

SUPPLY, INSTALLATION, TESTING, COMMISSIONING,
OPERATION AND COMPREHENSIVE MAINTENANCE FOR
400 SCMH BOOSTER COMPRESSOR PACKAGE

Project No. P.014714
Document No. P.014714 G11031 R003
Tender No. P.014714 G 11031 R003

CENTRAL UP GAS LIMITED (CUGL)
KANPUR | INDIA

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Technical, Vol II of II, Rev. 0

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(400 SCMH)**

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INTRODUCTION

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CENTRAL U.P GAS LIMITED (CUGL)

TRACTEBEL ENGINEERING PVT. LTD.

ELECTRIC MOTOR DRIVEN RECIPROCATING HYDRAULIC
BOOSTER COMPRESSOR WITH VARIABLE SUCTION
PRESSURE - 400 SCMH

INTRODUCTION

| | | | | | |
|-------------|-------------|------------------------|--------------------|-------------------|--------------------|
| 0 | 02.12.2020 | Issued for Procurement | Saurabh Sharma | Gunja Gupta | Nitish Nandi |
| Rev. | Date | Description | Prepared By | Checked By | Approved By |

TRACTEBEL



INTRODUCTION

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R 003

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1. INTRODUCTION
2. TECHNICAL SPECIFICATION

1.0 INTRODUCTION

CENTRAL UP GAS LIMITED (CUGL), a joint venture company of GAIL and BPCL, is responsible for distribution of Natural Gas for household, commercial & Industrial sectors including setting up CNG refueling stations for vehicles etc. in Kanpur (including Unnao), Jhansi and Bareilly.

Natural Gas (NG) is today increasingly gaining popularity over as alternate auto fuel primarily because it is environment friendly, economical and more efficient as compared to other conventional auto fuels. Emission of harmful oxide and other polluting particulates is minimal in case of CNG.

TRACTEBEL ENGINEERING pvt. ltd. (TE) has been appointed for providing consultancy services for tendering activities for CNG Expansion Project (hereinafter referred as Consultant), by CUGL.

Tractebel Engineering Pvt. Ltd. (TE) is now inviting tenders on Competitive Bidding basis for procurement of **“400 SCMH ELECTRIC MOTOR DRIVEN VARIABLE SUCTION PRESSURE HYDRAULIC RECIPROCATING BOOSTER COMPRESSORS PACKAGES”** for this project.

The present document covers the technical specifications for the tender.

2.0 TECHNICAL SPECIFICATIONS

The technical specifications for this present tender enquiry are as listed in Material Requisition (P.014714 G 11071 010).

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|    | <p>MATERIAL REQUISITION</p> | <p>P.014714 G 11071 R 010</p> |
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CENTRAL U.P GAS LIMITED (CUGL)

TRACTEBEL ENGINEERING PVT. LTD.

ELECTRIC MOTOR DRIVEN RECIPROCATING HYDRAULIC
BOOSTER COMPRESSOR WITH VARIABLE SUCTION
PRESSURE - 400 SCMH

MATERIAL REQUISITION

| | | | | | |
|-------------|-------------|------------------------|--------------------|-------------------|--------------------|
| | | | | | |
| 0 | 02.12.2020 | Issued for Procurement | Saurabh Sharma | Gunja Gupta | Nitish Nandi |
| Rev. | Date | Description | Prepared By | Checked By | Approved By |

Project : City Gas Distribution Project for M/s. CUGL

Subject : **Electric Motor Driven CNG Booster Compressor Packages - Capacity 400 SCMH**

A. DESCRIPTION OF GOODS AND/OR SERVICES

| Item | Quantity | Description | Identification Number |
|------|----------|--|-----------------------|
| 1. | 12 Nos. | <p>400 SCMH Electric Motor Driven CNG Booster (Hydraulic) Compressor package:</p> <ul style="list-style-type: none"> • Design, Engineering, Manufacture, Shop testing and supply of Electric motor driven CNG compressor package of min. average flow capacity of 400 SCMH for suction pressure range 30 to 200 kg/cm² and discharge pressure 255 kg/cm² at the specified condition (as per attached Technical Specification) complete with electric drive motor driven hydraulic CNG Booster compressor and desired heat exchanger suitable for above requirement and other accessories including erection and commissioning spares including acoustic enclosures. • Services for Erection, Testing, and Commissioning and performance acceptance testing of compressor as defined in PTS- Motor driven CNG Compressor Packages. • Scope also includes Operation and Comprehensive Maintenance for each compressor during warranty period of one year and further Four years after warranty period. <p>Capacity: 400 SCMH</p> | |

B. REMARKS / COMMENTS

1.0 VENDOR'S SCOPE

In Contractor's scope of work is included the equipment with all internals and accessories shown on the data sheets, specifications and all unmentioned parts necessary for a satisfactory operation and testing, except those which are indicated to be out of the Contractor's supply.

2.0 INSPECTION

The bidder shall appoint Third Party Inspection Agency for carrying out the inspection at bidder's works as per approved ITP/QAP/QCT and TPIA charges shall be borne by the bidder.

3.0 APPLICABLE DOCUMENTS

Applicable documents are listed in hereafter under Section C of this MR, complemented with general specifications, guidelines and / or standards, as listed in LIST OF REFERENCED DOCUMENTS as a part of specification.

In the event of any conflict occurring in applying the referenced documents, the order of precedence shall be:

- 1 – Particular Technical Specification
- 2 – Attachments

4.0 VENDOR'S DOCUMENTS

4.1 Submittal of Calculation Note:

Design calculations will be well explained for demonstration of compliance to specified code(s) and standard(s). Limitation to a listing of input data and series of results is not acceptable. The applied formulations, sections, subsections, figures, subfigures from code(s) and/or standard(s) will be indicated at calculation steps to permit straight verification.

4.2 Vendor's Documents and Drawings

- All vendor documents and drawings shall be numbered according to Engineer's in-charge specification.
- All drawings shall use SI units.
- All graphical symbols to be recognized to industry standard.
- All text to be clearly legible when the drawing is reduced to A3 size.
- All drawings and calculations shall be checked, approved and signed by a competent and authorized person employed by the Contractor.
- Drawings to be issued bound in A3 size. In addition, the planning drawing to be issued in A1 for submission to the planning authority.
- Hard copy of Quality & design dossier (Drawing to be on A3 format) for review.
- All drawings shall be issued on CD in both Auto CAD & PDF formats.
- Installation, Commissioning, Operation & Maintenance manuals for CNG compressor package.



MATERIAL REQUISITION

P.014714
G 11071
R 010

C. LIST OF ATTACHMENTS

| The table herebelow lists the documents which are integral part of this Material Requisition. The applicable revision index of each document is mentioned in the column below the current Material Requisition revision index. When the Material Requisition revision index is "A" or "1", all listed documents are attached. For other Material Requisition revision index, only modified or new documents are attached. | Material Requisition revision | | | | | | |
|--|-------------------------------|----|--|--|--|--|--|
| | 0 | 01 | | | | | |
| Documents | Revision of documents | | | | | | |
| Particular Technical Specification (PTS) - Compressor Package P.014714 M 11077 R 018 | 0 | | | | | | |
| Annexure - I – Guaranteed Parameters | 0 | | | | | | |
| Annexure – II – Compressor Data Sheet | 0 | | | | | | |
| Annexure – III – Electric Motor Data Sheet | 0 | | | | | | |
| Annexure - IV – List of Motors | 0 | | | | | | |
| Annexure - V – Specification for Instruments | 0 | | | | | | |
| Annexure - VI – Recommended Vendor List | 0 | | | | | | |
| Annexure - VII – Vendor Data Required | 0 | | | | | | |
| Annexure - VIII – Deviation Schedule – Not Applicable as “No Deviation” Tender | 0 | | | | | | |
| Annexure - IX – M.R. Compliance Schedule | 0 | | | | | | |
| Annexure -X – Experience Proforma Record | 0 | | | | | | |
| Annexure – XI – Parameters for SCADA | 0 | | | | | | |
| Annexure – XII – Quality Assurance Plan | 0 | | | | | | |
| Annexure - XIII – Data Sheet for - Medium Voltage Squirrel Cage Induction Motor, - Power Cable Sizes for 415 V Motors, - Pressure Vessels | 0 | | | | | | |

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PTS - ELECTRIC MOTOR DRIVEN
 RECIPROCATING 400 SCMH BOOSTER
 COMPRESSOR

P.014714
M 11077
R 018

CENTRAL U.P GAS LIMITED (CUGL)

TRACTEBEL ENGINEERING PVT. LTD.

**PTS - ELECTRIC MOTOR DRIVEN RECIPROCATING HYDRAULIC
 BOOSTER COMPRESSOR WITH VARIABLE SUCTION PRESSURE -
 400 SCMH**

| | | | | | |
|-------------|-------------|------------------------|--------------------|-------------------|--------------------|
| | | | | | |
| 0 | 02.12.2020 | Issued for Procurement | Saurabh Sharma | Gunja Gupta | Nitish Nandi |
| Rev. | Date | Description | Prepared By | Checked By | Approved By |

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1.0 GENERAL

Central UP Gas Limited (CUGL), a joint venture company of GAIL and BPCL, is responsible for distribution of Natural Gas for household, commercial & Industrial sectors including setting up CNG refueling stations for vehicles etc. in Kanpur (including Unnao), Jhansi and Bareilly.

