6	Operation charges for 6 <sup>th</sup> year per shift of (12 packages X 3 shifts X 365 days = 13140 shifts)	Nos. of shifts	13140

3.2	ITEMS FOR COMPREHENSIVE MAINTENANCE	Unit	Quantity
3.2.1	Comprehensive maintenance charges per Gas Engine driven 1200 SCMH Reciprocating CNG Compressor Package (including major overhaul) after completion of warrantee period in all Geographical Areas of CUGL inclusive of all manpower, spare parts, lubricants and consumables etc for the below mentioned years		
3.2.1.1	For 2 <sup>nd</sup> year (12 packages X 12 Months = 144)	Machine Months	144
3.2.1.2	For 3 <sup>rd</sup> Year (12 packages X 12 Months = 144)	Machine Months	144
3.2.2.3	For 4 <sup>th</sup> Year (12 packages X 12 Months = 144)	Machine Months	144
3.2.2.4	For 5 <sup>th</sup> Year (12 packages X 12 Months = 144)	Machine Months	144
3.2.2.5	For 6 <sup>th</sup> Year (12packages X 12 Months = 144)	Machine Months	144

**Notes:**



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1. The comprehensive maintenance for the first year shall be included under warrantee period & shall be inclusive of all consumables, spare parts, lubricants etc. CUGL/Owner will not pay any charges under warrantee period for comprehensive maintenance.
2. Evaluation shall be done on overall basis i.e. based on total price including quoted GST (CGST&SGST/ UTGST or IGST) for complete scope of work (supply+ services) after considering Price Loading & Compensation for under performance (if any). Bidders must quote for full quantity against the entire item (s) of SOR, failing which bid shall be rejected. The award shall be done on the overall lowest cost (L1) basis. The prices shall be compared on turnkey basis inclusive of all material supply and services with taxes/duties, cess, including inland transportation to site, all kind of insurance including transit insurance, etc and commercial loading on quoted prices due to technical performance of offered compressor (Refer clause no. 7 of Technical Specification).
3. Inspection shall be carried out by Owner or its authorized consultant/ TPI at Owner's cost.
4. Inlet piping shall be of class 300# (filter, inlet valve and 3-way valve).
5. CUGL shall give full contract up to six years of O&M service.
6. Comprehensive maintenance shall mean:

All activities recommended by OEM including but not limited to inspection/testing/removal/replacement of crankshaft and main bearing on completion of required numbers of running hour as specified by the respective OEM. These services shall include all but not limited to supply of spares, consumables, lubricants, lubricating oil, coolant, sealant, manpower, removal and re-installation of blocks (compressor) and other accessories required for carrying out the major overhaul services of the compressors.

Monthly Operation & Maintenance charges shall be payable from the date of compressors are taken under commercial operation by CUGL after submission of PBG as per tender terms & conditions. Bidder shall provide the compressor operator present at CNG station for round the clock operation inclusive of reliever as per statutory guidelines. CUGL shall operate the CNG station for 24 hrs in day which is three shift operations for CNG station. CUGL shall intimate 30 days in advance before changing the shift operation or at time of commissioning.

7. Bidder can submit separate transportation invoice.



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8. Minimum fixed charges for Annual Comprehensive Maintenance (item No. 3.2) in terms of percentage of unit Ex-works price of Item no. 1.1 quoted by the bidder shall not be less than 0.50% for 1 machine month flat for each consecutive year starting from 2<sup>nd</sup> year up to 6<sup>th</sup> year.





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## **Section-II**

# **TECHNICAL SPECIFICATION FOR 1200 SCMH GAS ENGINE DRIVEN CNG RECIPROCATING COMPRESSOR**



MECON Limited  
DELHI 110 092



**1200 SCMH ONLINE  
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**C O N T E N T S**

<b>SL NO:</b>	<b>DESCRIPTION</b>
1.	GENERAL
2.	UTILITIES & BATTERY LIMITS
3.	EQUIPMENT QUALIFICATION CRITERIA
4.	BASIC DESIGN
5.	ELECTRICS AND INSTRUMENTATION CONTROL (enclosed separately as Annexure -1 & Annexure-E-1)
6.	INSPECTION AND TESTING
7.	PRICE LOADING AND COMPENSATION FOR UNDER PERFORMANCE
8.	PAINTING AND PROTECTION
9.	ERECTION, TESTING AND COMMISSIONING AT SITE
10.	FIELD TRIAL RUN
11.	SPARE PARTS, SPECIAL TOOLS AND TACKLES
12.	DATA AND DRAWING
13.	OPERATION & MAINTENANCE SERVICES
14.	GUARANTEED PARAMETERS OF COMPRESSOR
15.	GAS COMPOSITION.
16.	CLIMATE
17.	DATA SHEET OF COMPRESSOR
18.	DATA SHEET OF GAS ENGINE & MOTOR
19.	OPERATING CONDITIONS & EXPERIENCE RECORD OF COMPRESSOR
20.	EXPERIENCE RECORD PROGRAMME OF GAS ENGINE DRIVEN COMPRESSOR
21.	QUALITY ASSURANCE PLAN
22.	PREFERRED MAKES
23.	CHECKLIST
24.	FORMAT OF DEVIATION TO THE TECHNICAL SPECIFICATION.
25.	<u>ANNEXURE – 1 &amp; ANNEXURE-E-1( Clause no 5.0 - Electrical &amp; Instrumentation)</u>



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### 1.0 GENERAL

Central UP Gas Ltd. (CUGL), a joint venture between India's two Navratna companies, GAIL (India) Limited and Bharat Petroleum Corporation Limited. The company was constituted for developing City Gas Distribution project in the State of UP.

Central UP Gas Ltd. (CUGL), (hereinafter referred as Purchaser), is supplying Piped Natural Gas (PNG) to domestic, commercial and Industrial consumers and Compressed Natural Gas (CNG) to automobiles in the in Kanpur, Unnao, Bareilly & Jhansi cities in the State of UP. CUGL is in the process of increasing its compression capacity for CNG distribution in these cities.

### 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, handling), loading at factory / store, unloading at purchaser's store / site . Further, re-transportation of the package from the store to the actual site/ station as per MR/ SOR and special conditions of contract. The scope also includes Erection, testing, commissioning, Field performance test of Compressor Package including air compressor and auxiliaries at site, comprehensive O&M service (During warranty period and post warrantee period, as per SOR / MR) of 1200 SCMh capacity "GAS ENGINE DRIVEN RECIPROCATING GAS COMPRESSOR PACKAGES" at a suction pressure of 16 kg/cm<sup>2</sup> (g), inlet line pressure range of 14 – 49 kg/cm<sup>2</sup>(g) (performance range 14 to 19 kg/cm<sup>2</sup>(g)) with discharge pressure 250 kg/cm<sup>2</sup> (g) with 9 bank Priority panels required for dispensing CNG to vehicles at various locations as defined in the MR / SOR. Various parts of this specification along with applicable codes and standards as referred shall be read in conjunction with each other and further in case of any ambiguity / confliction the more stringent requirement shall govern. The Compressor Packages shall be identical in all technical respects.

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.

### 1.2 CODES & STANDARDS

The design, construction, manufacture, supply, testing and other general requirements of the compressor package equipment shall be strictly in accordance with the data sheets, applicable API codes, and shall comply fully with relevant National/ International standards, Indian Electricity Act, Indian Electricity Rules, regulations of Insurance Association of India and Factories Act while carrying out work as per this specification.



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Any modification suggested by the statutory bodies either during drawing approval or during inspection, if any, shall be carried out by the Bidder without any additional cost and delivery implications.

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

API-11P, Second edition, API 618

ISO 13631-2002: Petroleum and natural gas industries packaged reciprocating gas compressors

PNGRB regulations

OISD 179-2016: Safety requirements on compression, storage, handling, refueling natural gas (CNG) for use in automotive sector.

ASME B 31.3 -2016 – Process piping

NFPA-37-2015: Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA-52: 2016- Vehicular natural gas fuel systems code

NFPA-496-2017: Standard for purged and pressurized enclosures for electrical equipment.

NFPA-68 -2013: Standard on explosion protection by deflagration venting.

NFPA-70 -2017: National electrical code

NFPA 12-2015: Standard on Carbon dioxide extinguishing system

ASME Sec IX: Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

Gas Cylinder rules-2016

IS: 5571, IS: 5572, IS: 5580, IS-325/IEC or EQV for electric motor.

ANSI, ASTM, NEC, NEMA, Indian Electricity Rules, Indian Explosives Act.

### 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. This Technical Specification
3. International standards/codes as applicable
4. Indian Standards / codes applicable



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Compliance with this specification 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 normally be accepted and offers not in compliance to the same shall be rejected summarily. 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

Bidder shall necessarily furnish the following along with the bid:

- (i) Proven Track Record Formats duly filled in along with general reference list shall be submitted for the earlier supplied CNG packages.
- (ii) Checklist duly filled in with regards to scope of supply
- (iii) Completely filled in Data Sheets of compressor, gas engine and electric motors.
- (iv) Deviations, if any, to this Technical Specification
- (v) Tentative Lay out / key plan/ General Arrangement indicating size of skids, center distance between skids and space required along with maintenance requirements. (a) Utilities requirements (b) Electrical Load summary
- (vi) Catalogues and datasheets of Compressor, Gas engine and instrumentation items.
- (vii) Guaranteed parameters alongwith Certificate from Compressor block manufacturer towards guaranteed shaft power required (inclusive of all compressor driven auxiliaries load) to deliver 1200 SCM per hour compression (on given parameters) and from Gas Engine manufacturer towards their gas consumption (gas consumption on guaranteed parameters) on above guaranteed shaft power to be submitted by bidders along with bid for CUGL/PMC otherwise the bid shall be rejected. Self-certification towards fuel consumption shall not be accepted. Also, electric motor driven gas coolers and radiator fans are not acceptable.

### 1.5 SCOPE OF SERVICES

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

- (i) Engineering, design, manufacturing and assembling.
- (ii) Procurement of raw materials etc., from sub-vendors.
- (iii) Preparation of documentation for design, approval by Purchaser/consultant.
- (iv) Inspection and testing as per Technical specification / Quality assurance plan.



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- (v) Surface preparation, protective coating and painting as per Technical specification.
- (vi) Packaging for transportation to site and supply.
- (vii) Erection, testing & commissioning as per Technical specification and SCC.
- (viii) Field trial run and performance test at site.
- (ix) AMC is inclusive of all spares, consumables, manpower etc. & Major Overhaul Services for Engine and Compressor.
- (x) Training of six engineers in three batches at Packager's works/ field. The travelling, boarding, and lodging of OWNER's engineers shall be borne by OWNER. Each training module shall be for one week span and shall cover the equipment constructional features, operational and maintenance procedures, practical hands-on experience on assembling, dismantling etc

### 1.6

#### SCOPE OF SUPPLY FOR EACH COMPRESSOR PACKAGE

Each compressor Package shall be complete with but not limited to:

- Lubricated balanced opposed reciprocating compressor /Trunk Piston design compressor with lube oil system and cooling system (console type) as required.
- Gas engine as compressor driver.
- Gas meter (3 nos.): Mass flow meter (with integral local display to measure gas flow at package inlet , fuel consumption at gas engine inlet& package discharge) based on Coriolis principle and as per AGA-11. While installing special care shall be taken to isolate the mass flow meter from piping vibration.
- Additionally, Thermal type mass flow meter to be provided to measure package gas loss/vent.
- Instrumentation and control system as specified on data sheets, P&ID including Local panel, Console/Local gauge boards, PLC with HMI (ref clause 5.0).
- Electrical equipment / Instruments indicated in the technical specification.
- Separate flameproof junction boxes for different type of signals like analog, digital signals, alarm, shutdowns, and thermocouples, RTDs etc. for interfacing to FLP local panel. Same is not applicable for direct run cable up to PLC panel.
- All cables and accessories shall be as specified in this specification.
- Common structural steel skid for the compressor- gas engine and for all auxiliary systems.
- Structural supports within the compressor package for all piping, electrical and instruments etc.



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- Inlet twin suction gas filter / Duplex suction filter of filtration level upto 5 micron with oil drain valve, differential pressure gauge and temporary suction line strainer at the package inlet and at other stage (if required). A conical/ Y-type strainer for filtration level upto 5 micron shall be installed in the inlet pipe after the isolation valve by the contractor at the battery limit.
- Inter-stage and discharge gas, air cooled heat exchanger.
- Exhaust fan in the enclosure, if required, in addition to the cooling fan of the heat exchanger.(see 4.12)
- Separator/ Knockout drums/volume bottles with drains operated by solenoid valves, as required. Bypass valves for automatic drain system with manual drain shall be as per manufacturer's recommendation and proprietary design. All drain lines shall be provided with level operated / time based auto drain valves and NRVs. Test certificates for coalescent filters to be submitted.
- Priority Panel at Package discharge as per Priority fill system.
- 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 to be provided for Pressure gauges (including DPG) and pressure Transmitters.
- NRV at gas suction, final discharge point, LCV and priority panel as required.
- Override facility in LCP or in HMI to fill LCV in priority panel of compressors shall be provided.
- Y- type strainers, valves, sight flow indicators, check valves with check valves protector, manual drain/ traps etc. as required for various auxiliary systems i.e. frame lube oil, cylinder lubrication system, cooling water systems, fuel supply/conditioning system etc. In case divider block lubrication system, paper filter for frame oil & check valve in that circuit are also acceptable.
- Coupling/V-belt/pulleys/Direct.
- Rigid type Copper jumpers for all the flange joints of piping outside the compressor package.
- Acoustic enclosure for Compressor package, Each package shall be provided with two nos. IR Type L.E.L. gas detector and two nos. UV - IR flame detectors to cover the enclosure effectively. In case there is separate compartment for Gas engine and compressor, each compartment should have atleast 2 nos. GD's and 2 nos. FD's i.e. total 4 nos. Gas Detector and 4 nos. Flame Detector for the package. Gas Detectors and Flame Detectors shall have indicators to see healthiness of the instruments.



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- CO<sub>2</sub> extinguishing system consisting of two cylinders, piping and valves. Inlet and outlet manual & automatic isolating valve and necessary Instrumentation with interlock with PLC as defined in specification.
- Piping from air compressor and CO<sub>2</sub> cylinders up to enclosures at a max distance of 30m each is in the scope of bidder and shall be treated as part of supply & erection.
- Each stage outlet temperature before cooler & after cooler to be displayed on PLC.
- For each compressor, 3 no. ESDs each One on LCP of compressor, on compressor body and in Operator room,
- CCOE/BIS approvals of cylinders used in CO<sub>2</sub> flooding system to be submitted.
- Priority Panel shall be fully operated through PLC (Pneumatic / Solenoid Actuated Valves 24/12 V DC). (client will provide only 230 V AC feeder; conversion in bidder's scope)
- The Compressor package foundation Size shall be not more than 20 Sqm.
- Gas flow directions to be marked "Gas In/ Gas out" with cylinder stage No. on all the inlet outlet tubes inside compressor package.
- Priority panel outlet connection shall be terminated through 3/4" OD full flow ball valves with 3/4" Tube OD end connections except Bus cascade and bus dispenser lines. Bus cascade and Bus dispenser lines shall be terminated through 3/4" OD full flow ball valves with 3/4" x 1" expander to connect 1" tube.
- Bidder shall furnish a Y-type / conical strainer fitted with adequate size mesh at the gas inlet. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. Flow area in any portion of strainer assembly shall not be less than the pipe cross sectional area. The strainer element shall be with the mesh of 5 micron. Pressure drop in clean condition shall not be more than 4.0 MWC. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data. The size of the strainer and the flow direction will be indicated on the strainer body casting. Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.
- All gas piping downstream of coalescent filter in compressor discharge shall be of SS 316 only.





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- The pressure in each bank shall be monitored through priority panel with the help of PLC by providing PT in each bank in priority panel.
- Pre alarm to be incorporated in the software before machine trips in predefined values of Pressure & temperatures
- Complete Erection, Testing & Commissioning of compressor packages.
- Structural supports required for fixing of piping, ESDs & PVC clamps for SS tubes are also included and to be erected, as required, at site of the package. Anchor fasteners for air receiver, air compressor, air dryer, CO2 flooding system, ESDs are also included and to be erected at site during installation of the package
- To cater to the normal power supply (Non UPS) requirement :-
  - a) One number of ~415 Volt ( $\pm 10\%$ ) 3-phases 4 Wire, 50 Hz ( $\pm 5\%$ ) shall be provided by client in PDB feeder for Air compressor.
  - b) One number of ~230 V (+/- 10%), 1 Phase, and 50 Hz ( $\pm 5\%$ ) shall be provided by client in PDB feeder for Air Dryer.

**Bidder shall indicate power/ Feeder (KW/Amp) requirement in the offer. Supply, Laying & termination of the cable from the outgoing terminal of PDB/LDB and further distribution are in the scope of bidder.**

- To cater to the UPS power requirement of the compressor for PLC based control panel, one UPS (220  $\pm 1\%$  V, 50  $\pm 1\%$  Hz) (feeder in UPS ACDB) shall be provided by Supplier/Bidder. Supply, Laying & termination of incoming cable from ACDB to Compressor and further downward distribution (as per requirement of proposed instruments) are in the scope of the Bidder. Bidder shall indicate power/ feeder (KW/Amp) requirement in the offer. Surge protection devices of approved make shall be provided in the control panel.
  - i. Supply, Laying and Termination of following cables including all erection accessories like Lugs, Glands etc is included in the scope of bidder:
    - a. Cables from PDB to compressor skid (Length shall be considered as 100 meter).
    - b. Cables from compressor to hooter and up to ESD push button in customer room (Length shall be considered as 100 meter).
    - c. Cables from compressor to ESD push button in field (Length shall be considered as 150 meter).
    - d. Cables from PDB to Air compressor (Length shall be considered as 50 meter).
    - e. Cables from LDB to Air Dryer (Length shall be considered



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- as 50 meter).
- f. Cables from CO2 flooding system to Compressor (Length shall be considered as 30 meter).
  - g. Cables from ACDB to compressor skid for PLC based control panel (Length shall be considered as 100 meter).
  - h. Cables from manual switch/call point of CO2 flooding system (located in customer room) to compressor skid. (Length shall be considered as 75 meter).
- ii. Suitable arrangement like cable trays, conduits etc shall be used for laying the cable.
- (Length of the cables provided here are tentative and at least 20% higher length if required shall be in bidder's scope)
- One number of dedicated Electronic earth pit shall be provided for the PLC based control panel of compressor at a distance of 5 meter from the compressor by Owner. However cabling from the pit to the PLC based control panel and further distribution is in the scope of bidder. For earthing of the body of the Gas compressor, Air Compressor, Dryer and other components, an earth grid will be provided at a distance of 5 meter from the compressor package. Cabling from the grid to the Gas Compressor, Air Compressor & Air Dryer shall be done through GI strip of 25X3 mm/cable of 1C X 10 sq.mm, Copper conductor whereas for panel it shall be done using Cu Strip of 25x3 mm/ cable of 1Cx10 sq.mm, Copper conductor including all accessories like lugs, glands etc is included in the scope of Bidder.
  - Comprehensive Annual O&M, as indicated in the MR / SOR with spares, consumables, man power and lubricants
  - During AMC, Vendor has to provide dedicated smart mobile phone & number for each site/compressor. Client shall not pay any extra charges towards phone & monthly bills.
  - Foundation bolts and aligning & leveling material
  - All spares, consumables, man power and lubricants during O & M warranty period
  - O&M charges (post warranty) with spares, consumables, man power and lubricants including major overhauling of compressor & engine as per MR/SOR.
  - CR corrugated sheets with minimum thickness of 16g for door & louvers and 18g for side walls shall be used. However, in case SS sheets it shall be as per manufacturer's standard design.
  - PLC shall be configured as a remote terminal unit of supervisory computer and data acquisition systems complete with dial up connectivity. One card for transferring data from minimum devices with RS 485 port shall be provided. The necessary communication protocol and other associated details shall be incorporated into the tender and



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shall be in the scope of bidder. Data shall be made available to purchaser on web portal and all necessary hardware & software shall be in the scope of bidder

- Periodic Calibration of MFM and measuring instruments shall be carried out as per the recommended industry practice from NABL certified lab.
- Periodic Hydrotest of Co2 cylinders shall be carried out in line to the gas cylinders rules
- Shed of appropriate size for safeguarding of the air compressor and other associated accessories shall be in scope of the bidder.
- At Site, package PLC panel shall be covered with sufficient external canopy/shed for prevention of PLC and compressor operator from rain/sunlight suitable sitting arrangement and space for keeping the documents. The size of the canopy shall be as per the instruction of the EIC only. The same shall be complied within 30 days from successful commissioning of the package.
- Bidder shall also include supply of catalytic converter along with all accessories required for its installation to reduce the levels of Carbon Monoxide, Hydrocarbons and NOx levels in the exhaust stream.
- Following documents shall be submitted by the successful bidder:
  - Pressure vessel thickness calculations to be submitted.
  - Preventive maintenances schedule.
  - Fan motor flameproof certificate to be submitted.
  - Spares parts manual (along with cross-sectional details) for the package required.
  - All documents / certificates shall be in English Language Only. No other language is permitted.
  - Valid PESO for all electrical / instrumentation items.