2.0 SCOPE

- 2.1** This specification along with applicable codes as referred describe the minimum requirements for Design, Engineering, Manufacturing, Assembly, Inspection, Testing, Packaging, Supply, transportation, Erection & Commissioning including Performance Acceptance Test at site along with operation and comprehensive AMC during One year warranty period and subsequent four year period including supply of all spares and consumable items for **“400 SCMH ELECTRIC MOTOR DRIVEN VARIABLE SUCTION PRESSURE HYDRAULIC RECIPROCATING CNG BOOSTER COMPRESSORS PACKAGES”** as required for dispensing CNG to vehicles at various locations in allotted GA as per this technical specification and applicable codes as referred. Various parts of this specification shall be read in conjunction with each other and in case where the different parts of this specification differ, the more stringent requirement shall govern.
- 2.2** The Booster compressor packages shall be identical in all technical respects. Various parts of these specifications shall be read in conjunction with each other and in case where the different parts of this specification differ the more stringent requirement shall govern.
- 2.3** 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.
- 2.4** Booster Compressors have to be installed at the CNG outlets of OWNER and Oil and Marketing Company (OMC) retail Outlets located in allotted GA as per the instructions of Engineer in charge to increase the pressure of natural gas for dispensing in vehicles.
- Booster Compressor packages may be installed in any of the GA of CUGL as mentioned in SOR.
- 2.5** Bidder shall also be responsible for supply, erection, commissioning and field trial run. Noise level test and performance test of all packages at sites. The field trial run of the compressor will be for minimum of 4 hours and the package should be kept under observation for 72 hours for stable operation and no major breakdown in which satisfactory performance of the package together with all accessories auxiliaries and controls shall be established for satisfactory performance for specified operating conditions. In case of any detect, discrepancies under specified site conditions. Supplier shall first rectify the same and repeat the field trial run.
- 2.6** It will be the endeavor of all the parties to get the performance acceptance test (PAT) at site conducted within a period of 20 days from the start of commercial operation of a particular package. The bidder has to keep the compressors operational round the clock (i.e. 24X7) as defined by EIC and all the expenditures including spares and consumables, oil etc. to make the compressors operational shall have to be borne by the bidder. The power required to run the compressors will be provided by OWNER/ OMC. The contractor shall maintain the compressors in sound mechanical condition at all times. The contractor shall rectify the defects notified by OWNER immediately and should submit all the history log sheets and spares availability status along with the report in the format mutually agreed between OWNER and the bidder.
- 2.7** The bidder shall depute adequate numbers of qualified, experienced and competent persons and supervisors for smooth maintenance of the compressors. The maintenance staffs have to be available round the clock (i.e. 24X7) daily throughout the year.
- 2.8** Periodic inspections of Safety Valves, Transmitters, Pressure vessel gauge and any other equipment as per statutory norms of State Factory Rules. SMPV and Gas Cylinder Rules shall have to be carried out by the bidder at his own cost during the period of maintenance by the bidder. The inspections have to be carried out by competent persons as per advice of Engineer-in-Charge and certificates have to be submitted to OWNER.

- 2.9** The bidder has to keep his services personnel ready to attend problems any time of the day. Name and mobile phone number of in-charge of the services team has to be provided to Engineer-in-Charge / his representatives.
- 2.10** The work force deployed by the bidder for the maintenance services at site shall be of sound relevant technical professional expertise which is otherwise also essential from the safety point of view of the personnel of the contractor as well as for the installation.
- 2.11** All personnel of the bidder entering on work premises shall be properly and neatly dressed while working on premises of the company including work sites.
- 2.12** Bidder shall maintain proper record of his working employee's attendance and payment made to them.
- 2.13** The bidder's representative/supervisor shall report on regular basis to the Shift-in-charge at OWNER control rooms for day to day working.
- 2.14** All the safety rules and regulations prevailing and applicable from time to time at the installations as directed by OWNER will be strictly adhered to by the Contractor and his workforce.
- 2.15** The bidder shall plan schedule maintenance in consultation and prior permission of Engineer in-charge or his representatives.
- 2.16** The bidder shall be responsible for the discipline and good behaviour of all his personnel deployed to carry out the services. In case of any complaint received against any of his employee, he shall arrange to replace such persons within 24 hrs 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 Contractor.
- 2.17** The bidder shall arrange to supply/renew identity cards to his workforce at his own cost. The contractor's personnel shall be required to carry their respective identity cards while on duty and produce on demand. Without valid identity cards, they will not be allowed to enter into the CNG station.
- 2.18** Engineer-in-charge shall have authority to issue instructions to the Contractor from time to time during the contract period necessary for the purpose of proper and safe execution of the contract and the Contractor shall carry out and bound by the same. In case of non-fulfilment of any obligations under the contract and /or non-execution of any instruction issued by Engineer-in-charge as per terms and conditions of the contract, Engineer-in-charge shall have power to withhold payment for an amount equivalent to the amount to be spent for execution the obligations/instructions issued by him. The decision of engineer-in-charge in this regard will be final and binding to the Contractor.
- 2.19** Receipt at site, storage in warehouse as per manufacturer's recommendation and safety and security from theft and breakage during transportation, handling including security guard at site.
- 2.20** Submission of drawings & documents.
- 2.21** Erection, O&M and all others relevant manuals for compressor & its accessories, priority panel, electrical motor & all instrumentation.
- 2.22** GENERAL
- 2.22.1** The contractor must follow the OPERATION & MAINTENANCE REQUIREMENT as stated below but not limited to and ensure to provide trouble free services as defined in the bid documents.
- A. ACCOMMODATION/ TRANSPORTATION/ MEDICAL
- The contractor 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 owner shall have no obligation in this respect.
- B. DISCIPLINE

The contractor shall be responsible for the discipline and good behaviour 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 contractor.

C. GATEPASS / IDENTITY CARD

The contract shall arrange to supply / renew identity card to his workforce at his own cost, if so required by OWNER for security or for any other reasons. Those contractor's personnel shall be required to carry their respective identity cards while on duty and produce on demand. Without valid identity cards, they will not be allowed to enter into the CNG station.

D. RIGHT TO GET SERVICES CARRIED OUT THROUGH OTHER AGENCIES

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

The maintenance services shall be provided in terms of shift pattern or the round the clock basis as mentioned in the bid document.

E. OWNER will notify the start date for operation and Comprehensive Maintenance services

- After the successful completion of test run & commissioning, system taking over certificate shall be issued by the owner.

2.23 Operation and Maintenance of Compressor Packages

- i. The contractor shall deploy adequate number of technicians / supervisors / Engineers / helpers as well as tools, spares, consumables and equipment for smooth and proper maintenance of the Compressor supplied in terms of the contract. In case required to meet operational requirements, the contractor shall augment the same as per direction of Engineer-in-Charge. Contractor to submit a detailed organogram with key person details before starting maintenance of the compressor package.
- ii. The contractor is required to carry out all services as mentioned in the Scope and Schedule of Rates on all the 365 days including Sunday and all Holiday & around the clock i.e. (24 X 7).
- iii. The contractor shall follow Central/State guidelines for labour laws, rules and regulations. 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 contractor for maintenance service of Compressors, shall be of sound relevant technical professional expertise which is otherwise also essential from the safety point of view of the personnel of the contractor as well as for the installation.
- v. Contractor 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 contractor shall make his own arrangements to provide all facilities like boarding and transport etc. to his workmen.
- viii. All personnel of the contractor entering on work premises shall be properly and neatly dressed and shall wear uniform, badges while working on premises of the Owner including work sites.
- ix. Contractor shall maintain proper record of his working employee's attendance and payment made to them.
- x. The contractor'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 OWNER will be strictly adhered to by the contractor.

- xii. It will be the responsibility of the contractor to pay as per the minimum wages of the appropriate government applicable under the Minimum Wage Act 1948.
- xiii. The services shall be provided in terms of shift pattern on the round the clock basis. The contractor 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.
- xiv. The contractor shall deploy adequate number of technicians/ supervisors / engineers at various site offices in consultation with Engineer-in-Charge to provide trouble free maintenance of the Compressors.
- xv. All arrangements for communication to the contact person working on job under the services shall be the responsibility of the contractor, viz. cell phone / walky-talky.
- xvi. The successful bidder shall indemnify the Owner from any claim of the contract labour.
- xvii. The successful bidder shall comply to all the rules regarding PF, ESI etc. as stated in the tender document
- xviii. All the jobs mentioned under scope of services shall be carried out as per sound engineering practices, work procedure documentation, recommendation of the manufacturer and as per the guidelines/direction of engineer-in-charge of authorized representative.
- xix. Summary of breakdown hour's station wise with analysis shall be submitted to CNG control room on a fortnightly basis both in hard and soft form as per OWNER format.
- xx. The contractor has to submit the following documents on monthly basis along with the bill:
 - o Preventative maintenance compliance report for that month along with the detailed service report.
 - o Details of the compressor breakdown, summary of break down hours for that month and the cumulative break down hours along with breakdown response time.
 - o Compressor parameter log book for the month.
 - o Certificate to be given by the bidder stating that they have complied with all the labour regulations and are following the minimum wages act.
- xxi. All spares, consumables, oil and lubricants required for carrying out the Operation and Maintenance of the complete compressor packages including periodic breakdown and any other materials required for operation and maintenance of the compressor packages, shall be provided by the bidder.
- xxii. 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's like crane, forklift, chain pulley block, etc required during the any maintenances activity.
- xxiii. Any correspondence required to be made with the principal company or OEM or various offices shall be made by the bidder or bidder's agent. All arrangements like phone, fax, computer, Internet etc required for above correspondences shall be arranged by the bidder at his own cost.
- xxiv. The periodic maintenance required to be done as per OEM recommendation shall be taken up promptly. The bidder shall provide the detailed preventative maintenance schedule along with
 - a) Estimated down time required for each type of maintenance schedule.
 - b) List of spares and their quantities required for each type of maintenance schedule per compressor.
 - c) Type and number of man days required for each type of maintenance schedule per compressor.
- xxv. The bidder shall plan such maintenances during non-peak hours and in consultancy with the Engineer In Charge (EIC) of OWNER. Any maintenance that needs to be taken up shall be well planned in advance with due approval of the EIC.
- xxvi. The bidder shall use only OEM's certified spares during maintenances. All spares shall be kept in sealed OEM stamped packages. The packages shall be opened in front of OWNER representative during maintenance. In case, the schedule maintenance of the OEM manual recommends to check and replace parts like valve spring, valve plates, piston rings etc. after certain time interval, same shall be replaced or used further only on approval from the OWNER's representative. However any untoward consequences

for non-replacement of such parts shall be the responsibility of the bidder and spares, repair required to put back the unit into operation will be to bidders account.

- xxvii. 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 Vernier calliper, micrometre screw gauge, fill gauges, bore gauge etc shall be in scope of the bidder and these instruments shall be calibrated every year.
- xxviii. All parts replaced by the bidder during the above contract period shall be disposed off periodically with permission from CUGL.
- xxix. The contractor 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 such as compressor parameter log book, complaint log book, service report, break down summary report etc. shall be in scope of the bidder.
- xxx. All the maintenance / inspection job carried out by the bidder shall be recorded in a service report and the report of the same shall be jointly signed by OWNER representative and submitted immediately after carrying out the maintenance. Service report format shall be approved by OWNER.
- xxxi. The EIC will be final authority to take decision with regards to maintenance or replacement of parts or any disagreement between the bidder and OWNER, during the execution of the contract.
- xxxii. The bidder shall carryout calibration of gas detectors and flame detectors every six months or earlier as per requirement or instruction of EIC of OWNER. Also yearly calibration of all instruments such as pressure gauges, transmitters, switches, mass flow meters etc shall be in the scope of the bidder. In addition to the above all safety relief valves shall also be tested and calibrated every year.
- xxxiii. Calibration shall be done from government-approved laboratories and shall be carried out at least 15 days prior to the calibration due date.
- xxxiv. The bidder shall keep 1 set of safety relief valves in spare for the purpose of calibration.
- xxxv. The bidder shall carry out retesting of pressure vessels periodically i.e. every year or earlier as per Gas Cylinder rules 2016 / Static & Mobile Pressure Vessels Rules.

3.0 CODES AND STANDARDS:

3.1 The design, construction, manufacture, supply, testing & 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.

3.2 Any modification suggested by 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.

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

- OISD 142:
- IS 5572
- OISD 179, NFPA-52: 2006, NFP-496, NFPA-68, NFPA-70 or equivalent
- NFPA – 37
- NFPA – 12- CO₂ Flooding system
- IS: 325/ IEC or International standards. – Standards for electric Motor
- IS: 6382
- Applicable ANSI, ASTM, NEC, NEMA code
- API – 618/API 11 P
- EURO EAN NORM P.E.D., Italian NOR M D.P.R. 47/55
- EURO EAN NORM P.E.D , D.M. 24.5.02 - D.M. 2 8 .6.02
- D.M 2 4.11.84 parte prima - sez. II° , D.M . 24.5.02 - D.M. 28.6.02, DIN 2413, S AE J 514
- EURO EAN NOR MS, CEI N 60079- 0/CEI EN 60079-14/ CEI, EN 60204-1/ CEI EN 60439-1, ATEX STAN DARD

- API – 661 : Specifications for Air cooled exchangers
- ASME Section – VIII Div. – 1/2 Design codes for pressure vessels.
- Gas Cylinder Rules 2016.
- Standard Specifications of Bureau of Indian Standards (BIS).
- Specifications/Recommendations of IEC.
- Indian Electricity Rules.
- Indian Explosives Act.
- State Factory Rules
- TEMA – C - Water cooled heat exchangers
- ASME / ANSI – B-31.3 Code for Process Piping
- DIN 2413-This standard covers the design of steel bends and bent pipes of circular cross section used in pressure pipelines.
- SAE J 514-Standard for CNG hydraulic tube fittings and O-ring
- CEI EN 60079-10-Classification of area for explosive gas atmosphere
- CEI EN 60079-14-Design, selection and installation of electrical systems for areas with potentially explosive atmosphere.
- CEI, EN 60204-1-Standard for safety of machinery — Electrical equipment of machine
- CEI EN 60439-1-Standard for safety of electrical equipment
- ATEX-Standard for describing electrical equipment and work space is allowed in an explosive atmosphere.

3.3 Precedence

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

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

In case of any conflict among the various documents of this requisition the more stringent requirement shall govern.

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

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

3.4 Document /Data Required along with Bid

Bidder shall necessarily furnish the following along with the bid, without which the offer shall be considered incomplete:

- (1) Proven Track Record Formats, duly filled in along with general reference list shall be submitted for the earlier supplied CNG compressor packages as per the BEC requirements.
- (2) Checklist duly filled in with regards to scope of supply
- (3) Completely filled in Data Sheets of compressor, motor
- (4) Deviations if any to this Technical Specification
 - Tentative Lay out/key plan/General Arrangement Drawing indicating size of skids, center distance between skids and space required along with maintenance requirements,

- The Design of trenches for installation of interconnecting pipeline if any
- (5) (a) Utilities requirements (b) Electrical Load summary
- (6) Datasheet of compressor, motor, instrumentation & controls

3.5 Gas Composition

| GAS COMPOSITION | | |
|------------------------|-------------------------------|-------------------------------|
| | Normal Gas Composition | Design Gas Composition |
| C1 | 82.43 – 99.10 | 97.98771 |
| C2 | 7.27 – 0.90 | 1.82832 |
| C3 | 3.47 – 0.00 | 0.04419 |
| I C4 | 0.65 – 0.00 | 0.00187 |
| N C4 | 0.78 – 0.00 | 0.00171 |
| I C5 | 0.17 – 0.00 | 0.00023 |
| N C5 | 0.13 – 0.00 | 0.00007 |
| C6 | 0.10 – 0.00 | 0.00013 |
| C7 | 0.00 – 0.00 | 0.00 |
| CO2 | 4.93 – 0.00 | 0.00011 |
| N2 | 0.06 – 0.00 | 0.13567 |
| H2O | 0.01 – 0.00 | 0.00 |
| Total | 100 | 100 |
| NC.V. (kcal/SCM) | 8150 – 8950 | 8236.314 |
| GCV (kcal/SCM) | | 9143.349 |

3.6 Climate

- Amb. temp min/max⁰C : 2⁰C / 47.5⁰C
- Design wet bulb temp (WBT), ⁰C : 27⁰C
- Design relative humidity % : 90
- Altitude above MSL, M : 205
- Wind velocities km/hr (max) : 160
- Air Cooler Design ⁰C : 47.5⁰C DBT, 27⁰C WBT & 90% RH

4.0 SCOPE OF SUPPLY FOR EACH COMPRESSOR PACKAGE

The scope of Supply to be provided by the bidder shall be inclusive of but not limited to:

- 4.1** Design, Engineering, Manufacturing, Assembly, Inspection, Testing, FAT, surface preparation and Painting, Packaging and forwarding, Insurance, customer clearances, Supply, handling and unloading, Erection & Commissioning including Performance Acceptance Test at site along with operation and comprehensive AMC including supply of all spares and consumable items along with associated electrical, instrumentation etc. as per bid document.
- 4.2** Hydraulic booster with lube oil system and cooling system as required.
- 4.3** Flame proof Electrical Electric Motor of rating not more than 22 KW as compressor driver.
- 4.4** 2 nos. mass flow meters to measure the Natural Gas consumption at packages inlet and package discharge (both Coriolis type) with online test arrangement. Both mass flow meters should be of same make and should have local display and should be weather proof. The flowmeters should be enabled with MODBUS/ RS 485 communications.