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

**Note:** In case of proprietary design of the offered compressor, the same can be accepted subject to the following:

- (i) The offered compressor shall meet the performance criteria as specified in tender documents.
- (ii) Bidder shall submit the PTR of the offered compressor.
- (iii) The offered compressor shall have all safety features as per tender requirement.
- (iv) The decision in this regard shall be of CUGL/ CUGL's Consultant & the same shall be binding on the bidder.



### **Exclusions**



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The following are excluded from the scope of the Bidder:

- a. All civil works and foundation design. However the Bidder shall furnish all the relevant data for design of pedestal/ foundation. Grouting of equipment on the foundation including supply of material with foundation bolts (if required for bidder's design) is a part of erection and is included in the scope of bidder's work.
- b. CNG storage cascade.
- c. Piping between priority panel to cascade/dispenser.
- d. Earthing pit for compressor



**Safety**

- 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.
- 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. All Devices shall meet the requirement for the specified area classification in which they are installed, including instrumentation leads.
- All exposed rotating parts shall be provided with adequate guards of non-sparking type.
- Drive belt, if used shall be of fire retardant and anti-static type.
- 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 from O&M point of view.
- Package enclosures 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. If two compartment then 4 each detectors has to be provided.
- All material used in the package shall be flame retardant.
- 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.
- 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: 2009 with R.V. venting as per cl. 11.18.6 of ISO 13631: 2009. All vented lines to be connected to common relief valve header.



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**1.8.1**

**CO<sub>2</sub> flooding system:**

The package shall be protected by automatically operated CO<sub>2</sub> flooding system designed as per NFPA-12 which should have minimum following features: -

- (i) Gas Detection by installation of hydrocarbon gas detector (IR type) with self-check function (have self-diagnostic LED to show the "HEALTHY" and "FAULTY" status) and transmitter with adjustable alarm levels (0-100%) with preset of 10%, 20% and 50%. Package should have at least 2 no. of gas detectors.
- (ii) Installation of flame detector (UV-IR type) and transmitter, alarm on detection of flame. Package should have at least 2 no. of flame detectors.
- (iii) CO<sub>2</sub> flooding system shall consist of 2 no. of 45 kg (min.) CO<sub>2</sub> cylinders. 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, 2016. 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 CO<sub>2</sub> cylinder from remote customer room. Pull down lever on cylinder valve for manual operation shall be provided.
- Compressor shall trip on detection of gas at preset level.
- Compressor shall trip on detection of flame at preset level and automatic discharge of CO<sub>2</sub> gas shall take place simultaneously.
- On detection of flame by any of the flame detector, the solenoid valve of selected cylinder will open and CO<sub>2</sub> will be flooded into the package.
- At that time, pressure switch /pressure transmitter will open (NO) because of pressure in CO<sub>2</sub> header. If the selected cylinder is empty, then pressure switch will operate (NC) and PLC will give signal to open solenoid valve of other cylinder, if flame is detected by flame detector



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- Even after discharge of selected cylinder, if flame remains detected by flame detector, other cylinder can also be operated after 20 sec (Settable from display) from the time of selected cylinder valve energized irrespective of pressure switch signal.
  - The limit switch provided on the weighing machine will be connected to PLC to indicate that the CO2 cylinders are full. Both are start permissive for compressor, i.e. if any of the cylinders is empty as sensed by limit switch, compressor will not start. If the operator wants to run the package even if one of the cylinders is empty, the compressor can be run by putting Limit Switch in By-Pass mode for obtaining start permissive.
  - When maintenance override switch put in By-Pass mode to keep the system off during maintenance, CO2 Solenoid valve shouldn't operate, even on detection of flame by any of the flame detector.
- (iv) Facility shall be made to operate the system manually from remote with the help of a switch/ call point and with help of pull down lever on cylinders. In this regard, manual switch / call point shall be provided to operate the desired (Main / Standby) CO2 cylinder remotely from customer room and Pull down lever shall be provided on each cylinder valve for manual operation.
- (v) Following Selector switches shall be provided:
- One Selector switch shall be provided in LCP to put Main/Stand by Cylinder in line at the turn of a switch as per requirement.
  - One maintenance override switch shall be provided in LCP to keep the system off during maintenance.
  - One switch shall be provided in LCP to bypass desired limit switch,
  - One switch in customer room to operate CO2 remotely.
- (vi) 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.
- (vii) CO2 Cylinders shall be provided with explosion-proof fittings
- (viii) Online weight (CO2) loss indication device to be provided to ascertain the health of the CO2 flooding system.
- (ix) All installation and instruments shall be compatible for hazardous area Class 1, Division 1, Group-D for Methane Gas.
- (x) Technical specifications, Operation and Maintenance Manual, CCOE Certificate i.e. 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



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hardware, calibration procedure shall be provided by the supplier along with the supply sufficient enough to handle the system independently.

- (xi) System shall be tested by the supplier after commissioning at site by creating fire signal and actual discharge of CO<sub>2</sub> 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.
- (xii) Warning and Operating instructions to be displayed at equipments as per the statutory/ safety regulations. .
- (xiii) Health status of CO<sub>2</sub> system shall be monitored & controlled through PLC.

### 2.0 UTILITIES & BATTERY LIMITS

#### 2.1 Utilities

**2.1.1** Bidder shall make his own provision for Instrument air with the flame proof electric motor driven air compressor, receiver and refrigerant type air dryer system.

**2.1.2** Air compressor preferably of IR/KPCL/Elgi/CP make having capacity of approx 16 kg/cm<sup>2</sup>(g) discharge pressure (with minimum flow rate of 10 CFM), and 1000 water liter capacity. Air receiver shall be supplied for each CNG compressor package for gas engine starting purpose. Receiver to be sized for 6 consecutive starts (each start of at least 6 seconds) of engine within one hour. Air dryer suitable for automatic operation shall also be supplied along with all accessories. The air compressor motor& air dryer shall be flameproof and will be kept in CNG area. Piping, electrical and instrumentation cabling shall be in bidder's scope.

Tapping in the 1000WL air receiver vessel shall be provided with NRV, PRV (If required) and isolation valve for CNG dispenser instrumentation line. Air receiver shall be provided with SRV (safety relief valve), pressure gauge and drains. Manual drains and automatic moisture traps/moisture separator cum regulator shall be provided in the system.

- Air Compressor Motor shall be FLP type 4 pole Induction motor and suitable for hazardous areas shall have protection Ex (d) as per area classification(Class-I, Division I, Group D as per NEC or Zone I, Group II A/ II B as per IS/ IEC).
- Starter of the Motor shall be FLP type for Zone-I operation.
- Power and Control Cable shall be in bidder scope.

**2.1.3** Tapping from air receiver/dryer shall be provided as follows;

- For dispenser: One ½" tapping with isolation valve.



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- 2.1.4** All electrical and instrumentation terminals shall be as specified.
- 2.1.5** Electric power shall be made available by Owner.
- 2.1.6** For running the Air compressor, Exhaust fan and illumination, ~415 Volt ( $\pm 10\%$ ) 3-phases 4 Wire, 50 Hz ( $\pm 5\%$ ) shall be provided by Owner at a single point (feeder in PDB) inside the electrical room. Bidder shall indicate power/Feeder(KW/Amp) requirement in the offer.
- 2.1.7** Bidder/Supplier shall arrange its own UPS supply for testing, installation, and commissioning of compressor-controlled circuitry. Supplying UPS of adequate rating along with battery back-up to be a part of bidder's scope.
- 2.2 Battery limits**
- 2.2.1** All customer interface connections (i.e. Gas Inlet & Gas Outlet) shall be brought out to the package edge. Gas inlet shall be terminated in nozzles with isolation valves having flange connections and Gas outlet (priority panel outlet connection) shall be terminated through high pressure  $\frac{3}{4}$ " full flow ball valves with 1" end connectors.
- 2.2.2** The piping along with structural supports, copper jumpers for all the flange joints from battery limit to Compressor package shall be in bidder's scope. Piping from air compressor to air receiver and CO<sub>2</sub> cylinders up to enclosures at a max. distance of 30m each is in the scope of bidder and shall be treated as part of supply & erection.
- 2.2.3** All the SS tubing shall be supported properly with PVC clamps only. All the drain pipes of air compressor, air receiver, air dryer shall be terminated to the nearest drain properly.
- 2.2.4** As and where specified on the data sheets all vents (i.e. Relief valve, distance piece and packing) shall be manifolded and terminated at skid edge outside the enclosure and vented to safe height of 3 m at package roof.
- 2.2.5** All drains from different process equipment, distance piece and packing shall be manifolded and terminated at single point for customer interface duly flanged with isolation valve.
- 2.2.6** 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. Approx distance of the CNG compressor package shall be 100 m from electrical room.
- 2.2.7** The Bidder work shall commence from Outgoing terminals of PDB/ACDB/LDB (PDB/ACDB/LDB is in the scope of Owner). Downstream distribution arrangement from the PDB to the Compressor is in the scope of Bidder.





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2.2.8 Electronic 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 package shall be in the bidder's scope.

**3.0 EQUIPMENT QUALIFICATION CRITERIA:**

Qualification criteria is included in Vol-I

**4.0 BASIC DESIGN**

**4.1 General**

4.1.1 The Compressor shall meet all the technical requirements as specified in:

1. Data Sheets: As enclosed
2. Technical Specification:
3. Codes and standards as indicated in clause 1.2
4. Compressor and its auxiliary's design shall be in conformity with API 11P, second edition, API 618.

4.1.2 Gas composition as indicated in these technical specifications 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.

4.1.3 The gas pressure in the inlet pipe at the battery limit varies from 14kg/cm<sup>2</sup>(g) to 49 kg/cm<sup>2</sup>(g). Bidder to provide PRV with slam shut off valve of 300# rating at gas inlet of compressor to protect the downstream distribution piping and fixtures from experiencing excess unsafe pressures in the event that outlet pressure of the high flow PRV rises above an acceptable level. Outlet pressure of PRV should be in the range of 14 to 19 Kg/cm<sup>2</sup>(g) and it may have multiple springs to regulate the pressure. Duplex filter shall be installed before PRV. However, sizing of the compressor for 1200 SCMH capacity at discharge pressure of 250 kg/cm<sup>2</sup>(g) shall be carried out at 16 kg/cm<sup>2</sup>(g) suction pressure. Suction pressure transmitters shall be provided to protect the compressor from very high and low pressure.

4.1.4 Bidder's offer shall be based on firm and final compressor / gas engine make and models on which basis the offer shall be evaluated and no alternate compressor / gas engine make and models or change of make and models to lower frame shall be entertained.

4.1.5 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 -ve tolerance) for compressor and indicate the same on the data sheets.



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### 4.2 Allowable speeds, temperature and vibration levels

- 4.2.1 The linear piston speed shall be limited to 4.5 m/sec.
- 4.2.2 The maximum discharge gas temperature for each stage shall be limited to 150°C.
- 4.2.3 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.

### 4.3 Piston Rod, Bearings and Cross Heads

- 4.3.1 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.
- 4.3.2 Crosshead shall be manufacturer standard material and designs. Adequate openings for removal of the crossheads shall be provided.
- 4.3.3 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.
- 4.3.4 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.

### 4.4 Packing Cases and Pressure Packing

- 4.4.1 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. In case pressurized crack case type design, the clauses of this tender which are not applicable due to inherent design will be acceptable. However, contractor has to furnish the published design data/document of the compressor.
- 4.4.2 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.
- 4.4.3 Packing vent piping inside of the distance piece shall be designed for the maximum allowable working pressure of the cylinder.



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### 4.5 Compressor Frame Lubrication

- 4.5.1 Compressor frame lubrication shall be pressurized system, with a main oil pump driven directly by the compressor shaft.
- 4.5.2 If required the Bidder shall provide manually operated/ air/electric motor driven pre lubrication pump. Crankcase shall be fitted with lube oil temp & oil level sight glass. The maximum and minimum operating levels shall be permanently indicated.
- 4.5.3 All lube oil piping after oil filter shall be 300 series stainless steel conforming to ASTM A269. Brass Fittings are also acceptable which should be suitable for required pressure.
- 4.5.4 Heating shall be provided for reservoir if applicable for the bidder's design of compressor when the minimum ambient temperature is less than the Bidder's required minimum start up temperature.
- 4.5.5 Heater besides meeting the area classification requirements specified in the Tender shall be star connected if designed for operation on 3-phase (4 wire), ~430V, 50 Hz supply.

### 4.6 Distance Pieces

- 4.6.1 Distance piece as per ISO 13631-2002 with cylinder side compartment vented to safe location is specified. Distance piece as per manufacturer's standard design which is used in the earlier supplied successfully running packages is also accepted.
- 4.6.2 Distance pieces shall be provided with gasket, solid covers and shall be suitable for a minimum differential compartment pressure of 1.75 kg/cm<sup>2</sup>g.
- 4.6.3 Distance piece as per API-11P with cylinder side compartment vented to safe location is specified.

### 4.7 Cylinder and Packing Lubrication

- 4.7.1 Secondary lubrication system with puppet check valve protector, filter & DNFT flow switch as per manufacturers design standards. Secondary lubrication system with divider block shall be provided.



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- 4.7.2 Lubricators shall be driven by crankshaft and bidder shall highlight any pre-lubrication requirements of the cylinders and the method of achieving the same.
- 4.7.3 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 flow indicator for Divider Block is also acceptable. Brass NRV shall also be acceptable.
- 4.7.4 Digital no flow timer (DNFT) shall be provided to stop the compressor in case of loss of cylinder lubrication.
- 4.7.5 Lubricator reservoir capacity shall be adequate for 100 Hrs of normal flow, and shall be equipped with low level alarm.
- 4.7.6 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.

### 4.8 Cooling System

#### 4.8.1 Compressor Cylinder

Compressor cylinders shall be air cooled. The usage of cooling water shall be limited to the engine cooling and the radiator thereof cooled by an air cooled heat exchanger.

#### 4.8.2 Inter / After Gas Coolers

Air-cooled inter-stage and final stage discharge coolers shall be provided which shall limit the gas temperature after the after cooler to 55°C. For calculating the surface area of the air cooler the ambient air temperature of 47°C and 90% RH shall be considered. Cooler design shall be on the basis of 20% excess capacity than required corresponding to suction pressure of 19 kg/cm<sup>2</sup>. Gas sections of coolers shall be designed as per API-11P requirements and shall be inspected by any approved 3rd party inspection agency. The Gas and water sections shall not be "U" code stamped but TPI inspected. For cooling of the Heat Exchangers a cooling fans to be provided inside the enclosure(s). 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/ records.

### 4.9 Separators & Oil Removal System



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- 4.9.1 Carbon Steel separators / KOD / volume bottles with auto and manual drain system shall be provided for the capacity as required.
- 4.9.2 All pressure vessels shall be designed as per ASME VIII Div 1.
- 4.9.3 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 dampers shall be fully (100 %) radiographed as per ASME VIII UW (a) or equivalent.
  - NRV shall be provided on suction of scrubber drains.
- 4.9.4 Minimum design temperature for separators/KOD/volume bottle shall be 71°C and minimum design pressure shall be maximum operating pressure plus 15% for inter-stages and plus 10% for final stage. However, All pressure vessel design shall be as per manufacturer's standards suitable for the required application as per national or international standards.
- 4.9.5 NRV shall be provided on suction, 1st stage, 2nd stage, 3rd stage separators/KOD /volume bottle drains
- 4.9.6 Gas recovery system:
- Blow Down Vessel shall conform to ASME SEC VIII DIV I Edition 2015.
  - The name plate of the BDV shall have the manufacturer's name and following parameters: Design Pressure, Design Temperature, Hydro Test Pressure, Corrosion Allowance, Radiography, Heat Treatment, Empty Weight & Capacity.
- Bidder shall provide blow down vessel 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 shall be as per Gas Cylinder Rules and duly certified for the purpose. The gas recovery vessel shall be provided with pressure relief valve and necessary instrumentation to avoid cold flaring of gas.
  - 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



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provided to connect gas recovery vessel with compressor suction. If suction damper and gas recovery vessel are combined pressure regulator after gas recovery vessel will not be allowed due to high pressure drop during compressor operation.

- Bidder to note that the compressor package required shall be suitable for operating at a suction pressure from 14 Kg/Cm<sup>2</sup>g to 19 Kg/Cm<sup>2</sup>g at 40 deg. C. Reduction of suction pressure by means of pressure regulating valve (PRV) is to be achieved which is to be supplied by the bidder. Gas inlet pressure regulator should be of 300# class rating with inlet pressure range of 10 kg/cm<sup>2</sup> to 49 kg/cm<sup>2</sup> with an outlet discharge range of 10 Kg/Cm<sup>2</sup> g to 19 Kg/Cm<sup>2</sup> g adjustable. Bidder to note that negative tolerance on the guaranteed capacity will not be acceptable. Also no advantage shall be given for positive tolerance of the capacity.
- The compressor Driver shall be suitable to start the compressor against the stabilized Pressure (30Kg/cm<sup>2</sup>g) of the system. A gas recovery vessel of suitable capacity shall be provided to collect the gas of 1st, 2nd & 3rd stage of compression. The operating pressure of gas recovery vessel shall be 25 kg/cm<sup>2</sup>g maximum. In the event of sudden stoppage or otherwise during operation / idling, the blow down vessel shall not vent gas into the atmosphere.
- One vent line from gas recovery vessel with double isolation valves shall be provided.