- 4.5 PLC based control panel with HMI.
- 4.6 Instrumentation and control system as specified as per tender documents.
- 4.7 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. Same shall be complied within 30 days from successful commissioning of the package.
- 4.8 Electric equipment / Instruments being required in the Compressor package.
- 4.9 Common structural steel skid for the compressor- Motor combination and for all auxiliary systems
- 4.10 Air-cooled heat exchanger for inter stage and discharge gas.
- 4.11 Priority Panel (3 bank) at Package Discharge as per priority fill system.
- 4.12 Selector switch at Booster Compressor panel for valve positioning to automatically switch over the inlet i.e. to take suction from LCV cascade or from Stationary cascade.
- 4.13 All interconnecting oil, gas, water, air piping within the compressor package.
- 4.14 Impulse and pneumatic piping/Tubing for all valves, fittings as specified & required for mounting the instruments.
- 4.15 Block and bleed valves to be provided for Pressure gauges and pressure Transmitters. In case needle valves are provided, proper bleeding arrangement shall be provided along with it.
- 4.16 Separate junction boxes for different type of signals like intrinsically safe signals, alarm, shutdowns, thermocouples, RTDs etc. for interfacing to local panel as per requirement.
- 4.17 Main incoming cable from owners Power Distribution Board (PDB) to main control panel of the compressor through heavy duty GI conduit or trenches, Earthing Cable from owner's electronic earth pit (EE) for electronic circuit in control panel, cable from owner's main earthing grid to control panel for body earth and all inter connecting cables including complete erection accessories like double compression cable gland, cable tags, lugs etc. as required.
- 4.18 Electrical cables required for providing connectivity with CO₂ system and ESD switches shall be supplied and laid by the supplier.
- 4.19 NRV as required for smooth operation.
- 4.20 Structural supports within the compressor package for all piping, electrical, instruments etc.
- 4.21 One no. relief valve at each stage discharge, first (1st) stage suction.
- 4.22 Coupling/V-belts/pulleys.
- 4.23 Single acoustic enclosure for Booster Compressor package, with one number L.E.L detectors and one UV detectors in the enclosure.
- 4.24 Common automatic CO₂ extinguishing system consisting of two cylinders of adequate capacity, piping, valves and control systems as per details given in this specification.
- 4.25 Inlet and outlet manual and automatic isolating valves for maintenance & emergency.
- 4.26 Framework shall be mounted on a suitable skid type base, external-lifting lugs shall be provided at each corner. Package shall not be larger than 3.5m (Length) x 2.5m (Width) x 2.8m (Height) size.
- 4.27 The provision for overhead mounting of cascade (3000 Water Liter capacity with approximate weight of 7 tons) should be there & same should be of enough strength having working space and with ladder arrangement. However, cascade supply and its mounting on the structure shall be in scope of purchaser. Structure Stability compliance Certificate of the unit where cascade will be mounted to be submitted during detail engineering. Same shall be endorsed by structural engineer.
- 4.28 **2 sets of following items along with each package:**
LCV filling hose (Synflex / Parker / Eaton) with Breakaway (OPW/PARKER/WEH/Staubli) & Quick Release Coupling (QRC) shall be in bidder's scope of supply. LCV filling Hose shall be of minimum 4.5 mtrs. long and shall have ½ "Parker make Quick Release Coupling (QRC) connected to it

to be provided by the bidder. Long refilling Hose (3.5 Mtr. before Break Away + 1 Mtr. after Break Away) should be provided with protective guard. Hose crimp to be provided with protective sleeve. Hose crimp should be of SS and have protection Sleeve. Filling post to be supplied with 4" Pressure Gauge for pressure monitoring of CNG. Supply & Installation of Filling Post (150 MM wide & 3mtr in height) and Hose Assembly with Breakaway / QRC shall be in bidder's scope. Cost of these items shall be included in supply cost of the booster compressor and no separate payment shall be given for these items. Hose will be installed with ¾" OD Three Way Ball Valve. Bidder to select end connection of Hose accordingly.

- 4.29** Complete Erection, Testing & Commissioning of compressor packages.
- 4.30** Field Performance test at site
- 4.31** Supply of all essential spares as specified, erection & commissioning spares.
- 4.32** One set of spare parts catalogue along with the priced bid (Part-II), as built drawings and Operation & Maintenance catalogue with each compressor package.
- 4.33** Closed circuit cooling water system (console type)/Air cooled as required including heat exchangers, coolant circulation system, fan operated radiator, etc. for inter stage and final cooling of compressed gas, lubrication oil and hydraulic oil.
- 4.34** Priority refuelling system outside of the package or as per vendors design.
- 4.35** Drive belt, if used shall be anti-static fire retardant type.
- 4.36** Five no. Emergency stop button (push type) along with one hooter in office/customer interface room.
- 4.37** Wires mesh type guard for heat exchanger fan.
- 4.38** Erection, O&M and all others relevant manuals for compressor & its accessories, priority panel, electrical motor & all field instruments.
- 4.39** Annual Operation and comprehensive maintenance services for a period of 1 (one) year during the warranty period, including supply of all spares and consumable items.
- 4.40** Annual Operation and comprehensive Maintenance services for a period of 4 (four) years after the warranty period including supply of all spares and consumable items.
- 4.41** Exclusions

The following are excluded from the scope of the bidder:

- All civil works and foundation design, however the bidder shall furnish all the relevant data for design of any pedestal/foundation. Grouting of equipment including supply of material is a part of erection and is in scope of Supplier.
- CNG Storage cascade.
- All piping beyond battery limits except from air compressor & air piping for air and piping from CO₂ cylinders up to the enclosure.
- CNG Dispensers and Interconnected SS tubes & fittings.

5.0 BATTERY LIMITS

- 5.1** 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 ¾" full flow ball valves with ¾" end connectors.
- 5.2** As and where specified on the data sheets all vents (i.e. Relief valve) shall be manifolded and terminated at skid edge outside the enclosure and vented to safe height 3Mtrs at package roof. Silencer has to be provided in the air vent line.
- 5.3** All drains from different process equipment's shall be manifolded and terminated as single point for customer interface duly flanged with isolation valve. Drains if any should be through a common header and discharge to be allowed in a pit to avoid spillage around compressor package.

- 5.4 Electronics/Instrument earth pit shall be constructed by Owner. Owner shall give instrument earth in UPS DB in separate core of cable. Wherever the UPS supply is given, instrument earthing shall be given by third core. For body earthing of compressor and its equipment's; Earthing shall be given from earth grid. Earth grid shall be in scope of owner. Owner's earthing main ring shall be made available at compressor foundation for equipment earthing. Electrical earthing for motor shall be done through Cable and the body earthing to be done through GI strip of 25 x 3 inside the compressor package shall be in the bidder's scope.

6.0 UTILITIES

- 6.1 Bidder to provide Instrument air with an electric motor driven air compressor with a suitably sized receiver & Refrigerant type air drier system. The instrumentation air shall also be used for CNG Dispensers. Hence the system to be designed considering the same.
- 6.2 Air Compressor with discharge pressure of 7 kg/cm² suitable for 1.5 KW electric motor rating with dryer shall be supplied by the bidder.
- 6.3 Air Compressor to be supplied along with air receiver of min. 100 water litre capacity.
- 6.4 Air dryer suitable for automatic operation shall also be supplied along with all accessories.
- 6.5 Air compressor, drier and air receiver for instrument air, shall be kept off the package in safe area or owner's building.
- 6.6 Piping, electrical & instrumentations cabling shall be in bidder's scope. Drain should be through a common header and discharge to be allowed in pot outside the package (capacity not more than 2.5 litres) to avoid spillage around the compressor package.
- 6.7 Manual drains and automatic moisture trap shall be provided in the system.
- 6.8 Air receiver shall be provided as provided with SRV, Pressure switch and pressure gauge shall have isolation valve. Air dryer shall be with bypass pass arrangement.
- 6.9 Tapping from air receiver and dryer shall be provided as follows;
For dispenser: one ½ "tapping with isolation valve from air receiver
For booster compressor: one ½ "tapping with isolation valve from air receivers.
- 6.10 Cooling water is not available as utility and the package shall be provided with self-sufficient cooling water system for compressor as required, with makeup tank. However cooling water for makeup tank is available.
- 6.11 All electrical and instrumentation terminals shall be as specified.
- 6.12 Electric Power shall be made by Purchaser.
- 6.13 Purchaser shall provide 415 V, 3Ph, 50Hz, 4 wire electric power for running the compressor and illumination in the electrical room. Supplier shall indicate power/ Feeder (KW/Amp) requirement in the offer, if different. All cabling (supply & laying) from electrical room to booster compressor shall be in bidder's scope. Bidder shall indicate power /Feeder (KW/Amp) requirement in the offer and shall supply power KWH meter for power consumption of the complete package including all accessories to be installed in the control panel. KWH reading shall be available at HMI.
- 6.14 Purchaser shall provide UPS (230+1% V, 50+1%Hz) for control supply requirement at single point (feeder in UPS ACDB) in the electrical room.
- 6.15 All cabling (supply & laying) from electrical room to booster compressor shall be in bidder's scope. Bidder shall indicate power Feeder (KW/Amp) requirement in the offer. Surge protection devices of Schneider/MTL/Phoenix make shall be provided in the control panel.

7.0 GENERAL DESCRIPTION

A. GENERAL DATA



**PTS - ELECTRIC MOTOR DRIVEN
RECIPROCATING 400 SCM³/HR BOOSTER
COMPRESSOR**

**P.014714
M 11077
R 018**

| | | |
|-------|--|--|
| 1.1 | Compressor type | |
| 1.1.1 | Oil lubricated | |
| 1.2 | Type of cooling | As per Manufacturer's Standard |
| 1.3 | No of compression stages | 02 |
| 1.4 | Cylinders | |
| 1.5 | Maximum intake temperature | 35°C |
| 1.6 | Compressor package BKW at Specified flow including all losses such as mechanical, leakage, transmission & power absorbed by compressor driven and other electric driven auxiliaries. | To be indicated in KW Detailed break up to be given as per Annexure –I |
| 1.7 | Maximum motor power | To be indicated with 10 % margin over BKW as per Annexure –I |

B. COMPRESSOR PERFORMANCE DATA

| | | | |
|-------|--|--|---|
| 2.1 | Gas pressure at compressor inlet | Refer below Section 2.5 | |
| 2.2 | Compressor Discharge Pressure | 250 Kg/Cm ² g at 52 deg. C (Max) | |
| | | Compressor Discharge temperature 52 °C (After cooler) with ambient air temperature of 47.5°C and gas inlet temperature of 35°C (max.). | |
| 2.3 | Compressor speed | To be indicated by bidder. | |
| 2.4 | Ambient Conditions | | |
| 2.4.1 | Ambient temperature | 2 °C to 47.5 °C. | |
| 2.4.2 | Maximum relative humidity | 90 % | |
| 2.5 | Required guaranteed capacities of electric motor driven compressor packages at rated suction pressure and discharge pressure as mentioned below: | | |
| | Rated Suction pressure at which guaranteed flow is required, and at 35 deg. C (MAX), in Kg/Cm ² g. | Rated Discharge pressure in Kg/Cm ² g and at 52 deg C (MAX.) | Guaranteed capacity at rated suction and discharge pressure in Sm ³ /hr (SCMH) |
| | 30 to 200 | 250 | 400 |

Hereinafter the rated suction pressure, where guaranteed flow is required, will be referred as Rated Suction Pressure range from 30 to 200 Kg/Cm²g at varying on continuous compressors. Suction pressures will be measured at inlet flange of the compressor package. Bidder has to ensure that compressors are designed such that the desired flow is achieved (without any negative tolerance) at Rated Suction Pressure.

Note:

- a) No advantage shall be given in case bidder offers compressor with flows higher than as detailed above for various types.
- b) Bidders offer shall be based on firm and final compressor model on which basis the offer shall be evaluated and no alternate compressor model or change of model, after submission of bid shall be entertained / considered. This is very important, and all bidders shall take full cognizance of this matter before submitting the bid.
- c) Bidder to indicate the capacity and absorbed power of the offered compressors at various suction conditions starting from 30 to 200 Kg/Cm²g (Temperature 35 deg C max.) and 255 Kg/Cm²g and 52 deg. C (max) discharge condition.

Performance curves and tables i.e. Flow versus suction pressure and temperature and power curves i.e. absorbed power versus suction pressure and temperature at specified discharge conditions shall be furnished. In addition to above, flow capacity and absorbed power values for suction conditions from 30 to 200 Kg/Cm²g in steps of 0.5 Kg/Cm² shall also be given in tabular form. The graph shall be plotted at

various suction pressures ranging from 30 to 200 Kg/Cm²g and at various suction temperatures ranging from 20° to 40° C. Similarly, the graphs shall be plotted at various discharge pressures ranging from 220 Kg/Cm²g to 250 Kg/Cm²g, however at 52° C (max) discharge conditions.

- d) Bidder to note that the compressor package required shall be suitable for operating at a suction pressure from 30 Kg/Cm²g to 200 Kg/Cm²g at 35 deg. C.

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.

8.0 SAFETY

- a) 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 hardware for all trips & also in software. The Compressor Package shall trip if any of the enclosure is opened while the machine is running.
- b) 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.
- c) Bidder needs to submit either the copy of valid type approval for compressor packages from PESO or copy of application towards the same along with the bid.
- d) All exposed rotating parts shall be provided with adequate guards of non-sparking type.
- e) Driver belt if used shall be of anti-static and fire resistant type.
- f) 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
- g) Each package ENCLOSURE shall have 1 No. (One) LEL detectors (IR Type) and 1 No. (One) Ultra Violet (UV) fire detectors to cover the enclosure effectively as already spelt in the scope of supply.
- h) All material used in the package shall be flame retardant.
- i) Relief valves shall be provided at suction and discharge and each inter stages of compressor with setting as per cl.7.20.4 of API-618 with R.V. venting as per cl. 7.20.4 of API-618. All vented to common relief valve header.
- j) Provide all the required warning notices, barriers, safety boards, padlocks etc, for safe commissioning of the equipment's.

8.1 Carbon Dioxide (CO₂) Flooding System

- a) CO₂ flooding system should be installed for the protection of CNG compressor by automatic actuation system. The package should be protected by automatic operated CO₂ flooding system designed as per NFPA-12.
 - Gas Detection by installation of hydrocarbon gas detector (IR type) with self-check function and transmitter with adjustable alarm levels (0-100%) with preset of 10%, 20% and 50%. Package should have at least one no gas detector.
 - Installation of flame detector (UV-IR type) with self-check function and transmitter, alarm on detection of flame shall be provided. Package should have at least one no flame detector. Self-check function to generate fault alarm and trip alarm in case of flame detection Indication lamp shall be provided for fault and trip signal in LCP.
 - CO₂ flooding system will consist of Min 2 nos. brand new CO₂ cylinders of adequate capacity. (should not be less than 22.5 Kg each). However actual size of the cylinder shall be as per compressor enclosure size and necessary calculation shall be submitted and approval shall be taken before finalization / supply. One cylinder will act as main & other as stand by, which shall have identical arrangement and connected to the system.

- The cylinders should be placed in a shed raised above ground level to protect from weather and direct sunrays as per Gas Cylinder Rules, 2016.
- Cylinders shall be fitted with automatic actuated Valves, Solenoid valves for automatic actuation No extra utility as air, and inert Gas shall be made available by OWNER /used by the supplier to operate the system other than the UPS.
Cylinder should be ISI marked as per IS: 7285 and CCOE approved.
- Control philosophy shall be such that in case detection of fire by fire detector cylinder shall discharge CO2 automatically.
- One pressure gauge to be located at gauge panel to detect the pressure in Cylinder shall be provided.
- b) The System shall be designed to operate on 24 V DC supply.
- c) FRLS (Fire resistant low smoke) cables shall be used for the wiring of the system.
- d) Interlock of CO2 Flooding system with compressor as per following sequence:
 - Compressor shall trip on detection of gas at preset level.
 - Compressor shall trip on detection of flame at preset level and automatic discharge of CO2 gas shall take place from the main cylinder simultaneously. Compressor shall not start if the CO2 Flooding System is faulty, not working, SWITCHED OFF etc.
 - Compressor shall not start if the CO2 flooding system is faulty, not working, SWITCHED OFF etc. The compressor shall be able to start only when the CO2 Flooding System is in healthy working condition.
 - Maintenance Override Switch shall be provided to keep the system off during maintenance.
 - Selector switch shall be provided to put Main/Stand by Cylinder in line at the turn of a switch as per requirement.
- e) Alarm panel for CO2 Flooding System shall be integral with the main compressor panel. Necessary displays as system ON, OFF, FAULT, RESET, Gas/ Flame indication, Remote actuation of solenoid valve, distinguished hooter etc., shall be provided for CO2 flooding system.
- f) CO2 Cylinders shall be provided outside the package at a safe place, where it is not exposed to fire in case of fire in the compressor. Facility shall be made to operate the system both manually and also from remote with the help of a switch/ call point and with help of pull down lever on cylinders.
- g) Suitable online weight (CO2) loss monitoring/ indication device to be provided to ascertain the health of the CO2 flooding system.
- h) All installation shall be compatible for hazardous area Class 1, Division 1, Group-D for Methane Gas.
- i) One Blinking aviation lamp shall be provided at the top of compressor canopy suitable for hazardous area for fire indication.
- j) The system designed by the supplier shall be duly approved by Owner/ Owner's representative.
- k) Technical specifications, Operation and Maintenance Manual, CCOE Certificate, Approval/ Manufacturing certificates for cylinders and cylinder valves, gas detectors, flame detectors, solenoid valves etc. shall be furnished by the supplier along with system.
- l) Software and hardware, calibration procedure shall be provided by the supplier along with the supply sufficient enough to handle the system independently.
- m) Necessary tools (1 set) shall be provided with the system.
- n) System shall be offered for testing to OWNER by the supplier after commissioning at site by creating actual Gas leak and Gas fire situations and actual discharge of CO2 Gas from the Cylinders. This shall form a part of performance test and thereby acceptance of the package. The cylinders have to be refilled by the vendor at no extra cost to OWNER after performance test. If the system fails during testing, subsequent testing and refilling would be at vendor's cost.

- o) Warning and Operating instructions to be displayed at equipment as per the statutory/ safety regulations.
- p) Piping of CO₂ flooding system shall be seamless high pressure pipe of Schedule 40 of 50 mm dia of appropriate length with a minimum safe distance of 4 Meter from CNG Compressor, The fittings like elbows, Tees, Union, sockets should be of same schedule and capacity for installation in a high pressure system as per NFPA-12.
- q) Flameproof online weighing system, complete frame with shed and all accessories should be of good quality, weighing scale should be of reputed make.
- r) Specifications:

Non Return Valve for CO₂ High Pressure Hose:

As per BIS specifications

Operating Media: CO₂

Body Material: Brass, BIS: 319

Ball: SS 316

Pin: SS 316

Seal: Teflon (PTFE)

Working Pr.: 60 Kg/cm²

Test Pressure: 90 Kg/cm² for 1 min

Weight: 70gm

Outlet Size: ¾ BSP at manifold end

Inlet Size: ½" BSP at CO₂ Discharge Hose end

Temp. Range: -29° C to 66° C

Hose Adaptor:

As per BIS specifications

Operating Media: CO₂

Body Material: Mainly Brass

Test Pressure: 250 Kg/cm²

Max. Working Load: 150 Kg/cm²

Temp. Range: -29° C to 66° C

Discharge Nozzle:

As per BIS specifications

Operating Media: CO₂

Body Material: Leaded Tin Bronze as per BIS: 318:1981

Design Nozzle Pr.: Not less than 20.6 kgf/cm² at 27° C

Test Pressure: 140 kgf/cm²

Marking for Code No. (on the basis of equivalent single orifice dia.): As per BIS: 6382:1982

Temp. Range: -29° C to 66° C

High Pressure Hoses:

As per BIS 7285:1974

Operating Media: CO₂

Hose Type: Double wire braided (perforated) rubber covered

Min. Bursting Pr.: 420 kgf/ cm² at 54° C

Length: 40 cm

Cross-section: ½"

End Connection: ½" BSP (F) xW21.614 TPI

End Fittings: Brass

Temp. Range: -29° C to 66° C

8.2 Following warning and caution signage shall be marked on the housing/package:

“No Smoking”

Caution notice “This Machine may automatically start at any time”.