4.9.7 All separators / KOD's/volume bottles shall be provided with 3 mm corrosion allowance.

4.9.8 Oil from all drains shall be collected into the oil recovery pot. Oil recovery pot of suitable capacity shall be provided with double isolation manual valve and level gauge.

4.9.9 Coalescent super fine filters (preferably two stage) Third Party approved, 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. Automatic drains/ Timer based Automatic drain as per manufacturer's standard design with On-off valve connected to Gas recovery vessel shall be provided. The filters shall be sized to flow min. 200% of the flow at suction pressure of 19 kg/cm<sup>2</sup>(g)and discharge pressure of 250 Kg/cm<sup>2</sup> (g). However mechanical design shall be based on safety set pressure.

#### 4.10 Pulsation, Vibration Control and Analog Study

4.10.1 Suitable arrangement for inter stage pulsation damping shall be provided in confirmation to API 618 and API 11P. The bidder has to give compliance report/ QRA Report / test report that they have already conducted such type of Pulsation, Vibration Control and Analog Study and offered compressor is safe.



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4.10.2 If felt necessary by bidder, the acoustic and mechanical evaluation study shall be carried out for 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. If acoustic and mechanical evaluation study is carried out, the same shall be submitted to purchaser /CONSULTANT for review.

**4.11 Gas Engine**

4.11.1 The gas engine offered shall be gas fired 4-stroke, spark ignited type. The integral gas engine & compressor type design is not acceptable.

4.11.2 The site rating of engine shall be max of the following two conditions;

- a. 110% of greatest BKW required by compressor including cooling fan, other auxiliaries and the losses at any of the compressor operating conditions corresponding to suction pressure of 14 ,16 or 19 kg/cm<sup>2</sup>(g) with suction valve fully opened and discharge pressure 250 kg/cm<sup>2</sup>(g).
- b. 105% of greatest BKW required by 1200 SCMH compressor including cooling fan , other auxiliaries and the losses at any of the compressor operating conditions corresponding to suction pressure of 14,16or 19 kg/cm<sup>2</sup>(g) with suction valve fully opened and discharge pressure at relief valve ( RV) set pressure.

4.11.3 The site rating of engine shall be worked out considering the de-rating specified under the latest edition of British Standard 5514/ISO 3046 and deducting the power absorbed by all the engine driven auxiliaries, as conceived by the Packager. The site rating of engine shall be based on 47oC ambient temperature, RH 90% and an altitude as per site location and taking design case gas composition as specified, the site rating so arrived shall be suitable for the maximum Compressor BKW as arrived at and which can be applied 24 Hrs a day seven days a week with a overrating capability of up to 10%. Bidder is requested to submit site-rating calculation along with de-rating calculation in their bid. Note that the Design Gas specified for the compressor shall be used as engine fuel.

4.11.4 All the auxiliary equipment including the cooling fans shall be engine driven.

4.11.5 The engine shall be provided with the shielded ignition system of breaker less type, low-tension solid state having vapour proof enclosure with a high-tension coil at each power cylinder. The spark plug shall be shielded and all low-tension wiring shall be enclosed in grounded steel conduits. But the spark plug



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connecting cables shall be enclosed in grounded, metal shielded flexible conduits.

- 4.11.6 Constant speed hydraulic/electronic governor preferably of WOOD WORD make adjustable for speed setting over the operating range.
- 4.11.7 The engine silencer shall be residential type mounted on the roof of the engine enclosure.
- 4.11.8 Bidder shall supply fuel gas conditioning system to condition the fuel gas so as to make it suitable for use in offered gas engine. The fuel gas-conditioning skid shall mainly consist of fuel gas filter, interconnecting piping, fittings, valves, pressure regulator, safety valve, mass flow meter and necessary instrumentation etc as required shall be incorporated by the bidder.

**4.12 Enclosure of CNG Compressor Package**

- 4.12.1 The maximum allowed temperature within the enclosure shall be 5°C above ambient temperature. Adequate arrangements shall be provided to meet the above. Also, measurement device for the same to be installed within the enclosure.
- 4.12.2 Bidders to provide ventilation / exhaust fans to vent out any entrapped gases in the enclosure before starting the main compressor. Necessary interlocking to be provided by the bidder for the same.
- 4.12.3 Heat Exchanger / gas cooler fan shall have mechanical drive only and the same cannot be utilized as ventilation fan.
- 4.12.4 The compressor package shall consist of single enclosure for Compressor and gas engine. The equipment shall be mounted on one common skid. The Enclosure to restrict maximum noise level to 80 dB (A) at 1 meter from the enclosure.
- 4.12.5 Compressor canopy shall be weather proof and designed such that water cannot enter in the canopy and material used inside canopy shall be fire retardant
- 4.12.6 The enclosures shall have doors for normal access and removable wall panels for ease of maintenance of all the components.
- 4.12.7 All the pressure, temperature, gas flow meter, oil level, lube oil pressure, coolant temperature, coolant level indicators shall be visible from outside of enclosures. Enclosures as per the design of the manufacturer through gauge panel. However if due to space constraint some of the Instruments not visible from outside of enclosure then proper accessibility has to be provided for reading the parameters from the Instruments. The Flow meters shall be installed in such a way that if





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required reading can be taken safely on running of compressor during performance testing.

- 4.12.8 All local pressure and temperature gauges shall have minimum dial size of 63 mm.
- 4.12.9 Enclosures shall have internal flame proof lighting arrangement. The local control panel should also have flame proof lighting.
- 4.12.10 Necessary arrangement as per requirement for handling of all heavy parts for maintenance purpose along with lifting arrangement shall be provided.
- 4.12.11 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.
- Components such as pressure gauges, temperature gauges, pressure switches, filter automatic ball valves, safety valves etc., which require in-site adjustment, maintenance and reading, shall be easily accessible..
  - Tray/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 item such as, but not limited to, crank case oil filters, inter stage gas filters, inlet and outlets gas filters and drive belt(if applicable) 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.
  - One vent line with double isolation valve shall be provided to emptying the package at 3rd stage separator.
  - Communication/Control cables shall be routed through Cable Trays/conduits

### 4.13 Piping

- 4.13.1 All gas piping shall be designed, fabricated & tested in accordance with ANSI B 31.3.
- 4.13.2 Low pressure Gas piping shall be seamless carbon steel manufacturing in accordance with ASTM A - 106 Grade B. All Gas piping shall be flanged



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connections. Pipe wall minimum thickness shall be in accordance with Table 4 of ISO 13631:2002.

- 4.13.3 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.
- 4.13.4 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.
- 4.13.5 The instrument air tubing material shall be SS316 as per ASTM A269.
- 4.13.6 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.
- 4.13.7 Bidder shall furnish a temporary start up conical/ Y type strainer fitted with adequate size mesh.
- 4.13.8 Bidder shall furnish a Y-type/Conical strainer fitted with adequate size mesh at the gas inlet. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area. The strainer element shall be with the mesh of 5 micron. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data. The size of the strainer and the flow direction will be indicated on the strainer body casting. Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.
- 4.13.9 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.



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- 4.13.10 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.
- 4.13.11 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 manufacturer's standard. The use of SA 515 material is prohibited.
- 4.13.12 All piping after coalescent filter at compressor discharge shall be of SS 316.
- 4.13.13 The instrument air header up to compressor enclosure and CO2 piping shall be seamless CS.
- 4.13.14 All low pressure and high-pressure gas piping joints fabricated at site / shop shall be 100% radiographed after welding.
- 4.13.15 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
    - (i) Electrode qualification test procedure
    - (ii) Proposed Welding procedure specification with impact test
    - (iii) Electrode qualification test results.
    - (iv) Procedure qualification test results and final WPS .
    - (v) Welder's qualification test.

**4.14 Coupling**



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Directly coupled driver-compressor arrangement and Power transmission should be preferably thro' flexible coupling. However, a V-Belt driven compressor is also acceptable. In case of belt drive, idler pulley must be provided for adjustment of belts.

### 5.0 **ELECTRICS & INSTRUMENTATION CONTROL:**

(Enclosed separately as Annexure – 1 & Annexure-E1)

### 6.0 **INSPECTION AND TESTING**

#### 6.1 **General**

- a) Inspection and Test Requirements have been spelled out in respective Equipment Data Sheets and this Technical Specification.
- b) Bidder shall confirm compliance to all inspection and testing requirements stipulated therein and include the inspection charges in the lump sum cost.
- c) Owner/consultant/authorized TPI shall witness final 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 shall depute their representative/ PMC/ authorized TPI for witnessing the tests. Boarding, Lodging and transportation shall be borne by purchaser whereas charges towards conducting the inspection and shall be borne by bidder.
- d) Bidder shall submit detailed Test Procedure for Approval of the Purchaser two months in advance of the actual date of conducting each test.
- e) Inspection testing for foreign bidder: Cost of third party inspection including fees payable and arranging the same shall be borne by bidder. Approved 3<sup>rd</sup> party inspection agencies are EIL, BVQ, DNV, MECON and Lloyd's reg. TUV/AB-Vincotee/SGS/American bureau services/ Velosi certification services/International certification services limited/BV/Dr.Amin Controllers Pvt. Ltd.

#### 6.2 **Mechanical running test (MRT)**

The MRT for the each compressors shall be carried out in presence of PURCHASER/CONSULTANT 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



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- 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: Internal Inspection certificate for strip test after no-load run of compressor is to be submitted for review of client / consultant.

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.

### 6.3 Mechanical String Test

Mechanical String Test 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. Only natural gas shall be used for string test. All parameters including discharge pressure shall be demonstrated. All the interlocking and performance of the instrumentation system will be verified during the MRT. String test at unload condition is not acceptable.

#### 6.3.1 Compressor capacity during string test for 1200 SCMH Gas Driven Compressor

The string test for this compressor shall be performed to ascertain guaranteed parameters by running package 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.

### 6.4 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 4 hours with compressor running on continuous basis, however if load is not available at site intermittent running for 4 hours shall be permitted with maintaining minimum continuous operation of 1/2 hour. Bidder to submit PG test procedure for review / approval. Complete package shall be performance tested as a module along with gas engine & compressor as per Performa (to be decided during engineering). Bidder shall demonstrate all controls, shutdown, trips & alarms, functioning of Instrumentation system,



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PLC, Motor / Gas engine etc. Pressure and temperature of gas shall be considered at purchaser's boundary limit (or before filter unit of package if provided) and as indicated in the Instrumentation schedule; if provision not available then supplier shall install necessary pressure and temp measuring devices. Discharge PT & TT of compressor will be used for discharge pressure and temperature measurements. All instrument duly calibrated, tools & tackles, any modification required for conducting PT shall be in the scope of supplier.

- 6.4.1 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 (i.e. due to inadequate load, non-availability of CNG vehicles for conducting PT).**
- 6.4.2 The test shall be the basis of assigning penalties on the Bidder 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.
- 6.4.3 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**, if provision is not available at compressor suction and discharge as explained above.

### 7.0 PRICE LOADING AND COMPENSATION FOR UNDER PERFORMANCE

- a This section describes the guaranteed parameter, which the CNG compressor package must fulfill and the penalty for shortfall in guaranteed parameters and rejection of compressor package by the Purchaser.
- b The guaranteed parameter shall be adjusted to account for variation in gas composition and prevailing ambient condition during testing.
- c Necessary calculations shall have to be furnished by Bidder, which shall be final and no deviation shall be permitted afterwards.
- d 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.

Bidder shall furnish guaranteed values as per cl. 14 of this specification.

### 7.1 Compressor Capacity



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Bidder shall guarantee 1200 SCMH capacity of compressor with given gas composition, at suction pressure of 16 kg/cm<sup>2</sup>(g) and at suction temperature of 300 C, discharge pressure of 250 kg/cm<sup>2</sup>(g) with no negative tolerance for errors in instruments and measurements.

Since the compressor suction pressure varies from 14 kg/cm<sup>2</sup> g to 19 kg/cm<sup>2</sup> g at present, the compressor shall be suitable to deliver flow corresponding to 14 and 19 kg/cm<sup>2</sup> (g) at present.

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. **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 SCMH as per MR item no. for design case gas composition, suction pressure and suction temperature as specified against guaranteed condition with discharge pressure of 250 kg/cm<sup>2</sup>(g) with no negative 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.

### 7.2

#### **Loading & Compensation Criteria**

This section describes the guaranteed parameter, which the CNG compressor package must fulfil, the penalty for shortfall in guaranteed parameters and rejection of compressor package by the Purchaser.

The guaranteed parameter shall be adjusted to account for variation in gas composition and prevailing ambient condition during testing.

Necessary calculations correction curves shall have to be furnished by Bidder along with bid, which shall be final & no deviation shall be permitted afterwards.

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.

Bidder shall furnish guaranteed value as per Annexure enclosed with this specification

#### **Compressor Capacity**

Bidder shall guarantee 1200 SCM/hr capacity (as the case may be) of compressor with design case gas composition, at suction pressure of 16 kg/cm<sup>2</sup>g, suction temperature of 30°C, discharge pressure of 250 kg/cm<sup>2</sup>g with the negative tolerance for errors in instruments and measurements.



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Since the compressor suction pressure varies from 14 kg/cm<sup>2</sup>g to 19 kg/cm<sup>2</sup>g the compressor shall be sized / selected for specified capacity of 1200 SCMH at 16 kg/cm<sup>2</sup>g (with no -ve tolerance) whereas the driver shall be selected on the basis of compressor BkW with either 14 kg/cm<sup>2</sup>g or 19 kg/cm<sup>2</sup>g whichever is higher.

For calculation purpose 1kg of CNG =1.44 SCM

The same shall be used to establish the capacity at test bed during package performance test.

### **A. Package Gas Loss:**

The bidder shall design the compressor package so that no venting and leakage of gas takes place. Bidder shall indicate actual vent & leakage losses through the compressor package. If package loss is quoted more than 1% of suction capacity gas consumption than bid shall be rejected. This quoted figure will be used for evaluation and total quoted price for all compressors towards supply, special tools and tackles, transportation, erection & commissioning, operations and comprehensive maintenance will be calculated as per following formulas:

$$F = G \times H \times I \times N \times W \times Df$$

Where,

F = amount in Rs.

G = Vent/Leakage rate quoted in percentage

H = Cost of Natural Gas per Kg @ Rs. 48 /- per kg

I = Avg. no. of running hours per year i.e. @ 3650 hours

N = Number of machines

W = 833 kg for 1200 SCMH

Df = Discounting factor @ 10 % to arrive at Net Present value (NPV) based on 6 Years i.e 4.35

### **B. Engine Fuel Consumption:**

The compressor package shall be designed in such a way that Gas Consumption of engine (Kg/Hr) should be minimum for production of CNG.

Bidder shall indicate actual gas 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 calculated as per following formulas:

$$F = G \times H \times I \times N \times Df$$

Where, F = amount in Rs.

G = Bidder's Gas consumption rate quoted in Kg/hr for every 1200SCMH (833 Kg) of CNG produced

H = Cost of Natural Gas per Kg @ Rs. 48/- per kg





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I = Avg. no. of running hours per year i.e. @ 3650 hours

N = Number of machines

Df = Discounting factor @ 10 % to arrive at Net Present value (NPV) based on 6 Years i.e 4.35

**Note:** Fuel Consumption quoted by the bidder under guaranteed parameters shall lie within the range of 30 to 33 Kg/hr for 1200 SCMH. No benefit will be given below 30 Kg/hr for 1200 SCMH. In case the fuel consumption quoted by the bidder exceeds the upper limit i.e. 33 Kg/hr for 1200 SCMH the bid will be rejected.

### 7.3 PENALTIES

#### 7.3.1 Penalty towards Excess Package Gas Loss:

During the O&M period, cost towards excess gas loss beyond the quoted figure shall be deducted from O&M bills.

Following calculations shall be used for deduction towards excess gas loss:

$$F = 1.2 \times [(G - (Q \times D)) \times H]$$

Where, F = Penalty in Rupees to be deducted from O&M bill

G = Monthly Vent/Leakage loss observed during O&M period in Kg

Q = Vent / Leakage loss quoted in percentage

H = Cost of Natural Gas per Kg @ Rs. 48/- per kg

D = Production of CNG during the month in Kg (discharge meter)

Considering G above shall be taken as (Suction Reading – Discharge Reading – Engine Fuel Consumption Reading of Mass Flowmeters) OR Reading from Vent Mass Flow Meter, whichever is higher.

#### 7.3.2 Penalty towards Excess Engine Fuel Consumption:

During the O&M period, cost towards excess fuel consumption beyond quoted figure shall be deducted from O&M bills.

Following calculations shall be used for deduction towards excess fuel consumption.

$$F = 1.2 \times [(G - Q) \times H]$$

Where, F = Monthly Penalty in Rs. To be deducted from O&M bills

G = Monthly Actual Gas consumption in Kg

Q = Guaranteed consumption rate quoted by supplier x CNG produced during the month

H = Cost of Natural Gas per Kg @ Rs. 48/- per kg

#### 7.3.3 Penalty towards Package Efficiency Loss

Rs. 5/ Kg will be recovered for delivering each kg lesser than the rated capacity & following calculations shall be used:



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$$F = 5 \times \{(1200 \times H \times RD \times AD) - M\}$$

Where, F = Penalty Amount in Rupees

H = Package actual running hours in a month

RD = Average RD for the month using GC Data

AD = Air Density = 1.22541

M = Discharge mass flow during the month in Kgs

Note:

- 1) Package Inlet Pressure at PLC shall be used as benchmark for imposition of penalties.
- 2) Pressure regulator shall not be used to reduce the pressure at the compressor block inlet below 16 Kg/Cm<sup>2</sup>.
- 3) In case pipeline pressure at the station itself is less than 16 Kg/Cm<sup>2</sup>, then the penalty shall be imposed if the package delivery falls below discharge values corresponding to the Compressor's pressure curve, supplied at the time of bid submission only.