“Flammable Gas”

9.0 BASIC DESIGN CRITERIA OF COMPRESSOR

9.1 Following specification is intended to give the bidder the technical and operating conditions the compressor must fulfil. Compressor shall be hydraulic booster type suitable for variable suction pressure.

9.2 The bidder shall meet all applicable statutory codes, national law and local regulation for safety and environment protection.

9.3 The design shall conform to API 618 or other relevant reputed international standards but approved by CCOE (bidders to indicate).

9.4 Offered package shall be complete with compressor, electric motor, hydraulic pump and piping, cooling system, suction and discharge filters, controls panel safety and control devices and other accessories required for automatic and safe operation the system.

9.5 The supply shall include all interconnecting piping/tubing/cables.

9.6 Cooling system shall be of closed circuit type. Ultimate cooling shall be by air.

9.7 The compressor package control system shall be designed for unattended safe operation in automatic mode and shall unload, start, load, stop safely.

9.8 The compressor shall start in auto in case high bank pressure in dispenser falls below 200 kg/cm² and stop once the pressure in all three banks reaches to 250 kg/cm².

9.9 Compressor shall be suitable for continuously variable suction pressure from 200 kg/cm²g to 30 kg/cm²g, supplied through LCV mounted CNG storage cascade.

9.10 Compressor should also stops when suction pressure falls below 30 kg/cm²g.

9.11 Compressor shall be suitable for discharge pressure from 250 kg/cm² to 220 kg/cm², corresponding to suction of 200 kg/cm²g to 30 kg/cm²g.

9.12 Compressor shall be designed to ensure flow capacity as indicated in data sheet

9.13 Due to space constraint, we will be installing the stationary cascade (capacity 3000 WL) of 7.0 tons (7000 kgs) on the top of the canopy of compressor. the bidder will therefore design the canopy to take the load of a stationary cascade of 7.0 tons. The bidder shall also provide 2 nos. stair case/ladders (in line with the gas cylinder rules) for safe climbing on the top of the canopy along with hand railing on the top for ease maintenance and operation. Provision should be made such that, the cascade can be placed anywhere above the canopy. the bidder shall ensure that adequate space (minimum 2 feet width) walk way in front side of cascades (i.e valve mounting side) is available for carrying out routine checking/ Maintenance.

9.14 Priority Fill System:

9.15 Vendor shall provide PLC Controlled Priority fill system with compressor top-up facility inclusive of regulating valves by pass valve & liquid filled pressure gauges all mounted in a stainless steel structural.

The priority fill system is to be installed to ensure that vehicle filling takes priority over cascade filling and direct CNG TO THREE STORAGE BANKS IN CORRECT SEQUENCE.

The compressor shall shut down once all three-cascade storage banks are filled to 250 Kg/cm² g.

Compressor shall start on pressing of manual start push button & automatically when the cascade storage high bank pressure of compressor falls to 200 Kg/cm² g and shutdown automatically when all 3 banks of stationery cascade are filled to a pressure of 250 Kg/cm² g

Full bore ball valves shall be provided so that compressor can take suction either from LCV cascade or stationary cascade.

All fittings and tubes used in priority system shall be of stainless steel of suitable pressure rating (5000 PSI) .

End connections shall be 3\4" size pipe OD.

Priority panel shall be of 3 Bank priority panel along with emergency actuators.

9.16 CASE – I : Valves positioned to take suction from LCV cascade.

- a) If the LCV cascade pressure is more than 200 kg/cm², the gas dispensing should take place directly from LCV to dispenser bypassing booster compressor.
- b) Compressor shall start on pressing of manual push button or auto start when the LCV Cascade and Stationary cascade at all banks pressure falls below 200 kg/cm². The priority of filling s hall be as follows;
 - First priority: Priority panel shall first fill the vehicle through dispenser
 - Second priority: If no vehicle is to be fuelled, priority panel shall fill the stationary cascade. The compressor shall shutdown automatically when either all stages of stationary cascade are filled to a pressure of 250 kg/cm² or pressure in mobile cascade is less than 30 kg/cm².

9.17 CASE – II : Valves positioned to take suction from Stationary cascade.

- a. Dispensing shall be done through stationary cascade without compressor running, if stationary cascade pressure is more than 200 kg/cm².
- b. Compressor shall start on pressing of manual/auto start push button if stationary cascade pressure is less than 200 kg/c m². Dispensing into the vehicle should take place as usual. Compressor shall trip if either there is no vehicle for fuelling or pressure in stationary cascade is less than 30 kg/cm².

Note: Automatic switch over shall be provided at Booster compressor panel to switch valve positioning as per above Case I and Case II.

9.18 The compressor package control system shall be designed for unattended safe operation in automatic mode and shall unload, start, load, stop safely. The compressor shall start in auto in case high bank storage pressure falls below 200 Kg/cm² g and stop once the pressure in all three banks of storage cascade reaches 250 Kg/cm² g.

9.19 Noise level shall not exceed 75 ± 3 dBA at 1m from the compressor package enclosure.

9.20 The compressor package control system shall be so designed that the first item to go into alarm condition shall "Lock out" to indicate the cause of the trip though the cause of the trip may have disappeared. The lock out condition shall be manually reset.

9.21 An automatic restart shall be provided on restoration of power with a 10-second delay after temporary interruption. Existing alarm condition shall remain indicated.

9.22 Prime mover (Electric Motor)

The motor shall be flame proof/ explosion proof and confirm to IS: 2148 & IEC 60079-1 suitable for zone 1 group II area as per IS/IEC. The Motor shall be of standard frame size as per IS/IEC and rated for continuous duty with high efficiency and shall be designed for star-delta starting. The Motor shall be provided with class 'F' insulation, however, temperature rise shall be limited to the temperature specified for class 'B' insulation as per IS and shall be suitable for voltage variation of 415V+ 10%. The bidder shall indicate the guaranteed total power requirement in KW. The motor rating shall be 110% of the greatest BKW required by the compressor.

9.23 Motor Specification

Electric Motor

- a) Type of drive Totally Enclose Fan Cooled (TEFC) high efficiency as per IEEEMA standard-19-2000
- b) Protection Flame proof & weather proof enclosure
- c) Insulation Class F with class B temperature rise
- d) Mounting Horizontal Foot Mounting
- e) Specification standard By Bidder
- f) Supply Voltage(assumed) 415+ 10% volt, 3 phases,50+ 5%Hz
- g) Synchronous speed By bidder
- h) Motor rating By bidder
- i) Motor Efficiency By Bidder
- j) Power factor By Bidder
- k) Speed of motor By Bidder
- l) Nos. of hot starts of motor 2 hot and 3 cold starts per hour
- m) Coupling Type By Bidder
- n) Torque speed cure By Bidder
- o) starting torque, speed, thermal withstand curve load, current speed curve, Efficiency power factor vs load curve by Bidder

Motor Accessories

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

9.24 Cooling system

Each compressor package shall be complete with its own cooling system. The cooler shall be air-cooled heat exchanger. The gas temperature after after-cooler shall not exceed 52 degree C.

Special attention to be given while designing the gas cooler considering the local conditions. Bidders shall ensure that final delivered gas temperature is less than 52 °C. Cooler design shall be on the basis of 10% extra load corresponding to maximum severe operating conditions based on thermal duty. Gas cooler shall be design as per manufacturer standard.

For cooling of the heat exchanger a cooling fan to be provided.

Cooling system to be in a single enclosure. Bidder to submit cooling sizing calculation for review.

Direction of flow should be marked on the pipe line and nomenclature of all vessels (e.g. 1st stage discharge dampener etc.) should be written on them. Cross head inspection windows if applicable should be transparent for ease of inspection during running. Set values should be prominently marked on the gauges.

Packages design should be such that its vent should not go upward (package vent in vertical direction not required) i.e opening of package vent should be in horizontal directional with duct arrangement.

9.25 Oil Filter

The ingress of oil into CNG adversely effects vehicle emission and storage system. Contractor to supply a proven, maintenance free oil removal system after after-cooler to remove oil from compressed gas. The offered oil mist removal system shall restrict the oil to less than 5PPM in discharge of compressor.

9.26 Gas recovery system

If required, the Contractor shall provide gas recovery system with gas recovery vessel. The gas recovery vessel shall be provided with pressure relief valve and necessary instrumentation to avoid cold flaring of gas. Gas recovery vessel shall be ASME/IBR code designed.

9.27 Piping & Appurtenances

The materials for gas piping shall be seamless carbon steel of ASTM A-106 Grade B. The piping / tubing at the outlet of the compressor and of priority fill system shall be of seamless stainless steel of proper pressure rating and specifications as under:

SS TUBING SPECIFICATIONS:

- Seamless SS Tubing
- Material of construction Stainless Steel 316L
- Tube hardness shall be less than 80 RB
- Sizes : Metric system (inch)
- Max Working Pressure : 350 Kg/cm² g

SS FITTINGS & VALVES SPECIFICATIONS:

- Material of construction Stainless Steel 316
- Sizes : Metric/SI
- Standard : ASTM/ ASME/ DIM
- End connections : Single or Double ferrule Compression type / NPT
- Max Working Pressure : 350 Kg/cm² g
- PSV Vent Line to be extended above the package to safe height.
- Priority system should be designed so that the gas flow from mobile cascade to dispenser is possible even with the Compressor shutdown & de-energized
- Dedicated Air compressor of adequate capacity

9.28 Electrical System

- All electrical equipment of compressor package shall be installed in accordance with NFPA 70, NEC for Class 1, Division 1, Group D, and IS 5571 and shall have approval of a recognized certifying authority.
- OWNER shall provide 415+ 10% volts, 3 phase and 50+ 3% Hz electrical connection at CNG station electrical panel only. Vendor shall distribute electrical power to all equipment and control system by providing cables and suitable switch-gear distribution panel.

- The electrical power supply distribution panel, switch gear panel and starter shall be in flame proof construction. 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.
- Heavy duty on-load phase changeover should be provided for H.E motor.
- Semiconductor fuses to be provided, where applicable.
- All illumination fittings should be single phase AC supply based and LED type only.
- All wire/ cable to be used in compressor and panel shall be of copper conductor and FRLS type through proper cable tray conduit etc.
- Sufficient space to be provided for Motor JB for cable glanding work.
- Necessary arrangement to be provided in package for easy extraction of motor from package
- Multifunction meter to be provided for metering of package total energy and other parameters (viz; KVAH, KWH, Voltage, current, PF, Frequency, MDI (KVA), MD (KWH).
- Multifunction meter also required for fan motor electrical parameters monitoring.
- Bidder to ensure that spares and service support of all switchgears, instruments, or meter etc. used in package/ panel, shall be available in Indian market.
- The power factor (PF) of the whole electrical system should not be below 0.95. Motor feeder shall be provided with energy meter, heavy duty switch, HRC link type with single phase presenter fuses, contractors (AC-3 Duty), bi-metal relay switch fuse unit, voltmeter, push buttons, earth leakage relays, indication lamps for start/stop/trip/ etc. Ammeters shall be provided for all motors above 3.7. KW rating. Stop push buttons shall be lockable and have stay put except in case of critical devices such as lube oil pumps etc.

9.29 Earthing System

The design & installation of earthing system shall be as per IS 3043 or equivalent international specification. One or more no of earth plates with provision of inter connection to main earth grid shall be provided. All hardware used for earthing system shall be hot dip galvanized or zinc passivated.

All cables shall be terminated at equipment by means of double compression type compression glands and shall be flame proof cable glands if located in hazardous area

9.30 Phase sequence preventer (current based) shall be provided.

9.31 Vibration

Compressor maximum vibration of cylinders shall not exceed 10 mm/sec unfiltered peak velocity. Maximum vibration level of installed compressor frame shall not exceed an unfiltered peak velocity of 5mm/sec or as per IEC Code unfiltered peak-to-peak vibration whichever is less. The bidder shall provide for all structural support within the package so that these levels can be achieved.

10.0 INSTRUMENTATION & CONTROLS

10.1 All the Instruments and Control Shall Be Suitable For Area Class I, Group D, Division I

10.2 All package mounted transmitters & temperature elements shall be intrinsic safe as per IEC 79-11 and solenoid valves, switches and related junction boxes shall be flame proof 'd' as per IEC 79-1. Other special equipment / instrument, where intrinsic safety is not feasible or available, shall be flame proof/ explosion proof as per IEC 79-1.

10.3 All pressure gauges shall have an accuracy of + 1% of FSD and 100mm dial size. Pressure sensing elements shall be minimum of SS316 and movement of SS304. All pressure gauges on process lines having range more than 40kg / cm²g.

- 10.4** Panel shall be complete with start and stop push buttons, hours run meter, power on and fault indication lamps, fault reset button. All necessary timers and intrinsically safe relays to control the system on an automatic starting and stopping basis shall be provided. The compressor package control system shall be designed for unattended operation in automatic mode and in case of any fault it will go in a safe mode.
- 10.5** Compressor package shall be provided with a PLC based local control cum operator panel (LCP), which shall be mounted on the package enclosure. PLC shall be housed inside flameproof iiA/iiB(Ex'd') enclosure. All the equipments/ sub panel of LCP shall also be provided on the flameproof enclosure. All the interlock, monitoring and controlling of the CNG compressor package shall be done through PLC based control system. PLC hardware shall be in accordance with IEC-61131-2 and however PLC shall be capable to convert programmed in flowchart, functional block diagram, structural text etc. In accordance with IEC-61131-3. PLC shall be provided graphics /text display & scrolling facilities to view process & machine parameters. All source & object codes including logic flowchart, ladder diagram etc is to be furnished by the packager during detailed engineering. The same can be view on client's laptop.
- 10.6** PLC shall be of modular in construction with EEPROM, redundant power supply for CPU and HMI, redundant power supply for load, non-redundant I/Os, communication cards for connecting mass flow meter, communication card card /port for future scada connectivity.
- 10.7** PLC shall be suitable for recording of compressor parameters as indicated in instrumentation and all other parameters that are recommended by the compressor manufacturer for recording on hourly basis for the last 24 hours. PLC shall be suitable for interfacing with printer (HP Laser printer) for getting the printout of the parameters recorded (as mentioned above) for the last 24 hours through remote HMI PC (if provided)/ external Laptop in same format as programmed in PLC.
- 10.8** Pressure Transmitter and Temperature Transmitters shall be used for CNG Gas application and not pressure and temperature switches. The units of measurement for flow shall be Kg/hr, for pressure shall be Kg/cm² (g) or and for temperature shall be degree C.
- 10.9** The selected I/O shall have 40 % spare of used capacity (40% in each used card) for future use. 10% of used IO or Minimum two of each card out of 40% shall be extended upto terminal block with necessary isolator/ barriers.
- 10.10** Diagnosis feature shall be available in CPU and I/O used in PLC.
- 10.11** Mounting of PLC components such as CPU, HMI, I/Os in one JB and power supply relay barriers/isolators, fuses, MCB, electrical earthing bus bar in other JB. PLC components / system shall be tropicalised, adopted with complete wiring and necessary terminals. Wiring to be color-coded with cross printed ferruling in position
- 10.12** PLC shall be configured as a remote terminal unit of supervisory computer and data acquisition system complete with Ethernet Port RS 485 (MODBUS TCP/IP) shall be readily configurable for communication over MODBUS TCP protocol through Leased Line/MPLS/VSAT/RF. PLC shall be capable of carrying out on line routines for at least ten separate loops without affecting the scan, cycle & up dating time etc.
- 10.13** Human Machine Interface
- 10.14** HMI shall be provided with text/graphic display and operating system software for interlocking, monitoring and control. All operational buttons shall be on display except the Emergency stop button. Display system shall be weather proof to IP65. This should be provided in the flame proof panel with HMI mounted on the door of the panel. The HMI screen shall be back side of the toughened glass. During running of the compressor the HMI should be assessable through the external push button provided on the panel. The PLC shall be interfaced with SCADA in future. All the parameters on the PLC shall be available on the HMI. Bidder shall provide application program for PLC, HMI on LCP (licensed one set) along with all interfacing adaptors and cables. Bid der shall also provide one set of source &object code s for PLC, HMI on LCP (in both forms, hard & soft).
- 10.15** The temperature gauge shall be generally mercury in steel field type. Capillary tubing shall be min. SS304 with SS flexible armouring. The gauge shall have an accuracy of +1% FSD and 100mm dial size. The range

shall be 1.5 times of operating temperature. Skin type temperature gauges shall not be used. In PLC pressure process values should be taken from pressure transmitters and should be independent from pressure gauges installed on local gauge panel. Temperature process values should be taken from temperature transmitters and should be independent from temperature gauges installed on local gauge panel. The compressor package instrumentation & control is to be configured for manual as well fully automatic control system including starting, shutdown as applicable for unattended operation.

- 10.16** Individual (2/3 core) cabling is required for each field instrument from field JB to avoid multiple JB's and multicore cables in field for easy trouble shooting & replacement.
- 10.17** Each cable shall be neatly tagged & dressed for each instrument.
- 10.18** The PLC System offered shall be supplied with monitor and memory card for Processing of live data and stored data. PLC shall be capable of
 - a) Compressor Control & Emergency Shut down
 - b) Fire and gas detection and monitoring
 - c) Graphics, Data acquisition, monitoring & logging, viewing, modifying set point and range of all process parameters for which transmitters are provided.
 - d) Record the last 20 Alarms of abnormal operations on separate page.
 - e) PLC shall be capable for display of flow meter data for flow rate and flow totalizer (i.e. Gas Suction, Gas Discharge) and power consumed by the motors, compressor running hour :
 - f) The above data will be viewed / analyze offline (during shutdown of compressor) or online through dedicated SCADA port (Ethernet / RS 485) on client laptop and local PC

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

Where three bank cascade has been envisaged; in auto mode, compressor shall start automatically/manual in case high bank storage pressure falls below 200kg/cm² and stop as soon as pressure in all three banks of stationary cascade reaches 255 kg/cm². The priority fill system (In Bidder's scope) shall ensure the filling of vehicle, storage cascade in correct sequence. Control system shall be designed such that in case of any fault, discrepancy or abnormality, it will go in safe mode. All controls shall be made in fail-safe mode failure of any control shall not lead to operation of equipments in unsafe condition.