#### **7.3.4 Penalty for Non-Performance during Period of Operation & Maintenance**

##### **Details of Penalty for non-performance of equipment**

- a. On normal day (i.e. the day other than the schedule maintenance day):
  - i. The party has to ensure that the equipment is available for operation for minimum 20 hours per day and on an average the equipment availability has to be 98% in a month.
  - ii. If the equipment is down for more than 4 hours on any day or availability is less than 98% in a month. Penalty would be applicable as follows:
    - Upto 4 hours: Nil
    - 4 hours to 12 hours: Rs. 10,000/- per day
    - 12 hours to 24 hours: Rs. 15,000/- per day
    - More than 24 to 72 hours – 25,000/- per day
  - iii. In case there is a continuous breakdown beyond 72 hours up to 15 days, 50% of monthly maintenance charges excluding operational part will be deducted.
  - iv. In case there is a continuous breakdown beyond 15 days, which is not in the control of the contactor, no maintenance charges will be paid. Only operation charges may be payable on sole discretion of EIC.
  - v. In case there is a continuous breakdown beyond 30 days of a calendar month, Entire Monthly Maintenance and operation charges shall be deducted.
  - vi. *In case of daily availability is 20 hrs. but monthly average availability is below 98%. Then penalty @ of Rs. 10,000 per % or part thereof shall be applicable.*
- b. On schedule maintenance day (excluding periodic major overhaul of compressor/ engine):



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- i. If the equipment is down for beyond the time indicated for the agreed schedule maintenance, the party would be penalized as per follows:
  - Upto 4 hours: Nil
  - 4 hours to 12 hours: Rs. 10,000/- per day
  - 12 hours to 24 hours: Rs. 15,000/- per day
  - More than 24 to 72 hours: Rs. 25,000/- per day
- ii. In case there is a continuous breakdown beyond 72 hours up to 15 days of a calendar month, 50% of monthly maintenance charges excluding operational part will be deducted.
- iii. In case there is a continuous breakdown beyond 30 days of a calendar month, Entire Monthly Maintenance and operation charges shall be deducted.

**8.0 PAINTING AND PROTECTION**

**8.1 SURFACE PREPARATION**

- (a) Rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. The minimum acceptable standard for blast cleaning shall be Sa 2-1/2 or equivalent as per Swedish Standard SIS-055900-1967 or equivalent.
- (b) Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.
- (c) The first coat of primer must be applied by brush on dry surface. This should be done immediately after cleaning.
- (d) Surface shall be inspected by Purchaser/ third party before application of primer.

**8.2 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) $\mu$ each



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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/ litre.
No. of Coats	1
DFT	100 micron
c) Finish Coat	: Acrylic Polyurethane paint
No. of Coats:	2
DFT	50 (micron) each coat
Total DFT	100 $\mu$
Total DFT after application of primer and paint shall be 275 $\mu$ (micron) minimum.	

- 8.3 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 at least 5 years in an environment of bright sunlight with an intense UV content.
- 8.4 The headers of air-cooled exchanger shall be zinc sprayed/ heat resistant epoxy painted.
- 8.5 Packing shall be sufficiently robust to withstand rough handling during ocean shipment & in-land journey. Sling points shall be clearly indicated on crates.

**9.0 ERECTION, TESTING AND COMMISSIONING AT SITE**

- 9.1 Bidder shall be responsible for erection commissioning; performance test, field noise level test and field trial run of all compressor packages at site.
- 9.2 Bidder shall be liable to pay all local taxes, levies applicable and comply with rules, laws prevailing in concerned state.

**10.0 FIELD TRIAL RUN (Commissioning and Commercial Operation)**

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 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. Further Commencement of commercial operation will be intimated by client.



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### 11.0

#### SPARE PARTS, SPECIAL TOOLS AND TACKLES

All spare parts as required, special tools & tackles with toolbox for erection and commissioning and during O&M period of compressor package shall be supplied by the packager and shall form his scope of supply.

Sufficient numbers of special tools and tackles for compressors, (such as tool for extraction of fly wheel, key to hold crank shaft for loosening & 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, engine timing light, engine barring tool, spark plug removal tool, etc) as required for Breakdown and scheduled maintenance during the 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 be handed over to purchaser after completion of O&M period.

### 12.0

#### DATA AND DRAWING

- a. Drawings and Data shall be furnished in conformity with the Bidder Data Requirements Forms attached with Enquiry Specifications.
- b. The data requirement after placement of Fax 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.
- c. After the placement of FOI/FOA, a conference (kick off meeting) will be held at such date and at such place, as 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.
- d. 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.



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

DESCRIPTION	Require d with bid	Certified Information Required after Purchaser order		
		Prints for review/ Approval	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)	(2)	(4)	(5)	(6)
<b>A</b>	<b>GENERAL</b>			
A.1	Schedule for furnishing the vendor data		Yes	
A.2	A specific statement that CNG compressor package is in strict accordance with data sheet , technical specification & applicable standards, In case of any deviation, specific list with details & reasons for each deviation.	Yes	Yes	
A.3	General arrangement (GA) indicating battery limit for electric and piping connection & schematic diagram. & Flange details of piping connection at battery limit. i. Compressor package ii. Air compressor, dryer & receiver ii. CO2 flooding system. iv. Duplex filter v. PRV+SSV	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.		Yes	
A.6	Duly filled in experience record program	Yes	Yes	



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DESCRIPTION		Required with bid	Certified Information Required after Purchaser order		
			Prints for review/ Approval	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)		(2)	(4)	(5)	(6)
A.7	Foundation plan drawings along with load details of compressor package, Air compressor, dryer, receiver, Duplex filter, CO2 flooding system & PRV+SSV			Yes	
A.8	Tentative load data for foundation design.	Yes		Yes	
A.9	List of sub-vendors with address / phone/ fax no. For all bought out items including electrical & instrumentation items.		Yes		
A.10	Leaflet, catalogues for all items.	Yes	Yes		
A.11	O & M manual		Yes	Yes	
<b>B</b>	<b>Compressor</b>				
B.1	Data Sheet duly filled in.	Yes		Yes	
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	
	- Lube oil pump	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		



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DESCRIPTION		Required with bid	Certified Information Required after Purchaser order		
			Prints for review/ Approval	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)		(2)	(4)	(5)	(6)
B.8	Torque angle diagram, piston rod load VS crank angle.	Yes	Yes		
B.9	Torque speed characteristic. Starting torque of engine 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.11	Itemized list with price of spares for erection / commissioning.	Yes	Yes		
B.12	Item list of spares for warrantee period	Yes	Yes		
B.13	Drg. For testing arrangement & test procedure to be adopted.	Yes	Yes		
B.14	Quality Assurance Plan (QAP) and Quality Procedure		Yes		
B.15	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.16	Design / Actual assembly clearance chart	Yes	Yes		
B.17	Test records of following		Yes		
	a) Mechanical running		Yes		
	b) Performance test		Yes		
	c) Noise level test		Yes		





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DESCRIPTION		Required with bid	Certified Information Required after Purchaser order		
			Prints for review/ Approval	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)		(2)	(4)	(5)	(6)
B.18	List of special tools & tackles for installation & maintenance	Yes	Yes		
B.19	Filled in air cooler data sheet	Yes	Yes		
C	<b>Electric equipment and motors</b>	Yes	Yes		
C.1	Performance curves of motor	Yes	Yes		
C.2	Technical literature/catalogue, selection charts, nomographs etc. for motors	Yes		Yes	
C.3	Filled in data sheet of motor and Gas engine and UV detection system	Yes	Yes		
C.4	Control schematics of motors	Yes	Yes		
C.5	Performance curves for auxiliaries like fan, pump along with motor	Yes	Yes		
C.6	Typical component cross sectional drawing and literature to fully describe the details of offering.	Yes	Yes		
C.7	Test procedure of motor		Yes		
C.8	Mill test report of motors		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 tested records.		Yes		
C.12	Schematic diagram with startup & shut down procedure & logic		Yes		
C.13	Inter connection & wiring diagram		Yes		
D	<b>INSTRUMENTATION AND ELECTRICS</b>				



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DESCRIPTION		Required with bid	Certified Information Required after Purchaser order		
			Prints for review/ Approval	For records & Information	Time from FOI in weeks (To be indicated by vendor)
(1)		(2)	(4)	(5)	(6)
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	Startup & 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.15D-17	P & ID of priority panel.	Yes	Yes		
D-16	Electrical Load summary	Yes			
	Power required from UPS Supply (230 V AC Single Phase)	Yes			
D-18	Power required from Non UPS Supply (415V TPN)	Yes			
D-19	Combined Speed-Torque Characteristic curve of engine and Compressor starting at rated inlet pressure.	Yes			

**Note:**

- 1) Drawings/ document as indicated above and which are required to be submitted after placement of order for approval shall be submitted in following sets:
  - a) Soft copy of all documents/drawing (As built drawings only);
  - b) 2 sets of prints;



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- d) One no. licensed software for compressor PLC

On successful award of work, the drawings/documents shall be submitted for approval as per the scope of work.

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

**13.0 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 cl. 7.3.4 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

**13.1 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.

**13.2 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.

**13.3 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.



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### 13.4 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.

### 13.5 Sub-letting of contract

Operation & comprehensive Maintenance Services may be sublet after the due permission of purchaser. The bidder may sublet the Operation & Comprehensive Maintenance services to an agency having experience of CNG compressors Operation & Comprehensive Maintenance 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 as per relevant SCC clause.**

### 13.6 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 Contractor at his own cost shall comply with all statutory regulations required for this Work. All statutory liabilities of payment of ESI/PF or other statutory payments as may be applicable will be borne by the Contractor. 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.

**Contract Labour Act & Minimum Wages Act:** Contractor shall ensure that all formalities like obtaining all permissions and licenses not limited to but including the contract labour license etc. as required by law are fulfilled by him



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at appropriate stipulated times. Contractor shall be responsible for all legal liabilities concerning the labour employed by him at site. The Contractor shall comply with all the statues and legislation including but not limited to Payment of wages, Minimum wages etc. relating to labourers/workers. The Contractor shall indemnify and keep purchaser indemnified against all or any of the liabilities that may arise out of its not complying with any of the legislations.

Contractor shall not engage /deploy any child and the persons to be deployed should be physically and mentally fit. The Contractor shall ensure that he does not violate any of the laws of land and shall ensure that he respect and follow the contents of purchaser Values Charter which will be given to successful bidder.

The Bidder has to ensure payment of wages shall be as per minimum wage of the appropriate govt applicable under the minimum wage act.

**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.

**13.7 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.

**13.8 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 demands, 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



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persons engaged under this contract. (A certificate to this effect shall be submitted by the bidder immediately on receipt of LOA).

**13.9 Details of Penalty for non-performance of staff**

On Non-performance of Staff or deviation from Scope of Work, Client will intimate supplier / bidder in form of 1st Notice. Bidder / supplier will confirm the time for resolution. Resolution time shall be agreed by both parties. If the issue not resolved within time frame or same issue is repeated, client shall impose penalty as under;

- a) Rs.100/- per incident, when any of person found continuing duty beyond 12 hours normal duty, on any given day.
- b) Rs.100/- per Incident Day penalty shall attract each up on failure by the contractor to provide the necessary PPEs (I Cards, Dress Code/ Uniform / Safety Shoes / Hard hat/Safety Belt ) to person and their failure to wear the same as specified by EIC per person.
- c) Rs. 100/- per Incident for the non-compliance found in the log book readings of CNG Compressors.
- d) Rs. 500/- per Incident for the untrained CNG Compressor operator is on duty.

**13.10 Bidder's responsibility**

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

**13.11 Employment liability of Bidder**

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

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.

**13.12 General**



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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.

- i) 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.
- ii) 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.
- iii) The bidder shall allow weekly rest and daily working hours to his workmen as per the relevant Act/Law/and Rule made thereunder. 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
- iv) 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.
- v) 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.
- vi) Regarding work completion, the decision of the Engineer-in-Charge will be final and binding.
- vii) The bidder shall make his own arrangements to provide all facilities like boarding and transport etc. to his workmen.
- viii) 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.
- ix) Bidder shall maintain proper record of his working employee's attendance and payment made to them.
- x) The Bidder's representative/supervisor shall report daily to the Shift-in-Charge for day to day working.
- xi) 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.



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- xii) 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.
- xiii) 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.
- xiv) 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.
- xv) The bidder shall establish a complaint addressable mechanism available 24 hours, seven days a week where complaint regarding non-performance of the compressors in terms of the contract can be lodged. Further, to ensure immediate redressal of complaint round the clock manpower shall be made available, 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.
- xvi) 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 smartphone.
- xvii) 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 authorized representative.

**13.13 Operation and Maintenance of compressor packages as per Schedule of Rates**

**13.13.1 Scope of supply during 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.

**13.13.2 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 including major overhauling of compressor & engine during the post





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warranty period till contract validity, 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 or in any way engine or compressor's major overhaul is required during breakdown the same shall be replaced or rectified by the bidder, at his own cost. Electricity shall be supplied free of cost to the Bidder.

**13.13.3 Scope of services:**

- i. 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.

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.

- ii. 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.
- iii. The periodic maintenance required to be done as per OEM recommendation, inclusive of major overhaul maintenance, 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.

Note:- Major Overhaul Maintenance is defined as:

Highest mentioned maintenance interval in terms of running hours (as per OEM) in which inspection/ testing or removal of crankshaft and crankshaft main bearing is recommended as per OEM.

- iv. The 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



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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.

- v. 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, micrometer screw gauge, fill gauges, bore gauge etc shall be in scope of the Bidder and these instruments shall be calibrated every year.
- vi. 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.
- vii. 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.
- viii. 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.
- ix. Calibration shall be done from government-approved laboratories and shall be carried out at least 15 days prior to the calibration due date.
- x. The Bidder shall keep 1 set of safety relief valves in spare for the purpose of calibration. For total PR quantity of compressor packages.
- xi. The Bidder shall carry out retesting of pressure vessels periodically as per Gas Cylinder rules 2016 or Static & Mobile Pressure Vessels Rules.
- xii. 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.
- xiii. 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 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 bidder's scope.

However, all major overhaul required due to breakdown during AMC period shall be in bidder's scope.

- xiv. 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 bidder. 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. After that the



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purchaser will arrange insurance for fire, war, earthquake, civil commotion, riots and flood. Any other risk over and above will be in the scope of supplier.

**14.0 GUARANTEED PARAMETERS:**

**14.1 Parameters at Suction pressure of 14 Kg/ Cm<sup>2</sup> (g); Compressor Capacity by Bidder:**

SL NO	DESCRIPTION	By bidder
1	Compressor capacity in SCMH at suction pressure of 14kg/cm <sup>2</sup> (g), discharge pressure of 250 kg/cm <sup>2</sup> (g) and gas inlet temp 30 <sup>0</sup> C (No -ve tolerance):	
2	Compressor BKW excluding (engine 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 (engine cooling fan , after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable ) in Kw (No +ve tolerance)	
4	Gas engine heat rate in Kcal/ KW hr (No +ve tolerance)	
5	Site rated BKW of gas engine at operating RPM (No -ve tolerance)	
6	Over all transmission efficiency %	
7	Kcal required by gas engine to drive compressor package per hour sl no {( 2+3)*4/6}	
8	Net CV of gas considered in Kcal/Sm <sup>3</sup> : 8300	
9	Fuel gas consumed by gas engine in KG/HR (basis of Loading and Penalty) : (No +ve tolerance)	
10	Noise level at 1 meter from enclosure (required 80dBA max)	
11	Package Gas Loss in percentage (in %)	

**14.2 Guaranteed parameters at Suction pressure of 16 KG/CM<sup>2</sup>(g); Compressor Capacity required = 1200SCMH**

SL NO	DESCRIPTION	By bidder
1	Compressor capacity in SCMH at suction pressure of 16 kg/cm <sup>2</sup> (g) discharge pressure of 250 kg/cm <sup>2</sup> (g) and gas inlet temp 30 <sup>0</sup> C (No -ve tolerance):	



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2	Compressor BKW excluding (engine 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 (engine cooling fan , after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable ) in Kw (No +ve tolerance)	
4	Gas engine heat rate in Kcal/ kW hr (No +ve tolerance)	
5	Site rated BKW of gas engine at operating RPM (No –ve tolerance)	
6	Over all transmission efficiency %	
7	Kcal required by gas engine to drive compressor package per hour sl no {( 2+3)*4/6}	
8	Net CV of gas considered in Kcal/Sm3 : 8300	
9	Fuel gas consumed by gas engine in KG/HR (basis of Loading and Penalty) : (No +ve tolerance)	
10	Noise level at 1 meter from enclosure (required 80dBA max)	
11	Package Gas Loss in percentage (in %)	

**14.3 Parameters at Suction pressure of 19 Kg / Cm2 (g); Compressor capacity by Bidder:**

SL NO	DESCRIPTION	By bidder
1	Compressor capacity in SCMH at suction pressure 19kg/cm <sup>2</sup> (g) discharge pressure 250 kg/cm <sup>2</sup> (g) and gas inlet temp 30° C (No -ve tolerance):	
2	Compressor BKW excluding (engine 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 (engine cooling fan , after cooler and inter cooler fan, lube oil pump, water pump etc. if applicable ) in Kw (No +ve tolerance)	
4	Gas engine heat rate in Kcal/ kW hr (No +ve tolerance)	
5	Site rated BKW of gas engine at operating RPM (No –ve tolerance)	
6	Over all transmission efficiency %	
7	Kcal required by gas engine to drive compressor package per hour sl no {( 2+3)*4/6}	
8	Net CV of gas considered in Kcal/Sm3 : 8300	



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9	Fuel gas consumed by gas engine in KG/HR (basis of Loading and Penalty) : (No +ve tolerance)	
10	Noise level at 1 meter from enclosure (required 80dBA max)	
11	Package Gas Loss in percentage (in %)	

### Note:

- Bidder shall indicate the specific fuel consumption kg/hr/BHP and the fuel consumption (above defined compressor capacity) in KG/HR as guaranteed value in the offer on the design case gas composition. **The guaranteed value of fuel consumption of gas engine in KG/HR shall be between 30 to 33 Kg/hr corresponding to flow of 1200 SCMH for the given gas. Bidder shall not be given any credit/advantage for quoting fuel consumption below the lower limit. But in case the fuel consumption quoted by the bidder exceeds the upper limit, the bid will be rejected. Therefore bidders are requested to indicate the fuel consumption very carefully.**

If any bidder quotes less than 30 Kg/hr as fuel consumption by engine for running the package, 30 Kg/hr will be considered as fuel consumption by packager calculation purpose.

- For Calculation purpose, fuel consumption corresponding to guaranteed parameters of 1200 SCMH at 16 kg/cm<sup>2</sup>(g) suction pressure shall be considered.

### 15.0 GAS COMPOSITION:

	Normal Gas Composition	Design Gas Composition
C1	82.43 – 99.10	89.45
C2	7.27 – 0.90	4.58
C3	3.47 – 0.00	0.83
I C4	0.65 – 0.00	0.07
N C4	0.78 – 0.00	0.06
I C5	0.17 – 0.00	0.09
N C5	0.13 – 0.00	0.28
C6	0.10 – 0.00	0.17
C7	0.00 – 0.00	0.00
CO2	4.93 – 0.00	4.38
N2	0.06 – 0.00	0.10
H2O	0.01 – 0.00	0.00
<b>Total</b>	<b>100</b>	<b>100</b>
Average C.V. (kcal/SCM)	8950 – 8150	8302.3

### NOTE:

Compressor guaranteed performance shall be estimated for the design case gas composition and performance shall be reported for the two extreme gas compositions above.



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**16.0**

**Climate**

- Altitude: 205m above MSL(Mean Sea Level)
- Max. RH: 90%
- Wind Velocity: 160Km/hr
- Minimum Ambient temperature: 2 deg C.
- Minimum Ambient temperature: 47 deg C.

**17.0**

**DATA SHEET OF COMPRESSOR**

**17.1**

**Data Sheet of Main Compressor:**

1	<b>General:</b> <input checked="" type="checkbox"/> Means required <input type="checkbox"/> Means bidder shall indicate; if not indicated shall be in bidders scope		
2	<b>Project:</b>		
3	<b>Owner:</b>		
4	<b>Service:</b> Procurement of CNG Compressor		
	<b>Site:</b>	As per MR	
	<b>No. required :</b>		
5	<b>Compressor Capacity</b> :1200 SCMH	<b>Driver: Gas engine</b>	
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"/> ModelNo.:	
8	<input type="checkbox"/> Place of manufacture:		
9	<input type="checkbox"/> No. of stages: by Bidder	<input type="checkbox"/> Cylinder Arrangement:	
10	Cylinder Lubrication: <input type="checkbox"/> Lubricated <input type="checkbox"/> Minimum Lubricated <input type="checkbox"/> Non-Lubricated		
11	<input checked="" type="checkbox"/> Driver Type: Gas Engine		
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 clockwise		
14	<b>■ SITE / INSTALLATION DATA</b>		
15	SITE DATA:		
16	AMBIENT TEMP. (30°C):	MAX:	47.5
		MIN:	2
17	RELATIVE HUMIDITY (%):	MAX:	90
	ALTITUDE (M):		25
18	Earth Quake Zone :As per site WIND VELOCITY : As per site		



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19	INSTALLATION:    ■ OUTDOOR		
20	■ Mounted on a common skid along with driver, enclosed inside a acoustic enclosure		
21	■ <b>Electrical Area Hazard:</b>		
22	CLASS/ZONE: <b>CLASS I ZONE I</b> DIVISION: I    GAS GROUP: <b>D, GROUP IIA, IIB</b>		
23	<b>Applicable Codes and Standards</b>		
24	COMPRESSOR: <b>Preferably API 618 API 11P2nd ed</b>	PIPING: <b>ASME/ANSI B 31.3</b>	
25	PRESSURE VESSELS: <b>ASME SEC-VIII, DIV-1.</b>	GAS COOLER: Preferable <b>API 661</b>	
26	OIL COOLER: Oil cooler will be as per manufacturer standard	SOUND: 80dBA @ 1M FROM ENCLOSURE	
27	<input type="checkbox"/> AUX. ELECT. MOTORS:		
28	Control panel & instrumentation refer: technical specification		
29	<b>UTILITIES DATA</b>		
30	<input type="checkbox"/> Cooling Water ( <b>Not Available</b> )		
31	<input type="checkbox"/> Type:	<input type="checkbox"/> Supply temperature (°C):	<input type="checkbox"/> Max            return temperature (°C):
32	<input type="checkbox"/> Fouling Factor:	<input type="checkbox"/> Supply pressure (kg/cm <sup>2</sup> G):	<input type="checkbox"/> Min. return pressure(kg/cm <sup>2</sup> G):
33	<input type="checkbox"/> Design pressure (kg/cm A):	<input type="checkbox"/> Design temperature (°C):	
34	<input type="checkbox"/> Water Flow Rates (m <sup>3</sup> /hr)		
35	<input type="checkbox"/> <b>Electricity</b>		
36	Auxiliary Motors:	V	Ph            Hz
37	Oil Heaters:	V	Ph            Hz
38	Solenoid Valves: A.C/D.C	V	Ph            Hz
39	Instruments: A.C/D.C	V	Ph            Hz
40	Local Panel INDI./Alarm/Ann :	V	Ph            Hz
41	Local Panel Trip Circuit: A.C/D.C	V	Ph            Hz
42	UPS: KVA,	V	Ph            Hz
43	<input type="checkbox"/> <b>Total Utility Consumption</b>		
44	<input type="checkbox"/> Cooling Water (Make UP) (mP <sup>3P</sup> /hr)		
45	<input type="checkbox"/> Power (Auxiliaries) (kW)		
46	<input type="checkbox"/> Power (Heaters) (kW)		
47	REMARKS:		



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48	<b>Vendor/ Bidder should estimate the requirement for all the Utilities and indicate the same in tabular form.</b>						
49	<input type="checkbox"/> <b>CONSTRUCTION / DESIGN FEATURES</b>						
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 Displacement	MP <sup>3P</sup> / hr					
58	Cylinder Liner (Yes / No) or as per proprietary design						
59	Type of Cylinder Liner : Dry/Wet -						
60	Clearance Pockets Yes / No						
61	Max. Allow. Working Pressure, Cylinder	kg/cm <sup>2</sup> a					
62	Max./Min Allow. Working Temp., Cylinder	P <sup>0</sup> PC					
63	M.A.W.P, Cylinder @ Amb. Temp.	kg/cm <sup>2</sup> a					
64	Safety Valve Set Pressure, Cylinder	kg/cm <sup>2</sup> a					
65	G Helium Test Pressure, Cylinder	kg/cm <sup>2</sup> a					
66	Hydrostatic Test Pressure, Cylinder	kg/cm <sup>2</sup> a					
67	Cylinder Jacket Cooling Type As reqd.						
68	Cooling Media, Cylinder Jackets Water /AIR						
69	Max. Allow. Working Pressure, Cylinder. Jacket	kg/cm <sup>2</sup> a					
70	Hydrostatic Test Pressure, Cylinder. Jacket	kg/cm <sup>2</sup> a					





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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 Diameter	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 Comp.	Kg					
89	Distance piece / Packing						
90	Type of Packing						
91	Packing Vent Connected to ##						
92	Packing Cooling						
93	Type of Distance Piece						
94	Cylinder. Side Compartment Purged						
95	Frame Side Compartment Pressurized						
96	Distance Piece purge gas Pressure	Mm HB <sub>2</sub> O					
97	Distance Piece purge gas Flow	NmP <sup>3P</sup> /hr					



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98	Distance Piece Vent to		Safe Height	Safe Height	Safe Height		
99	Distance Piece Hydrostatic Test Pressure	kg/cm <sup>2</sup> G					
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	<input type="checkbox"/> <b>Lubrication Systems</b>						
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	Level Sight Glass on the Crankcase	Type :		Material :			
115	Type of Oil Cooler :	Standby Pump-Make :		Model :			
116	Size of Filter:	Type :		Material :			
117	Oil Heater (if required).						
118	Electric Heater with thermostat (Kw)						
119	Thermostatic Valve						
120	Type of Cylinder Lubrication	Lubricator Equipped With :					
121	Lubricator Type: Manzel or Equivalent.	Level sight glass					
122	Single plunger per feed	Oil heater electric with thermostat					
123	Divider blocks type.	Electric Heater (Kw) (if required)					
124	Lubricator Driven By :	Auxiliary Oil Tank (if required)					
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	<input type="checkbox"/> <b>Cooling System</b>						
130	<input type="checkbox"/> Static filled coolant system for						
131	All Stage Cylinders						
132	Including expansion chamber, Vents, Drains, Level Gauge, Piping, etc.						



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133	All Piping prefabricated <input type="checkbox"/> Material
134	<input type="checkbox"/> Atmospheric thermosyphon cooling system for
135	All Stage Cylinders <input type="checkbox"/>
136	Including expansion tank, Vents, Drains, Coolers, and Level & Temp. indicators, Piping, etc.
137	All Piping prefabricated. <input type="checkbox"/> Material
138	<input type="checkbox"/> Forced Cooling Water System
139	All Stage Cylinders
140	<input type="checkbox"/> Packings <input type="checkbox"/> Oil Coolers <input type="checkbox"/> Gas Coolers
141	<input type="checkbox"/> Including drains, Vents, flow & temp. Indicators, Temp. regulating & Isolation valves, complete piping to provide one
142	<input type="checkbox"/> Common inlet and one common outlet connections for Purchaser's interface terminated by a flanged block valve
143	<input type="checkbox"/> Block valve.
144	<input type="checkbox"/> Each isolatable circuit to be provided with thermal relief valve.
145	All Piping prefabricated. <input type="checkbox"/> Material
146	<input type="checkbox"/> Self contained, forced circulation, closed circuit Cooling Water System (if reqd.)
147	All Stage Cylinders <input type="checkbox"/>
148	<input type="checkbox"/> Packing <input type="checkbox"/> Oil Coolers <input type="checkbox"/> Gas Coolers
149	<input type="checkbox"/> Including drains, Vents, flow & temp. Indicators, Temp. Control Valve, Regulating & Isolation valves, complete piping
150	<input type="checkbox"/> Main circulating pumps with drivers & suction strainers <input type="checkbox"/> Single Coolers
151	<input type="checkbox"/> Reservoir (Make Up) <input type="checkbox"/> Heater (if required)
152	<input type="checkbox"/> Pumps, Reservoirs, Coolers etc. to be mounted on a common skid as to make a separate console.
153	<input type="checkbox"/> Material of piping:
154	<input type="checkbox"/> Type of coolant:
155	<input type="checkbox"/> Jacket cooling
156	<input type="checkbox"/> Gas Piping System
157	<input type="checkbox"/> Vendor's Supply Includes:
	■ Separator
158	■ Pulsation suppression 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 <input type="checkbox"/> 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 Values
166	■ Process Gas Piping
167	■ Supply starts at inlet flange of CNG PACKAGE
168	■ Terminates after priority panel with isolation valve
169	<input type="checkbox"/> <b>Materials:</b>
170	<input type="checkbox"/> By-Pass Line Piping



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171	<input type="checkbox"/> Between					
172	<input type="checkbox"/> Gas cooler					
173	<input type="checkbox"/> Interconnecting Piping Between Packing Vents, PSV Relief terminating to Vent Recovery System.					
174	<input type="checkbox"/> Interconnecting piping between distance piece terminating to Vent Recovery System upto package B/L					
175	<input type="checkbox"/> Interconnecting piping between Drains terminating as a single point					
176	<input type="checkbox"/> Interconnecting piping between Instrument Air terminating					
177	<input type="checkbox"/> Pulsation Suppression Equipment					
178	Stage #:	Stage#1	Stage#2	Stage#3		
179	Suction					
180	Puls. Equipment Required Yes/No	YES	Yes			
181	Inlet Pressure					
182	Residual Peak to Peak Pulsation % As per API 618 ( APPROACH -3 ), CI 3.9.2.7					
183	Inlet Nozzle Size / Rating/Position					
184	Discharge Nozzle Size / Rating/Position					
185	Design Pressure Kg/cm <sup>2</sup> a					
186	Design Temperature °C					
187	Volume					
188	Material : vessels	SA 516 Gr.70	SA 516 Gr.70			
189	Internals					
190	Corrosion Allowance mm	3	3			
191	Hydrostatic test Pressure kg/cm <sup>2</sup> ,g	1.3XMAWP	1.3XMAWP			
192	Discharge					



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193	Puls. Equipment Supplied Yes/No	YES	YES			
194	Inlet Pressure					
195	Residual Pulsation %	Peak to Peak	As per API 618, CI 3.9.2.7			
196	Inlet Nozzle Size / Rating/Position					
197	Discharge Nozzle Size / Rating/Position					
198	Design Pressure Kg/cm <sup>2</sup> a					
199	Design Temperature °C					
200	Volume					
201	Material : vessels	SA 516 Gr.60	SA 516 Gr.60			
202	Internals					
203	Corrosion Allowance mm	3	3			
204	Hydrostatic test Pressure kg/cm <sup>2</sup> ,g	1.3XMAWP	1.3XMAWP			
205	Design Code:. ASME SEC. VIII DIV. 1					
206	Analog Piping Study / Acoustic Simulation, As per Approach 3, Cl. 3.9.2.6 API618, 4P <sup>th</sup> edition					
207	Upstream / downstream      Inter-stage					
208	Performed By: <input type="checkbox"/> Vendor <input type="checkbox"/> Any other agency having similar experience					
209	Piping Mechanical Analysis					
210	Performed By: <input type="checkbox"/> Vendor <input type="checkbox"/> Any other agency having similar experience					
211	<input checked="" type="checkbox"/> Automatic Drain Valves For Each Stage suction KOD					
212	<input type="checkbox"/> Capacity Control					
213	<input checked="" type="checkbox"/> Start / Stop, based on discharge receiver pressure: Fully Automatic					
214	Unloading for Startup/Shut down :Automatic Through <input type="checkbox"/> Valve Unloader <input type="checkbox"/> Recycle Valve					
215	<input checked="" type="checkbox"/> Interlock against loaded start					



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216	■ Automatic Control based on				
217	<input type="checkbox"/> Suction Pressure Signal	<input checked="" type="checkbox"/> Discharge Pressure	<input type="checkbox"/> Flow Manual		
218	<input type="checkbox"/> Type of Actuator	<input type="checkbox"/> Actuation fluid to load	<input type="checkbox"/> Actuation fluid to unload		
219	■ On Power / Actuation fluid failure : Compressor to <input type="checkbox"/> Load <input checked="" type="checkbox"/> Unload				
220	■ Continuously		<input type="checkbox"/> Maximum Hrs.		
221	<input type="checkbox"/> Continuously		<input 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	<input type="checkbox"/> Intermediate Devices (Solenoid Valves   Pneumatic Relay / Valves)				
226	■ Actuators				
227	<input type="checkbox"/> Recycle valves				
228	<input type="checkbox"/> Control Logic and System for Complete Capacity Control				
229	■ Inter Connecting Tubing, Piping, Cabling & Wiring				
230	■ Protection against extended unloaded operation (Trip)				
231	<input type="checkbox"/> Valve unloaders are required as such Compressor should start / stop at specified receiver pressures.				
232	<input type="checkbox"/> Purchaser's Interface				
233	Type of Interface (Single Point)	Size	Rating	Face	Position/Locati on
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	NB <sub>2B</sub> Inlet Supply				
242	NB <sub>2B</sub> Vent (Safe location)				
243	Drains				
244	■ <b>MATERIALS</b>				
245	Cylinder Materials				
246	Stage		1 Stage	2 Stage	3 Stage
247	Cylinder				
248	<input type="checkbox"/> Liner				
249	<input type="checkbox"/> Piston				
250	Piston Rings		PTFE	PTFE	PTFE.
251	Rider Rings		PTFE	PTFE	PTFE
252	Piston Rod				
253	<input type="checkbox"/> Packings Rings				



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254	<input type="checkbox"/> Valve Seats				
250	<input type="checkbox"/> Valve Stops				
256	Valve Rings / Plates				
257	Valve Springs				
258	<input type="checkbox"/> Cylinder Head				
259	<b>Motion Work Materials :</b>				
260	Item	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 two 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	<input type="checkbox"/> <b>CONTROLS &amp; INSTRUMENTATION</b>				
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 Gas Engine				
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 Pre-lubrication				
288	Notes :				
289	Minimum required indications, alarms & 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	<b>INSPECTION AND TESTS</b>				
293	Material Composition and Physical Properties Certificates Required For:				
294	■ Cylinder and Liner	■ Piston			



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295	■ Crankshaft	■ Connecting Rod		
296	■ Pressure Vessels	■ Heat Exchangers		
297	■ 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.		■	<input type="checkbox"/>
303	■ Field Trial Run ,under Vendor's Supervision (Package)		■	■
304	■ Valve Leak Test		■	<input type="checkbox"/>
305	■ Lube Oil Console Run test		■	<input type="checkbox"/>
306	■ Closed Circuit C.W. System test		■	<input type="checkbox"/>
307	<input type="checkbox"/> During package performance test			
308	<input type="checkbox"/> Test Certificates Required For:			
309	■ Auxiliary Motor & Pumps	■ Safety Relief Valves		
310	■ Safety Switches	■ Solenoid Valves		
311	<input type="checkbox"/> 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	■ Cylinder and packing lubrication system			
321	■ Cooling system			
322	■ Process Gas system			
323	■ Local instrumentation			
323	■ Local Gauge Board			
325	■ Local Control Panel	■ PLC Panel	■ Human Machine Interface	
	located on skid			
326	■ Main driver			
327	■ Barring Device:	■ Manual	■ Electric.	Pneumatic
328	■ Flywheel			
329	■ V-Belts with Pulley			
330	■ Couplings			
331	■ Driver Compressor			
332	■ Guards for moving parts ■			
333	■ Base plate Common for Compressor and Driver			
334	■ Fabricated Steel skid Common for compressor, driver and accessories			





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335	■ Ladders and platforms
336	■ Special Tools - One Set for each package
337	■ Anchor Bolts for Complete Package
338	■ Piping supports and brackets : ■ prefabricated for piping in Vendor's Scope
339	■ Supports For Cylinders & Auxiliaries, Prefabricated & fitted in the Package
340	■ Commissioning Spares, erection and commissioning spares
341	■ Spares as specified in the Job Specification
342	■ Vendor Data as specified
343	NOTE : Refer checklist for scope of supply

**17.2 Data sheet- heat exchangers to be submitted for compressor.**

1	<b>GENERAL</b>
2	<b>PROJECT:</b>
3	<b>OWNER :</b> SITE :
4	Service : <b>Intercooler / After cooler for Compressor Package</b>
5	<b>No. Reqd.:</b>
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 <sup>2</sup> □ Bare Tube : m <sup>2</sup> □ Section/Unit :
11	□ Surface/Unit : m <sup>2</sup> □ Bare Tube : m <sup>2</sup> □ Plot Area/Unit :
12	<b>PERFORMANCE (Of One Unit)</b>
13	□ Heat Exchanged : kcal/hr □ MTD (Corrected) : °C
14	□ Transfer Rate : kcal/hr m <sup>2</sup> °C □ (Finned Surface) □ (Bare Surface)
15	<b>■ TUBE SIDE</b>
16	■ Fluid Circulated: GAS Gravity : Liquid API SG @ 15.4EC
17	■ Total Entering Gas kg/hr Enthalpy / Latent Heat kcal/kg
18	□ Operating Temperature In : Out : Fouling Resistance hr m <sup>2</sup> °C/kcal
19	□ Operating Pressure Passes / Bundle kg/cm <sup>2</sup>
20	<b>AIR SIDE</b>
21	■ Temperature ■ In: Out : ■ Altitude m:115,168.3,172respeccively
22	□ Total Flow/Unit kg/hr Static Pressure kg/cm <sup>2</sup>
23	□ Quantity/Fan kg/hr Power/Fan kW



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24	<input type="checkbox"/> Face Velocity m/sec Power/Unit kW
25	<b>CONSTRUCTION (Each Bundle)</b>
26	<input type="checkbox"/> Design Pressure : kg/cm <sup>2</sup> g <span style="float:right"><input type="checkbox"/> Test Pressure : kg/cm<sup>2</sup>g</span> <input type="checkbox"/> Design Temperature : °C
27	<input type="checkbox"/> Code Requirements :
28	■ Type of Tubing : <span style="float:right">■ Tube Material : ■ Fin</span> Material : <b>Al</b>
29	■ Tube Bare Tubes (no's): <span style="float:right"><input type="checkbox"/> No. of rows: O.D. <input type="checkbox"/></span> BWG/Thk <input type="checkbox"/> Length
30	<input type="checkbox"/> Fins: Spacing /inch. O.D. <span style="float:right"><input type="checkbox"/> Root Dia <input type="checkbox"/></span> Thickness :
31	■ Header Type: Plug / Cover <span style="float:right"><input type="checkbox"/> No. of Splits:</span> Material :
32	<input type="checkbox"/> Plugs/Gaskets <span style="float:right">■ Side Frame : <b>C.S. Inside Zinc</b></span> <b>Protected</b>
33	<input type="checkbox"/> <b>Nozzles</b> <span style="float:right">In : <input type="checkbox"/> Out : <input type="checkbox"/></span>
34	<input type="checkbox"/> <b>Couplings</b> <span style="float:right"><input type="checkbox"/> <b>Vent:</b> <input type="checkbox"/></span> Drain :
35	<b>CONSTRUCTION (Each section)</b>
36	■ Structure <b>CS</b> <span style="float:right"><input type="checkbox"/> Sec. /Gr. No. <input type="checkbox"/></span> Design Wind Load : kgf/m
37	■ Plenum Chamber <span style="float:right"><b>CS inside Zinc Protected</b></span> Type :
38	<input type="checkbox"/> Fans <span style="float:right">No. <input type="checkbox"/> Dia. <input type="checkbox"/> RPM</span> Mfr.
39	<input type="checkbox"/> Blades <span style="float:right">Material : <input type="checkbox"/> No./Fan <input type="checkbox"/></span> Pitch Angle(Design) :
40	<input type="checkbox"/> Hubs <span style="float:right">Material: <input type="checkbox"/> Pitch: Auto variable /</span> Adjustable (No.)
41	<input type="checkbox"/> Louvers <span style="float:right">Material : <input type="checkbox"/> Type : <input type="checkbox"/></span> Mfr.
42	<input type="checkbox"/> Weights kg Each Section(Dry) : <span style="float:right">Full of Water: <input type="checkbox"/></span>
43	<input type="checkbox"/> Each Bundle (Dry) : <span style="float:right">Full of Water: <input type="checkbox"/></span>
44	■ <b>APPLICABLE SPECIFICATIONS API Standard 661</b>
45	■ REMARKS 1. Air coolers should be designed for 10% excess capacity than required normally.
46	■ Exchanger should be designed with air side temperature of 44 °C.
47	■ Separate data sheet should be filled by the bidder for each service i.e. Inter cooler and After cooler

**18.0 Data Sheet of Gas Engine (Compressor) & Motor (For Air Compressor)**

**18.1 Data Sheet of Gas Engine (Compressor)**

1	GENERAL
2	<b>PROJECT: PROCUREMENT OF CNG COMPRESSORS</b>
3	<b>OWNER:</b>
4	<b>SERVICE: DRIVER FOR CNG COMPRESSOR</b>



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5	NO. REQD.:	<b>ONE FOR EACH UNIT.</b>
6	NOTE: ■ SCOPE OPTION / INFORMATION SPECIFIED BY PURCHASER □ INFORMATION REQUIRED FROM VENDOR.	
7	<b>SITE / INSTALLATION DATA</b>	
8	<b>SITE CONDITIONS:</b>	
9	<b>LOCATION:</b> ■ <b>OUTDOOR</b> ■ CLOSED ROOM WITH FORCED AIR VENTILATION SYSTEM.	
10	SITE DATA: AMBIENT TEMP. (°C):	As per site
11	RELATIVE HUMIDITY (%):	MAX : As per site
12	ALTITUDE (M):	
13	EARTH QUAKE ZONE <b>As per site</b> WIND VELOCITY (KM/HR): As per Site	
13	<b>ELECTRICAL AREA CLASSIFICATION</b>	
14	CLASS 1 GROUP D DIVISION I OR 2	
15	CLASS 1 GROUP IIA, IIB ZONE I	
16	□ <b>UTILITY DATA</b>	
17	<b>COOLING WATER</b>	
18	COOLING WATER TEMP. (°C) (DESIGN/MAX/NOR/MIN):	SUPPLY RETURN (MAX):
19	COOLING WATER PR. (KG/CM²G) (DESIGN/MAX/NOR/MIN):	SUPPLY RETURN (MIN):
20	COOLING WATER CHARACTERISTICS:	
21	□ <b>INSTRUMENT AIR:</b>	
22	SUPPLY PRESSURE (DESIGN/MAX/NOR/MIN)(KG/CM² G):	
23	□ <b>ELECTRIC POWER</b>	
24	ELECTRIC SUPPLY: AC / DC                      VOLTS:                      Ph:                      HZ:	
25	□ <b>APPLICABLE CODES &amp; STANDARDS</b>	
26	■ <b>NOISE SPECIFICATION:</b> ■ APPLICABLE TO M/C <b>MAX. 80 DBA @ 1.0 M OUTSIDE THE ACOUSTIC ENCLOSURE</b>	
27	EXHAUST GAS EMISSION: - Statutory requirements as per state and central pollution control board. Provide catalytic convertor in the exhaust of gas engine	
28	■ LISTING/APPROVAL OF ENGINE REQUIRED FROM: ■ UL/FM □ TAC	
29	■ AIR RECEIVER FOR STARTING AIR SYSTEM <b>ASME SEC-VIII DIV 1</b> □ AIR COMPRESSOR FOR STARTING AIR SYSTEM MANUFACTURER'S STD. AIR STARTER WITH SILENCER.	
30	□ SHELL AND TUBE TYPE EXCHANGERS MANUFACTURER'S STD. □ AUXILIARY PUMPS MANUFACTURER'S STD.	
31	□ AIR COOLED HEAT EXCHANGERS/RADIATOR MANUFACTURER'S STD. □ OTHER TANKS AND VESSELS MANUFACTURER'S STD.	
32	<b>DRIVEN EQUIPMENT</b>	
33	■ RECIPROCATING GAS COMPRESSOR	
34	■ DUTY: INTERMITTENT	



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35	PROBABLE PERIOD FOR CONTINUOUS RUNNING: 20 HOURS WITH FREQUENT STARTS AND STOPS
36	■ DURATION OF MAX. LOAD: 20 HOURS
37	□ MINIMUM BKW OF THE DRIVEN EQPT. KW: @ RPM:
38	□ RATED BKW OF THE DRIVEN EQPT. KW: @ RPM:
39	□ MAXIMUM BKW OF THE DRIVEN EQPT. KW: @ RPM: (@ R.V. SET PRESSURE)
40	□ FOR MECH. DRIVE APPLICATIONS: MINIMUM SITE RATING OF THE ENGINE REQUIRED KW @ RPM
41	
42	□ ACCOUNTING FOR ENGINE DERATION FOR SITE CONDITIONS & ALTERNATOR EFFICIENCY WITH ENGINE DRIVING ITS ALL AUXILIARIES.
43	□ DIRECTION OF ROTATION OF DRIVEN EQUIPMENT VIEWED FROM COUPLING END :
44	□ METHOD OF DRIVE: DIRECT THRU FLEXIBLE COUPLING OR V-BELTS
45	<b>CONSTRUCTION FEATURES</b>
46	□ MANUFACTURER: □ ENGINE MODEL:
47	■ TYPE OF ENGINE: FOUR-STROKE ENGINE COOLING : ■ WATER COOLED
48	□ TURBO-CHARGED WITH CHARGE AIR COOLER □ NORMALLY ASPIRATED
49	□ NO. OF CYLINDERS: □ CYLINDER ARRANGEMENT:
50	□ BORE/STROKE (MM/MM): □ COMPRESSION RATIO:
51	□ SPEED (RPM): □ MEAN PISTON SPEED (M/SEC.):
52	□ <b>PERFORMANCE</b>
53	RATED ENGINE POWER AT STANDARD OPERATING CONDITIONS AS PER ISO 3046/ BS 5514 ( <b>ISO STD. POWER</b> ): KW @ RPM
54	(USING ONLY THE ESSENTIAL DEPENDENT AUXILIARIES AND WITH 10 % OVERLOAD PROVISION
55	RATED ENGINE POWER AT SITE CONDITIONS GUARANTEED, NO NEGATIVE TOLERANCE): KW @ RPM
56	(USING THE ESSENTIAL DEPENDENT AUXILIARIES AND WITH 10 % OVERLOAD PROVISION
57	MIN. ENGINE SITE POWER AT, WHICH ENGINE CAN BE OPERATED CONTINUOUSLY. KW @ RPM
58	MIN. ENGINE SPEED & CORRESPONDING SITE POWER AT WHICH ENGINE CAN BE OPERATED CONTINUOUSLY. RPM @ KW
59	STARTING TIME REQUIRED FOR FULL LOAD OPERATION (SECONDS):
60	AIR FLOW REQUIRED FOR OPERATION OF THE ENGINE FOR: □ COMBUSTION & SCAVENGING □ COOLING & VENTILATION OF ENCLOSURE □ AIR COOLERS



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61	ESSENTIAL DEPENDENT AUXILIARIES ARE:				
62	ENGINE SHAFT DRIVEN RADIATOR FAN:		KW		
63	ENGINE SHAFT DRIVEN CW PUMP:		KW		
64	ENGINE SHAFT MAIN LO PUM:		KW		
65	<input type="checkbox"/> <b>SPECIFIC FUEL CONSUMPTION:</b>				
66	DESCRIPTION	FUEL CONSUMPTION, GM/KW-HR @ REFERENCE CONDITIONS *			
67		ISO 3046*	MANUFR'S. STD.*	SITE *	MANFR' S. SHOP *
68	(A) GUARANTEED ENGINE RATED POWER (100 % CONTINUOUS RATING)				
69	(B) 75 % OF (A)				
70	(C) 50 % OF (A)				
71	(D) 110 % OF (A)				
72	*STANDARD REFERENCE CONDITIONS:				
73	TOTAL BAROMETRIC PRESSURE, P, KG/CM <sup>2</sup> A				
74	ATMOSPHERIC TEMP. °C				
75	RELATIVE HUMIDITY %				
76	CHARGE AIR & COOLANT TEMP °C				
77	<input type="checkbox"/> <b>SPEED GOVERNING SYSTEM</b>				
78	TYPE:	<input type="checkbox"/> SINGLE SPEED	<input type="checkbox"/> MULTIPLE SPEED	<input type="checkbox"/>	<input type="checkbox"/>
79	GOVERNOR TYPE:	<input type="checkbox"/> ELECTRONIC	<input type="checkbox"/> ELECTRO HYDRAULIC	<input type="checkbox"/>	<input type="checkbox"/>
80	■ MAKE: WOODWARD	<input type="checkbox"/> MODEL:			
81	GOVERNOR ONTROL MECHANISM:	REMOTE	<input type="checkbox"/> MANUAL	<input type="checkbox"/>	<input type="checkbox"/>
82	<input type="checkbox"/> <b>STARTING SYSTEM</b>				
83	■ METHOD OF STARTING: AUTOMATIC				
84	■ METHOD OF STOPPING: AUTOMATIC				
85	<input type="checkbox"/> TYPE OF COLD STARTING:	(CONSIDERING MIN. AMBIENT TEMP			
86	■ TYPE OF STARTING SYSTEM:	AIR	STARTING	THROUGH	
87	<b>REMARKS:</b>				



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88	<b>1. BIDDER SHOULD ENGINEER AND SUPPLY THE COMPLETE AIR STARTING MECHANISM INCLUDING AIR COMPRESSOR, AIR RECEIVER.</b>
89	<b>THE PURCHASER SHALL PROVIDE ELECTRICITY FOR AIR COMPRESSOR MOTOR.</b>
90	<b>■ STARTING AIR SYSTEM: (TO BE PLACED OUTSIDE THE ENCLOSURES)</b>
91	<b>■ AIR COMPRESSOR TYPE: RECIPROCATING</b>
92	<input type="checkbox"/> RATED CAPACITY (M <sup>3</sup> /HR AT INLET CONDITIONS):
93	<input type="checkbox"/> DISCHARGE PRESSURE (KG/CM <sup>2</sup> G):
94	<input type="checkbox"/> BKW: <span style="float:right"><input type="checkbox"/> RPM:</span>
95	<b>■ AIR COMPRESSOR DRIVEN BY: ELECTRIC MOTOR</b>
96	<input type="checkbox"/> DRIVER RATING <span style="float:right"><input type="checkbox"/> KW:</span> <span style="float:right"><input type="checkbox"/> RPM:</span> <span style="float:right"><input type="checkbox"/></span> <b>VOLTS/N/HZ.: 230/ SINGLE/ 50</b>
97	<b>■ AIR RECEIVER WITH RELIEF VALVE &amp; MANUAL DRAIN VALVE:</b>
98	<b>■ START-STOP SWITCH FOR COMPRESSOR: <span style="float:right">AUTOMATIC</span></b>
99	<input type="checkbox"/> NO. OF AIR RECEIVER: ONE /TWO <span style="float:right">CAPACITY OF</span> <input type="checkbox"/> EACH AIR RECEIVER (M <sup>3</sup> ):
100	
101	<b>■ COOLING SYSTEM</b>
102	TYPE: <span style="float:right">CLOSED CIRCUIT COOLING</span>
103	WATER PUMP DRIVEN BY: <span style="float:right">ENGINE</span>
104	COOLANT CIRCUIT PIPING WITH TEMP. CONTROL & MAKE-UP TANK.
105	HEAT EXCHANGER WITH ANCHOR/FOUNDATION BOLTS: AIR COOLED EXCHANGER
106	BY-PASS VALVE: <span style="float:right">CHECK VALVE:</span>
107	HEAT EXCHANGER TEMP (°C) INLET: OUTLET:
108	<b>■ FAN DRIVEN BY: DRIVER <span style="float:right"><input type="checkbox"/> RATING/SPEED</span></b> (KW/RPM):
109	<input type="checkbox"/> ENGINE WATER TEMP (°C): <span style="float:right">INLET:</span> OUTLET:
110	<b>PACKAGER MAY CLUB THE ENGINE JACKET AND COMPRESSOR CYLINDER COOLING WATER SYSTEM WITH ENGINE SHAFT OR COMPRESSOR SHAFT DRIVEN PUMP</b>
111	<b>■ FRAME LUBRICATION SYSTEM</b>
112	<b>■ TYPE: FORCE FEED LUBRICATION INCLUDING VALVES, OIL PUMP &amp; PIPING</b>
113	<input type="checkbox"/> OIL COOLER TYPE: <input type="checkbox"/> <span style="float:right"><input type="checkbox"/> AIR COOLED</span> <input type="checkbox"/> WATER COOLED
114	<input type="checkbox"/> OIL FILTERS <span style="float:right"><input type="checkbox"/> SELF CLEANING</span> <input type="checkbox"/> DUPLEX <input type="checkbox"/> PAPER CARTRIDGE
115	<input type="checkbox"/> PRELUBE OIL PUMP DRIVEN BY (IF REQUIRED):
116	<input type="checkbox"/> PRELUBRICATION <span style="float:right"><input type="checkbox"/> MANUAL</span> <input type="checkbox"/> AUTOMATIC
117	<input type="checkbox"/> TYPE/GRADE OF LUB. OIL:
118	<input type="checkbox"/> OIL CONSUMPTION (LPH):
119	<input type="checkbox"/> OIL SUMP CAPACITY (LITRES):
120	<input type="checkbox"/> OIL COOLER TESTING PRESSURE (KG/CM <sup>2</sup> G):
121	<input type="checkbox"/> EXPLOSION RELIEF VALVE FOR CRANKCASE
122	<b>■ AIR INLET SYSTEM</b>



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123	<input type="checkbox"/> SUCTION AIR FILTER <input type="checkbox"/> AIR INLET DUCTING / PIPING / MANIFOLDS <input type="checkbox"/> INLET SILENCER
124	EXPANSION BELLOWS (IF REQUIRED) & ALL SUPPORTS / HANGERS
125	<b>ENGINE EXHAUST SYSTEM</b>
126	<input type="checkbox"/> EXHAUST MANIFOLDS / DUCTING / PIPING TERMINATED AT SAFE HEIGHT OUTSIDE ENGINE ENCLOSURE EXHAUST SILENCER (RESIDENTIAL TYPE)
127	<input type="checkbox"/> EXPANSION BELLOWS <input type="checkbox"/> EXHAUST STACK / CHIMNEY <input type="checkbox"/> ALL SUPPORTS / HANGERS <input type="checkbox"/> PROTECTION INSULATION FOR COMPLETE EXHAUST PIPING
128	<input type="checkbox"/> PROVIDED AS ABOVE <span style="float:right"><input type="checkbox"/> YES</span> <input type="checkbox"/> NO
129	<input type="checkbox"/> <b>CONTROLS &amp; INSTRUMENTATION</b>
130	<b>ELECTRIC SUPPLY:</b>
131	LAMPS: ± V:                      AC/DC:                      N:                      ± HZ:
132	ALARM CIRCUIT: ± V:                      AC/DC:                      N:                      ± HZ:
133	TRIP CIRCUIT: ± V:                      AC/DC:                      N:                      ± HZ:
134	CONTROL CIRCUIT:  ± V:                      AC/DC:                      N:                      ± HZ:
135	SOLENOID VALVES: ± V:                      AC/DC:                      N:                      ± HZ:
136	CONTROL SWITCHES:
137	<input type="checkbox"/> AC POWER ON/OFF SWITCH WITH INDICATION LAMP
138	<input type="checkbox"/> CONTROL POWER ON/OFF SWITCH WITH INDICATION LAMP
139	<input type="checkbox"/> START SWITCH WITH INDICATION YES
140	<input type="checkbox"/> START/STOP PUSH BUTTON FOR AUX. DRIVE MOTOR
141	<input type="checkbox"/> EMERGENCY STOP PUSH BUTTON
142	<input type="checkbox"/> LAMP TEST PUSH BUTTON
143	<input type="checkbox"/> ALARM/TRIP ACKNOWLEDGE /RESET PUSH BOTTON YES
144	<input type="checkbox"/> LUBRICATING OIL HEATER 'ON' INDICATING LAMP (IF PROVIDED)
145	<input type="checkbox"/> INTERLOCK AGAINST START WITHOUT PRELUBRICATION
146	
147	<b>NOTE: VENDOR TO PROVIDE CONTACT/SIGNAL FOR EXECUTION IN DCS.</b>
148	<input type="checkbox"/> <b>MATERIAL</b>
149	CHARGE AIR COOLER      SHELL:                      TUBES:
150	WATER COOLER              SHELL:                      TUBES:
151	AIR COOLER                      SHELL:                      TUBES:
152	AIR RECEIVER
153	
154	<b>INSPECTION AND TESTING</b>
155	WITNESS <input type="checkbox"/> OBSERVE BY SUPPLIER <input type="checkbox"/>
156	<input type="checkbox"/> STAGE INSPECTION DURING MANUFACTURE
157	<input type="checkbox"/> FULL LOAD TEST AT ENGINE MANUFACTURER'S SHOPAS PER ISO (PERFORMANCE TEST)



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158	<input type="checkbox"/> FUEL CONSUMPTION & GOVERNING TEST AT ENGINE MANUFACTURER'S SHOP AS PER ISO
159	<input type="checkbox"/> FULL LOAD TEST FOR 4 HRS FOR GAS ENGINE WITH ALL AUXILIARIES & 1 HR @ 110 % LOAD AT SITE.
160	<input checked="" type="checkbox"/> NO LOAD MECHANICAL RUN TEST AT PACKAGER'S / DRIVEN EQUIPMENT MFR. SHOP
161	<input checked="" type="checkbox"/> VENDOR'S STANDARD MECHANICAL RUN TEST (FOR ALL ENGINE)
162	INSPECTION/TESTING WITNESSED BY: <input type="checkbox"/> OTHERS <input checked="" type="checkbox"/> Client OR THEIR REPRESENTATIVE
163	<input type="checkbox"/> <b>WEIGHTS</b>
164	NET WEIGHT OF ENGINE WITH MOUNTED ANCILLARIES (KG):
165	HEAVIEST PART TO BE HANDLED DURING ERECTION AND ITS WEIGHT (KG):
166	HEAVIEST PART TO BE HANDLED DURING NORMAL MAINTENANCE AND ITS WEIGHT (KG):
167	RECOMMENDED CRANE CAPACITY (TONS): <span style="float:right">CRANE</span> HOOK HEIGHT (M):
168	<input type="checkbox"/> <b>MAINTENANCE DATA</b>
169	EXPECTED PERIOD OF RUNNING BETWEEN TOP OVERHAULS: HOURS
170	EXPECTED PERIOD OF RUNNING BETWEEN MAIN OVERHAULS: HOURS
171	THE TYPE AND GRADE OF LUBRICATING OIL RECOMMENDED:
172	LUBE OIL CONSUMPTION (KG/HR)/ (LITRES/HR)
173	CHANGE OF LUBRICATING OIL AFTER: HOURS
174	<input checked="" type="checkbox"/> <b>SCOPE OF SUPPLY / WORK</b>
175	ENGINE WITH LUBRICATION SYSTEM, GOVERNING SYSTEM, FUEL SYSTEM, COOLING SYSTEM AND STARTING SYSTEM AS SPECIFIED
176	SUCTION AIR FILTER WITH SUCTION PIPING
177	INSTRUMENTS AND CONTROLS AS SPECIFIED
178	INLET AND EXHAUST MANIFOLDS, EXHAUST PIPING WITH FILLINGS, BENDS AND INSULATION
179	EXHAUST SILENCER (RESIDENTIAL, SPARK ARRESTING TYPE) WITH EXPANSION BELLOWS AND COMPLETE WITH EXHAUST PIPING FROM
180	MANIFOLD TO OUTSIDE SHED WITH FITTINGS AND INSULATION.
181	FLYWHEEL WITH BARRING DEVICE
182	GUARDS FOR MOVING PARTS
183	COUPLING FOR ENGINE - DRIVEN EQUIPMENT
184	BASE PLATE FOR ENGINE & DRIVEN EQUIPMENT
185	SPARES AS PER ORDER
186	ERECTION AND COMMISSIONING SPARES
187	TORTIONAL ANALYSIS REPORT ON ENGINE
188	REFER TECHNICAL SPECIFICATION FOR COMPLETE SCOPE OF SUPPLY
189	FOUNDATION/ ANCHOR BOLTS
190	ANTI VIBRATION PADS
191	FIRST FILL OF LUBRICATING OIL AND COOLANT.
192	ACCOUSTIC ENCLOSURE WITH FORCED VENTILATION FAN





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188	
193	
194	<b>REMARKS</b>
191	
192	

**18.1 DATA SHEET OF AIR COMPRESSOR MOTOR:**

1	Project name:	
2	Driven equipment	Air Compressor
3	Tag No. / Equipment No.	
4	Duty	
5	Manufacturer	
6	Motor Duty & Type	
7	Frame Size/Mounting	
8	Output _____ KW	
9	Voltage _____ VOLT	415 V+/- 10%
10	Full load current _____ AMP	
11	Starting current with star delta starting _____ AMP	
11	Full load speed _____ RPM	
12	Enclosure	TEFC/FLAMEPROOF/IP55 AS PER IS:4691-1985
13	Mounting	
14	Insulation Class	F' – Temp. rise limited to Class – 'B'
15	Ambient temperature _____ °C	47
16	Temp. Rise by resistance _____ °C	
17	Applicable Code	
18	Full load torque _____ Kg-m	
19	Starting torque _____ FLT	
20	Efficiency at _____ 100% Load	
	_____ 75% Load	
	_____ 50% Load	
21	Rotation viewed from DE	
22	Bearing type No.	
23	Type of Lubrication	
24	Coupling / pulley	DIRECT / FLEXIBLE



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25	Net weight (approximate) _____kg	
26	Cable size / type _____ mm sq.	
27	Phase / connection / No. of terminal	
28	Frequency _____ Hz.	50 Hz + / - 5%
29	No. of poles _____	
30	Locked rotor current _____%FLC	
31	LR withstand time (HOT) _____Sec	
	(COLD) Sec	
32	Stator / rotor time constant _____Min	
33	Power factor at – 100% Load	
	- 75% Load	
	- 50% Load	
34	Break down or pull out torque ____ %FLT	
n35	Space heaters _____WATT / VOLT	
36	Vibration Level / Noise Level	As per IS12065 / IS12075

**19.0 Operating Conditions & Experience Record Of Compressor (1200 SCMH)**

**19.1 Compressor Suction Pressure: 14 kg/cm<sup>2</sup>(g)**

Sl no		Units	Stage 1	Stage 2	Stage 3
S1	■ Gas Handled (See Analysis)				
2	□ Corrosion Due to		<b>NONE</b>	<b>NONE</b>	<b>NONE</b>
3	<b>Suction Conditions</b>				
4	■ Pressure (@ Vendor's B/L)	kg/cm <sup>2</sup>	<b>14</b>		
5	■ Temp. (+@ Vendor's B/L)	°C	<b>30</b>		
6	<b>Discharge Conditions</b> (Vendor's Battery Limit :				
7	■ Pressure (@ Vendor's B/L)	kg/cm <sup>2</sup>			
8	Pressure @ Cylinder Flg.	kg/cm <sup>2</sup>			
9	Temp., Adiabatic @Cyl. Flange	°C	<b>&lt;150</b>	<b>&lt; 150</b>	<b>&lt;150</b>
10	Temp., Actual @Cyl.Flange	°C			



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11	Temp.,After Cooler	After	°C			
12	Cp/Cv Ratio					
13	Compr. Factor (ZB <sub>2B</sub> ) or (Z avg)					
14	<b>Operating Characteristics</b>					
15	Capacity (wet)		SM <sup>3</sup> /Hr			
16	Mfr's Rated Cap. (Design)		(No –vetol.)			
17	Actual Inlet Flow (wet)		SM <sup>3</sup> /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 <sup>2</sup> / mm <sup>2</sup>			
23	Valve Velocity		m/sec			
24	Compressor Speed		RPM			
25	Gas engine sped in		RPM			
26	Compressor Shaft Power ( without cooling fan )		KW			
27	Compressor Shaft Power KW @ RV Set Pr.		KW			
28	Transmission efficiency		%			
29	Gas engine heat rate		Kcal/ Kwh			
30	Driver Power		KW			
31	Kcal required by gas engine to drive compressor per hour slno( 26*29/28)		KW			
32	Kcal required by gas engine per hour to drive fan and other auxiliaries.		KW			
33	Specific gravity of gas					

**19.2 Compressor Suction Pressure: 16 kg/cm<sup>2</sup>(g) (Guaranteed Clause)**

Sl no		Units	Stage 1	Stage 2	Stage 3
1	<input checked="" type="checkbox"/> Gas Handled (See Analysis)				
2	<input type="checkbox"/> Corrosion Due to		<b>NONE</b>	<b>NONE</b>	<b>NONE.</b>
3	<b>Suction Conditions</b>				
4	<input checked="" type="checkbox"/> Pressure (@ Vendor's B/L)	kg/cm <sup>2</sup>	<b>16</b>		



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5	■ Temp. (+@ Vendor's B/L)	°C	<b>30</b>		
6	<b>Discharge Conditions</b> (Vendor's Battery Limit :				
7	■ Pressure (@ Vendor's B/L)	Kg/cm <sup>2</sup> (G)			
8	Pressure @ Cylinder Flg.	Kg/cm <sup>2</sup>			
9	Temp., Adiabatic @Cyl. Flange	°C	<b>&lt;150</b>	<b>&lt; 150</b>	<b>&lt;150</b>
10	Temp.,Actual @Cyl.Flange	°C			
11	Temp.,After After Cooler	°C			
12	Cp/Cv Ratio				
13	Compr. Factor (ZB <sub>2B</sub> ) or (Z avg )				
14	<b>Operating Characteristics</b>				
15	Capacity (wet)	SM <sup>3</sup> /Hr			
16	Mfr's Rated Cap. (Design)	(No –vetol.)			
17	Actual Inlet Flow (wet)	SM <sup>3</sup> /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 <sup>2</sup> / mm <sup>2</sup>			
23	Valve Velocity	m/sec			
24	Compressor Speed	RPM			
25	Gas engine sped in	RPM			
26	Compressor Shaft Power ( without cooling fan )	KW			
27	Compressor Shaft Power KW @ RV Set Pr.	KW			
28	Transmission efficiency	%			
29	Gas engine heat rate	Kcal/ Kwh			
30	Driver Power	KW			
31	Kcal required by gas engine to drive compressor per hour slno ( 26*29/28)	KW			
32	Kcal required by gas engine per hour to drive fan and other auxiliaries.	KW			
33	Specific gravity of gas				

**19.3 Compressor Suction Pressure : 19kg/cm<sup>2</sup>(g) :**

Sl no		Units	Stage 1	Stage 2	Stage 3
1	■ Gas Handled (See Analysis)				
2	□ Corrosion Due to		<b>NONE</b>	<b>NONE</b>	<b>NONE</b>



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3	<b>Suction Conditions</b>				
4	■ Pressure (@ Vendor's B/L)	kg/cm <sup>2</sup>	<b>19</b>		
5	■ Temp. (+@ Vendor's B/L)	°C	<b>30</b>		
6	<b>Discharge Conditions</b> (Vendor's Battery Limit :				
7	■ Pressure (@ Vendor's B/L	kg/cm <sup>2</sup>			
8	Pressure @ Cylinder Flg.	kg/cm <sup>2</sup>			
9	Temp., Adiabatic @Cyl. Flange	°C	<b>&lt;150</b>	<b>&lt; 150</b>	<b>&lt;150</b>
10	Temp.,Actual @Cyl.Flange	°C			
11	Temp.,After After Cooler	°C			
12	Cp/Cv Ratio				
13	Compr. Factor (ZB <sub>2B</sub> ) or (Z avg )				
14	<b>Operating Characteristics</b>				
15	Capacity (wet)	SM <sup>3</sup> /Hr			
16	Mfr's Rated Cap. (Design)	(No –vetol.)			
17	Actual Inlet Flow (wet)	SM <sup>3</sup> /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 <sup>2</sup> / mm <sup>2</sup>			
23	Valve Velocity	m/sec			
24	Compressor Speed	RPM			
25	Gas engine sped in	RPM			
26	Compressor Shaft Power ( without cooling fan )	KW			
27	Compressor Shaft Power KW @ RV Set Pr.	KW			
28	Transmission efficiency	%			
29	Gas engine heat rate	Kcal/ Kwh			
30	Driver Power	KW			
31	Kcal required by gas engine to drive compressor per hour slno ( 26*29/28)	KW			
32	Kcal required by gas engine per hour to drive fan and other auxiliaries.	KW			
33	Specific gravity of gas				

**20.0 Experience Record Programme Of Gas Engine Driven Compressor For 1200 SCMH**

SI. No.	Description	INFORMATION OF OFFERED COMPRESSOR
	REQUIREMENT AS PER TENDER	



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Sl. No.	Description	INFORMATION OF OFFERED COMPRESSOR
1	a) Status of bidder (Indicate packager or agent of packager)	
	b) In case bidder is the agent submit the agreement of agent ship/dealership with packager.	
2	<b>COMPRESSOR</b>	
	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-618	
	Lubricated or non-lubricated	
	Nos of stages	
	Max stage temperature deg C ( 150)	
	Compressor Operating RPM ( max RPM-1500 )	
	Piston speed ( 4.5 m/s lub)	
	Compressor maximum vibrations at cylinders and at frame shall not exceed 10 mm /sec. And 5 mm/s respectively unfiltered peak velocity	
	<b>Material for all stages</b>	
	Cylinder	
	Piston Rings	
	Rider Rings	
	Piston Rod	
	Valve (Rings / Plates/ spring)	
3	<b>PERFORMANCE OF COMPRESSOR</b>	
<b>CASE-L</b>	Performance of compressor at 14 kg/cm <sup>2</sup> (g) suction pr, 250 kg/cm <sup>2</sup> (g)discharge pr and 30 deg c suction temperature	
<b>CASE-G</b>	Performance of compressor at 16 kg/cm <sup>2</sup> (g) suction pr, 250 kg/cm <sup>2</sup> (g)discharge pr and 30 deg c suction temp	
<b>CASE-H</b>	Performance of compressor at 19 kg/cm <sup>2</sup> (g) suction pr, 250 kg/cm <sup>2</sup> (g) discharge pr and 30 deg c suction temp	
	a) Capacity Sm <sup>3</sup> /h	<b>CASE-L</b>
		<b>CASE-G</b>
		<b>CASE-H</b>



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Sl. No.	Description	INFORMATION OF OFFERED COMPRESSOR
	<b>b) BKW required by compressor including compressor's lube oil pump BKW at RV set pressure</b>	<b>CASE-L</b>
		<b>CASE-G</b>
		<b>CASE-H</b>
	<b>c) BKW required by compressor including compressor's lube oil pump BKW at RV set pressure</b>	<b>CASE-L</b>
		<b>CASE-G</b>
		<b>CASE-H</b>
	<b>d2) Power required for all heat exchanger fans including radiator fan of engine in Kw</b>	<b>CASE-L</b>
		<b>CASE-G</b>
		<b>CASE-H</b>
	<b>e) Ventilation fans for enclosure</b> No of fans Type of fans (induced or forced draft) Power required for all ventilation fans in Kw	
	Capacity of gas engine (max of b+ max of d2 +e above) *1.1	
	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: Design	
	----Cross head pin loading :calculated at safety set pr condition	
	<b>Gas Engine</b>	
	Make and model	
	Anticipated Life in running hours	
	Compression ratio	
	Power ( ISO power) & corresponding Max RPM	
	Power ( ISO) and corresponding Operating RPM	
	Site power ( kW) at operating RPM after deration	



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Sl. No.	Description	INFORMATION OF OFFERED COMPRESSOR
	KW of engine with availability of 10 % overload for one hour within a period of 12 hrs operation with no negative tolerance.	
<b>5</b>	<b>PACKAGE</b>	
	Name of packager	
	Place of packaging	
	Name of enclosure manufacturer	
	Place of enclosure manufacturing	
	Sound level at 1 m distance from package in db(A) – 80	
	Make & model LEL detector	
	Make & model fire detector	
	Co2 flooding system ( 2 cylinder each of 100% capacity required)	
	Quantity of CO2 in each cylinder in Kg	
	Volume of enclosure in m3	
	Min 3 Nos of explosion proof tube light	
	Coupling Direct/V-belt	
	Separators between inter stage of compressor	
<b>6</b>	<b>Gas inlet train</b>	
	WNRF, 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 filter	
	Inlet manual isolation valve	
	Inlet automatic isolation valve	
<b>7</b>	<b>Gas recovery system</b>	
	Gas recovery system with pressure relief valve, pressure regulator, pressure gauge, manual & automatic drainage system	
<b>8</b>	<b>Gas delivery system</b>	
	High pr piping with SS 316 tubing, compression 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. Residual Oil Contents shall be less than 1 PPM.	
	Discharge isolation valve	





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Sl. No.	Description	INFORMATION OF OFFERED COMPRESSOR
	PLC based Priority panel with SS 316 double ferrule compression fittings, tubing, and full bore valve ball. Indicate no's of banks	
	Mass flow meter: Coriolis principle; interfaced with PLC; head mounted integral local display to indicate flow rate (Kg/hr), cumulative gas compressed (in Kgs) etc.; inbuilt totalizer non-volatile & non-resettable type ; suitable for hazardous area classification ; One at compressor discharge One at compressor inlet One for engine fuel gas	
	Final gas outlet connection from priority panel 3/4" ( 1" for bus ) pipe OD SS double ferrule compression fittings.	
9	ESD system	
10	<b>Volume bottles/ dampers at each compressor stage of compressor.</b>	
11	Drainage system :Manual isolation valve and automatic valves	
12	<b>Heat exchanger:</b> The gas and water sections shall not be "U" Code stamped but TPI inspected.	
13	Piping between stages shall be continuous with flange and welded connection or SS316 L tubing with ferrule fittings.	
18	Instrument air tubing shall be SS 316	
20	Area classification; "Class 1, Group D, Division 1 as per NEC" OR "Zone 1, Group IIA /IIB as per IS/ IEC"	
	Instruments.	
	Engine	
22	The size of the complete package	
23	Beam for chain pulley block with Chain pulley block ( indicate cap of chain pulley block )	
24	Acoustic and pulsation study	
25	Separate Acoustic enclosure for engine and compressor or only one.	
26	Instrumentation are as per tender.	
27	The offered compressors and gas engine and auxiliaries are new.	
28	Human-machine interfacing unit (MMI	
29	String test at shop	
30	Field trial run at site	
31	Electric power requirement (purchaser will give electric power for air compressor, ventilation fans and compressor controls)	



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Sl. No.	Description	INFORMATION OF OFFERED COMPRESSOR
	List out if any deviation w.r.t. tender.	
	Other information of existing compressor package :	
	<b>a)</b> Year of manufacturing / packaging the compressor package	
	<b>b)</b> Name and address of user with FAX no ,Phone no , E-mail address	
	<b>c)</b> No's of hours the compressor have clocked on bid due date. ( Enclose certificate from user)	
	<b>d)</b> Documentary evidence that the bidder/ manufacturer or packager having the capability and facilities (i.e. shop, manpower, testing facility etc.) for manufacturing / packaging compressor packages.	
	<b>e)</b> 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 gas engine driven compressor package	



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**21.0 QUALITY ASSURANCE PLAN AND CONTROL:**

The supplier shall perform all test and inspection as per tender and as per this quality assurance plan.

<b>CUSTOMER'S REF..... :</b>  <b>REF..... :</b>  <b>COMPRESSOR MODEL.....:</b>
--

Sl. No.	Description	D	R	TW	W	
	<b>Compressor</b>					
	Material TC for : crank shaft, connecting rods, cylinder, liner piston (compliance report/ certificate)	Yes	Yes	-	-	
	Hydro test of cylinder heads	Yes	Yes	-	-	
	Hydro test of pressure vessels (at sub-vendor works)	Yes	Yes	-	-	
	Ultrasonic test of – crank shaft, connecting rod,piston rod. (refer note: 1)- (MFR's compliance report/ certificate)	Yes	Yes	-	-	
	End clearance of the cylinders, piston rod run out	Yes	Yes	-	-	
	No load mechanical run test as per manufacturers standard (4 hours test at packager's end)	Yes	Yes	-	-	
	Strip check and internal inspection after "NLMRT" of all compressors –Refer note: 2 at packager's end	Yes	Yes	-	-	
	<b>Engine</b>					
	Manufacturers' compliance report	Yes	Yes	-	-	
	Dimension and Visual Inspection Report as per drawing	Yes	Yes	-	-	
	Material test certificates for RAW Material (Pressure Parts)	Yes	Yes	-	-	
	Radiography of pressure vessels at applicable	Yes	Yes	-	-	
	Hydro test of pressure vessels	Yes	Yes	-	-	
	Final painting and cleaning	Yes	Yes	-	-	
	<b>Heat Exchangers (at sub-vendor works)</b>					
	WPS / PQR – Welder Qualification	Yes	Yes	-	-	
	Material test certificates for RAW material (pressure parts)	Yes	Yes	-	-	
	Dimension and visual inspection report as per drawing / Data Sheet	Yes	Yes	-	-	



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	Radiography of heat exchangers as applicable	Yes	Yes	-	-	
	Hydro test of heat exchangers	Yes	Yes	-	-	
	Final painting and cleaning	Yes	Yes	-	-	
	<b>Control Panel and Soft Starter</b>	Yes	Yes	Yes		
	Dimensions / visual as per drawing	Yes	Yes	-	Yes	
	Functional test	Yes	Yes	-	Yes	
	<b>Instrumentation</b>					
	Manufacturers test certificates / calibration certificates of meas. Instruments for transmitters, gauges, switches & safety valve, filter, SS tubes, chain pulley block, acoustic material, pipe, fittings, flanges, fastners, valves, etc.	Yes	Yes	-	-	
	Manufacturers' test certificates	Yes	Yes	-	-	
	PLC/HMI	Yes	Yes	-	Yes	
	<b>Acoustic Encloser</b>					
	Surface preparation after cleaning & prior to primer painting, dimensions / visual as per drawing	Yes	Yes	-	-	
	Assembly check as per P&ID for each package	Yes	Yes	-	Yes	
	Mechanical string test with Natural Gas for each package.	Yes	Yes	-	Yes	
	Field trial run at site for each package after commissioning.	Yes	Yes	-	Yes	
	Package performance test at site for each package.	Yes	Yes	-	Yes	

**LEGENDS :** **D** = Documents to be submitted by vendor / sub-vendor ; **R** = Review of documents by client/consultant; **TW** = witness by third party; **W** = Witness by client or consultant/ Third Party in case of foreign bidder.

**NOTES:**

- |   |   |
|---|---|
| 1 | Crank Shaft, Connecting Rod : UT / MPT shall be conducted 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 | If bidder is only packager and not manufacturer of main CNG compressor the standard QAP of compressor OEM with test report of compressor and motor from manufacturer or as witnessed by TPE appointed by manufacturer shall be accepted<br>The final QAP of the successful bidder shall be submitted for review / approval of client / Consultant . Any testing / inspection activity felt appropriate by Client / consultant during Detailed engineering shall be incorporated in the final QAP. |



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**22.0 PREFERRED MAKES:**

**Preferred makes of equipment shall be as follows:**

Sl. No.	Item description	Preferred Makes
1.	FLP motors	ABB / Compton Greaves / Kirloskar / Siemens / Bharat Bijlee/ Weg/ Marelli/LHP
2	FLP Switchgear	Baliga/ FCG/ FPE / Flexpro/ Sudhir
3	Switches/fuses/contactors	L & T/ GEC/ Siemens/ Schneider
4	Push Button	L & T/ Vaisno/Technik
5	MCCB	Siemens/ Legrand/Schnieder
6	Vibration switch	Robertshaw Control/ Murphy/Metrix
7	PLC	Rockwell Automation/ GE Fanuc/ Siemens/ Allen Bradley / L&T/Telemechnique/ LHP /ABB PHOENIX
8	IR Gas detectors	General Monitors / Crowcon / Honeywell / Sieger / Detronics/ Khrome Schroder / Net safety/ESP Safety Pvt. Ltd/M/s Oldham, Honeywell Net Safety General Monitors/ MSA/ Crow On /SIEGER/ ESP Safety
9	UV Flame detectors / Surge Protectors	General Monitors / Crowcon / Honeywell / Sieger/ Detronics / Khrome Schroder/ Net safety/ Esp Safety Pvt. Ltd/M/S Oldham, Spectrex Detronics Honeywell Net Safety Crow On Sieger Isolators Barriers Esp Safety, Meggitt Avionics
10	Mass Flow meter	Micromotion CNG 50 , Endress&HauserCNGmass DCI,EMERSON PROCESS MANAGEMENT, MAGNETROL, PROCESS CONTROL DEVICES (PCD)
11	Pressure Transmitter	Druck/ Wika/ Honeywell/ ABB/Fisher/Rosmount/ Yokogowa/BAUMER/WAAREE
12	Pressure Regulator & Slam Shut Valve	M/s Pietro Fiorentini S.p.A. (Italy)/ M/s Emerson Process Management/ M/s RMG-RegelMesstechnik (Germany) / M/s Mokveld Valves BV(Netherlands)/ Tartarini / Fisher /M/s Gorter Controls (Netherlands)/M/s Dresser/ Nirmal /M/s Vanaz
13	Pressure Safety Valve	M/s BHEL, OFE & OE Group (New Delhi)/ M/s Keystone Valves (India) Pvt. Ltd. Baroda/



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		M/s Sevim Sarasin Valves India (P) Ltd. (New Delhi/ Halol-Gujarat)/ M/s Tyco Sanmar Ltd. (New Delhi/ M/s Parcol SPA, Italy/ M/s Nuo pignone, Italy/ M/s Sarasin, France/ M/s Tai Milano SPA, Italy/ M/s Fisher Rosemount (Now M/s Emerson Process) Singapore/ Mercer USA/ M/s FaingerLeser., Alsthom Fluids Sapag Anderson Greenwood Crosby Bhel (Trichy ) Aspro, Dresser Inc. Fukui Seisakusho Co. Ltd. Instrumentation Ltd. (Palghat) Nakakita Seisakusho Co Ltd. Nuovo Pignone Spa (Italy) Parcol Spa Safety Systems Ur Ltd. Sarasin Rsbid Sebin Valves India Pvt. Ltd. Tai Milano Spa Tyco Sanmar Ltd. Tyco Valves & Controls India Pvt. Ltd Farinosla Fainger Laser Mercer Fisher Rosemount (Emerson) Ofe & Oe Group Keystone Valves Pvt. Ltd Baroda Sevim Valves Pvt. Ltd. Halol
14	Pressure Gauges & Temperatures Gauges.	M/s AN Instruments Pvt. Ltd., New Delhi/ M/s General Instruments Ltd., Mumbai/ M/s WIKA/M/s,Altop Badotherm Process Instruments B. V. Bourdon Haenni S.A British Rototherm Co. Ltd Budenberg Guage Co. Ltd. Dresser Inc. General Instruments Consortium Manometer (India) Pvt. Ltd. Nagano Keiki Seisakusho Ltd. Waaree Instruments Limited Baumer Walchandnager Industries Ltd. Wika Alexander Wiegand & Co Gmbh Wika Instruments India Pvt. Ltd. Druck Ashcroft Filtration Technique Beko, YIL, Ashcroft Baumer
15	RTDs :	M/s General Instruments Ltd. Mumbai/ M/s Nagman Sensors (Pvt.) Ltd./ M/s Pyro Electric, Goa/ Altop/ WIKA /SIEMENS/ WAREE/ BAUMER/ YIL
16	SS Tubes for CNG application	M/s Sandvik, Sweden/ M/s Tubasax/ M/s Ratnamani Metals & Tube, M/s Parker, M/s FAE
17	SS tube Fittings/ On Off SS ball/ needle/ non-return valve for CNG application	M/s Swagelok (USA)/ M/s Parker (USA)/ M/s Hoke (Circore Instruments)/ M/s Hamlet/ M/S SSP/M/S BMT Korea/ HYLOK/ M/s Dk-Lok, ABAC/ VOSS
18	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/ PARKER/ STAUFF
19	Solenoid Valve/ Actuator	M/S ASCO / M/S Rotex / M/S Parker Hanifen/M/S Swagelok, Alcon Alexander Controls Limited Asco (India) Limited Jeffersons Asco Joucomatic Ltd.



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		Asco Joucomatic Sa Avcon Controls Pvt. Ltd. Barksdale Inc. Blue Star Ltd. Herion Werke Schrader Scovill Duncan Limited Rotex Automation Limited, Operated Valves Asco Parker Hanifen Habonim Vass Festo Compac New Zealand Micromecanic/ EI-O-Matic
20	Cables and wires	INCAB/ Universal/ ASEAN/CCI/ Duracab/ FORT Gloster/ Finolex/ KEI/ Hylite/ Polycable/ Associated cables/ HAVELLS
21	Barrier/ Isolators/Surge protector	MTL / Phoenix / P&F
22	Air exchanger	GEI HamonInd Ltd/ GEA India / Patel Air temp / M/s Kirloskar Pneumatic Co. Ltd./CP
23.	SMPS	Telemecanique (Schneider)/ Siemens/Phoenix
24.	Pressure & Temperature Switch	Orion/Switzer/Danfoss /Wika /IFM /INFOS/ CCS
25	Air Filter Regulator	Asea Brown Boveri Ltd. Blue Star Ltd Divya Control Elements Pvt. Ltd. Placka Instruments & Controls Pvt. Ltd Shah Pneumatics Shavo Norgren (I) Pvt. Ltd Veljan Hydrair Pvt. Ltd. Parker Swagelok Vanaz Engineers Limited
26	Coalescent Filter / Regulators	Asea Brown Boveri Ltd. Blue Star Ltd Placka Instruments & Controls Pvt. Ltd Shah Pneumatics Shavo Norgren (I) Pvt. Ltd V Automat & Instruments Pvt. Ltd. Veljan Hydrair Pvt. Ltd. Compac Newzealand
27	Field Instruments (P, DP, F,L,T)	ABB Automation Ltd. Ashcroft Brown Bovert Ltd. Murphy Ccs Waree Fisher Rosemount India Limited Fisher Rosemount Singapore Pte Ltd. Fuji Electric Co. Ltd. Honeywell Inc. ,Tata Honeywell Yokogawa Electric Corporation, Yokogawa Blue Star Ltd. Wika Druck Beko Filtration Technique
28	Suction And Discharge Filter	Beko Filter Ultra Filter Filtration Technique Parker
29	Vibration Switch	Murphy, Metrix ,Robertshaw Contro
30	Cartridge Filters	Beko Filter Ultra Filter Filtration Technique Zander Gmbh (Germany) Grand Prix Fab (Pvt.) Ltd., New Delhi Multitex Filtration Energy Pvt. Ltd.
31	Air Compressor	Ingersol Rand (Ir) Elgi Anesta Iwata Motherson Chicago Pneumatics
32	Self Actuated Pr. Control Valve	Daniel Industries Inc Dresser Produits Industries Aspro Esme Valves Ltd. Fisher Rosemount Singapore Pte Ltd. Fisher Exmox Sanmar Limited Gorter Controls B.V. Instromet International Nv Keye & Macdonald Inc Nuovo Pignone Spa (Italy) Pietro Fiorentini Spa Richards Industries (Formerly Treloar) Rmg Regel + Messtechnik Gmbh Vanaz Nirmal Industries Limited Compac Industries Ltd., Nzl.



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33	Special Control Valves	Fisher Rosemount Sigapore Pte. Ltd. Flowserve Pte. Ltd. (Formerly Duriron) Hopkinsons Limited Metso Automation Pte Ltd. (Formerly Neles) Nuovo Pignone Spa (Italy) Spx Valves & Controls (Formerly Dexurik) Compac Ind. Ltd. Nzl
34	Two Way / Three Way Valves/ 2-Way Drain Valves	Swagelok, Parker, Compac, Hamlet, Hylock, Sealexcel, Oasis, Stauff, SSP/ DK-Lok
35	Cartridge Filters	Beko Filter Ultra Filter Filtration Technique Zander Gmbh (Germany) Grand Prix Fab (Pvt.) Ltd., New Delhi Multitex Filtration Energy Pvt. Ltd., Ingersol Rand (Ir) Elgi Anesta Iwata Motherson Chicago Pneumatics
36	CO2 Cylinder Valve With Actuator For Co2 Flooding System	GINGEKERR ,CEODUEX (ROTAREX), KIDDE, FIKE ANSUL ,LPG, VTI ROTEX, KEW
37	ON OFF BALL/NEEDLE VALVE	PARKER ,SWAGELOK ,ABAC ,SPIRAX SARCO ,WORCESTER, WAREE / BAUMER ,STAUFF ,SSP L&T ,SANKEY CONTROLS ,ROTEX, AUDCO

**Note-1**

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: -

- 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.
- The vendor/ supplier should not be in the Holiday list of Client / Any other PSU.

**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.

**23. CHECKLIST**

**Scope of Supply for Reciprocating Gas Compressor Package:**





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**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. No.	Description	Specified by Purchaser (Yes/No)	Included by Bidder (Yes/No)	Remarks
1	<b>Each Reciprocating Compressor package complete with :</b>			
1.1				
1.2	Suction / discharge pulsation dampers	<b>Yes</b>		
1.3	Process equipment such as separator complete with supports, manual drain with isolation valves, and automatic drain system for separators	<b>Yes</b>		
1.4	Air cooled, lube oil, cooling water, inter-stage and discharge gas coolers with necessary air cooling arrangement	<b>Yes</b>		
1.5	Combined or separate closed circuit cooling water system for compressor (As required)	<b>Yes</b>		
1.6	Lubricating oil system for compressor .	<b>Yes</b>		
1.7	Safety relief valves on each stage of the compressor	<b>Yes</b>		
1.8	All interconnecting oil, gas, water, air piping within the compressor package	<b>Yes</b>		
1.9	All valves, tubing, fittings as specified and required within the compressor package	<b>Yes</b>		
1.10	Fuel supply hardware complete with SS piping, control valves, Regulators, Flow-meter, filter, vent/drain within the package suitable for the specified fuel gas	<b>Yes</b>		
1.13	Common skid for compressor and other auxiliary systems	<b>Yes</b>		



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1.14	Acoustic enclosures for compressor for noise attenuation up to 80 dBA @ 1 m distance fitted with fire detection and extinguishing system as specified	<b>Yes</b>		
1.15	Instrumentation and control system complete with PLC based control panel configured as RTU of supervisory computer and data acquisition, instrumentation as specified.	<b>Yes</b>		
1.16	Cabling with cable trays for all the electrical devices within the package.	<b>Yes</b>		
1.17	Mass flow meter with integral display	<b>Yes</b>		
1.18	Inlet Pressure Regulators (Compressor Suction)	<b>No</b>		
1.19	Priority Panel (as specified) at Package Discharge	<b>Yes</b>		
1.20	Compressor gas twin inlet Y-type temporary strainer, permanent inlet filter.	<b>Yes</b>		
1.21	Y-type strainers, valves, sight flow indicators, check valves, auto/manual drain traps as required for various compressor auxiliary systems, i.e. frame lubrication system, cylinder lubrication, cooling water systems etc.	<b>Yes</b>		
1.22	Manual package isolating valves and auto inlet isolation valve	<b>Yes</b>		
1.23	All couplings and guards	<b>Yes</b>		
1.24	Flywheels, barring device	<b>Yes</b>		
<b>2</b>	<b>Spares and Tools / Tackles</b>			
2.1	Mandatory Spares if specified in the (Indicate separate price for each item)	<b>No</b>		
2.2	Erection and commissioning spares as recommended by Bidder including lube oil consumables etc. as required for erection & commissioning of each compressor package.	<b>Yes</b>		
2.3	Two year normal operation and maintenance spares over and above the spares as required during one year warranty period normal operation and maintenance of each package by the Bidder	<b>No</b>		
2.4	Quote for five year Normal operation & maintenance spares (excluding lube oil etc.)	<b>No</b>		



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2.5	Special tools and tackles required for normal operation & maintenance of each equipment of compressor package as required and recommended by the Bidder	<b>Yes</b>		
3	<b>Inspection and Testing</b>			
3.1	As specified on the datasheets and tech. Spec.	<b>Yes</b>		
4	<b>Vendor data and drawings</b>			
4.1	All data & drawings as required	<b>Yes</b>		
5	<b>Erection, commissioning and trial runs at site of the complete package</b>	<b>Yes</b>		
6	<b>Miscellaneous</b>			
6.1	Foundation and anchor bolts	<b>Yes</b>		
6.3	Acoustical and mechanical analysis report & pulsation study (approach-3)	<b>Yes</b>		
6.4	Additional items not specified by Purchaser but recommended by Bidder for safe smooth and normal operation. (Bidder shall indicate separate list of such items in his proposal)	<b>Yes</b>		
6.5	Optional price quoted for complete compressor package with Non-flame proof electric panel in lieu of flame proof electric panel.	<b>Yes</b>		
6.6	Data sheet of compressor, gas engine motor, LEL and UV Detection system duly filled.	<b>Yes</b>		
6.7	Combined Speed-Torque Characteristic curve of gas engine and Compressor at rated inlet pressure.	<b>Yes</b>		
6.8	Electrical Load summary	<b>Yes</b>		
6.9	Catalogues of electric motor, flame proof equipments and Instrumentation	<b>Yes</b>		
6.10	Power required from UPS Supply (230 V AC Single Phase)	<b>Yes</b>		
6.11	Power required from Non UPS Supply (415V TPN)	<b>Yes</b>		
7	Operation maintenance contract including all operating spares, consumables, man power etc.	<b>Yes</b>		

**24.0 FORMAT OF DEVIATION TO THE TECHNICAL SPECIFICATION:**

All deviations sought by the vendor shall be furnished in this format. If some deviations/ observations/comments are furnished by the vendor at some other places of the offer,



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the same shall not be considered as deviation. Purchaser may accept some deviation in the interest of project. However, 1.5 times the cost of deviation shall be loaded in the offered cost for evaluation purpose.

S No.	Clause no.	Tender Specification	Deviation taken	Reasons for deviations / remarks

**Certified that, only the above-mentioned deviations have been taken against this tender.**

Name of the Bidder  
Signature

Seal of the Company.

**25.0 ANNEXURE – 1 & Annexure-E-1 (Clause no 5.0 - Electrical & Instrumentation )**

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**ANNEXURE -I & Annexure-E-1**

**INSTRUMENTATION & ELECTRICAL**



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