In case of fault, a warning hooter shall operate, the sound of which should be audible at distance of at least 15 meter. Further the fault alarm and emergency stop PB shall be duplicated in the CNG station control room. Acknowledgement/resetting of fault shall be possible only from compressor panel. Emergency stop PBs shall be mushroom head turn lockable type. Once the fault is acknowledged or compressor is under normal maintenance, the valves of priority panel shall take the position so that gas available in the stationary CNG storage cascade can be dispensed.

Calibration certificates required for all instruments such as Mass Flow Meter, Pressure transmitters, Pressure gauges, Temperature gauges, Temperature transmitters, Gas detectors, Flame detectors etc.

- 10.19** PLC make should be as per suggested vendor list.
- 10.20** All the instrumentation shall be capable or operating for full range of operation.
- 10.21** Separate junction boxes shall be provided for each type of signal i.e. analog, digital, solenoids RTD, thermocouple, intrinsic safe and for power supply. No cable shall share power & signal. This is not applicable for direct run cable.
- 10.22** Suitable bypass for interlocks shall be provided for start-up.

- 10.23** Compressor package shall be provided with the following indicators:
- Pressure indicator each stage suction and discharge.
 - Oil pressure indicator on each pressure lubrication system
 - Oil levels indicator, field mounted
 - Hour meter
 - Non- resettable electromechanical hour meter on local control panel.
 - Compressor jacket water coolant temperature indicator on local gauge panel
 - Hydraulic oil cooler inlet & outlet temperature on local gauge panel (if required)
 - Hydraulic oil pressures each stage on local gauge panel (if required) The Compressor package shall be provided with the following trip devices:
 - a. Low oil level protection devices
 - b. High oil temperature devices
 - c. Low suction pressure protection devices
 - d. High discharge temperature protection device
 - e. Coolant flow low devices
 - Flame detection
 - Gas detection
 - Emergency stop devices
 - Fail safe/ wire break alarm for safe operation
 - Interlocking provision in PLC program for tripping of machine
- 10.24** Compressor package shall be furnished with the following trip logic that shall stop the compressor and suction of compressor shall be isolated:
- On high oil temperature
 - On low suction gas pressure
 - On high discharge pressure
 - On high discharge gas temperature
 - On coolant flow low
 - On fire detection
 - On gas detection
 - On pressing manual stop button at local control panel
 - On pressing emergency stop devices
- 10.25** Compressor package shall be furnished with following tripping circuit (the motor shall stop and suction of compressor shall be isolated)
- On actuation of gas detector alarm.
 - On actuation of flame detection alarm.
 - On pressing of manual stop button at compressor package
 - On pushing of emergency stop device

10.26 Each compressor package shall be provided with an audible and visual alarm system for annunciation on compressor abnormalities.

10.27 Junction box shall be of explosion proof type with 10-20% extra terminal strip & cable gland shall be of double compression type.

10.28 Gas detectors and flame detectors should be mounted with the canopy.

10.29 All instrument shall be of internationally reputed manufacturer

10.30 Emergency shut down devices

The emergency shut down (ESD) system is also in scope of vendor. This shall be in accordance with NZS 5425. A fail safe system shall be designed and incorporated to isolate cascades storage from dispensers, stop compressor isolate the compressor suction storage line and cut off power supply on activation of ESD switch. This ESD switch shall have to be manually reset to restart the compressor package again. Red ESD button (5 nos.) shall be located in Control Room, Process Area fencing, one side of compressor, one control panel and one to be kept in electrical room. A separate hooter for customer interface room shall be provided with annunciation window alarm (if required) of individual protection device.

10.31 Local Control Panel

- There shall be three independent ports available in the PLC with all the parameters available on each individual port.
- Redundancy in PLC is required. PLC shall incorporate all process parameters (specified elsewhere) and status of compressor & priority panels and shall be modular in construction with 100% redundancy with respect to CPU, Power supply, Interface. PLC components/ system shall be tropicalized, MIL standard adopted with complete wiring and necessary terminals. Wiring to be color coded with cross ferruling in position. PLC shall be capable of carrying out on line routines for at least ten separate loops without affecting the scan, cycle & updating time etc. PLC shall be configured as a remote terminal unit of supervisory computer and data acquisition system complete with GPRS and Ethernet connectivity. One card for transferring and accessing data from minimum twenty devices with RS485 port shall be provided. In case of failure of master/ active controller/ CPU, standby controller/ CPU should take over the control in bump less manner. All values & data should be available through both the controllers immediately, i.e. there should be no data loss.
- Successful bidder to include in scope live demonstration of remote monitoring of all PLC logged parameters in one machine at his works. OWNER may ask for the same. However, this may be required to be demonstrated at site.
- PLC based logic circuits shall be used for control & interlock of the compressor package with RS485 SCADA Connectivity as per details in Annexure-XI.
- Local control panel shall be furnished with window alarm of individual protection device and a common hooter for audible alarm.
- Local panel should have separate push button for start, stop, emergency stop, alarm acknowledge, alarm rest & test button for checking healthiness of annunciation system.
- PLC shall be housed inside flameproof IIA/ IIB (Ex'd'). Local operator panel shall also be provided on the flameproof enclosure. The operator panel is provided for parameterization, indication, monitoring, and alarms and first out sequence of the system. PLC system shall have memory modules for storing user programs, symbol lists, program comments and should facilitate debugging/ trouble shooting without the application program. Program shall be ladder logic and communication shall be in English for each run. Program should have signal/ parameter tags as labels for easy identification/ troubleshooting. Each section of the program whether it is in the form of rung or page or network should have comment to classify the interlock being executed. A soft copy of the program should be sent by email/ CD.
- PLC & electronic shall be housed in flameproof control panel & shall be mounted on compressor skid itself. Main cable entry shall be bottom to up. Also control panel shall have 2 nos. spare 2.5 sq mm slots with copper gland arrangement.

- Bidder to quote for complete package with all relevant panels required for the compressor to perform as desired. The electric panel shall consist of electric MCC, switchgear, contractors, power supply distribution panel etc. and shall be located in hazardous area. The compressor package with control panel (including PLC and other controls) and other electric/ electronic instruments etc. shall meet hazardous area classification of Class I, Division I, Group D as per NEC or Zone I, Group IIA/ IIB as per IS/ IEC.

10.32 Priority fill system

Contractor shall supply 3-bank priority fill system with compressor top-up facility inclusive of regulating valves, check, by pass valves & liquid filled pressure gauges all mounted in a stainless steel panel. All fittings and tubes used in priority system shall be of stainless steel of suitable pressure rating. The priority fill system is to be installed to ensure that vehicle filling takes priority over cascade filling and direct CNG to three storage banks in correct sequence. The compressor shall shut down once all three-cascade storage banks are filled to 250 Kg/cm² g. Compressor shall start on pressing of manual start push button & automatically when the cascade storage high bank pressure of compressor falls to 200 Kg/cm² g and shutdown automatically when all 3 stages of stationery cascade are filled to a pressure of 250 Kg/cm² g.

10.33 Documents

- 10.33.1 Operation and Maintenance Manual (In English) – 02 Copies
- 10.33.2 Calibration certificates of all instruments & devices
- 10.33.3 P&ID Diagrams
- 10.33.4 Interlock Block Diagrams
- 10.33.5 Bill of Material with Tag No & Technical Specifications
- 10.33.6 Wiring Diagram of Electrical & Instrument Panel
- 10.33.7 Electrical Power & Control Diagram
- 10.33.8 Specifications of Electric Motor & Characteristic Curves
- 10.33.9 Foundation Drawings
- 10.33.10 Capacity vs. Suction Pressure curve
- 10.33.11 Capacity vs. Energy Consumption curve
- 10.33.12 List of spares for three years of operation and maintenance. The list of spares should include ordering specification and manufacturer’s catalogues.
- 10.33.13 List of special tools & tackles to be provided along with the bid.

11.0 SKID AND ENCLOSURE

The maximum allowed temperature within the enclosure shall be 5° C above ambient temperature. Adequate ventilation fans shall be provided to meet the above and also to account for heat dissipation of the coolers. Interlock shall be provided to start the exhaust fan to vent out any entrapped gases in the enclosure before starting the main compressor. In case heat exchanger fan is compressor shaft driven, the same can’t be utilized as ventilation fan.

The compressor package shall consist of single enclosure for Compressor and Electric Motor. The equipment shall be mounted on one common skid. The Enclosure to restrict maximum noise level to 75±3 dB(A) at 1 meter from the enclosure.

Material used in the enclosures shall be fire retardant. Rain water should not enter into the enclosure and forced ventilation system shall be provided.

The enclosure shall have doors for normal access and removable wall panels for ease of maintenance.

All the pressure, temperature, oil level, lube oil pressure, coolant temperature, coolant level indicators shall be accessible through gauge panel fitted outside of the package.

Enclosures shall have internal flame roof lighting arrangement.

For handling all heavy arts for maintenance purpose necessary lifting arrangement such as beam fitted with chain hoist shall be provided in enclosure

The Compressor shall be located inside an acoustic enclosure. All Coolers, Knock Out Drums, Scrubbers, Cooling System, lubrication system along with interconnecting piping shall be inside an enclosure. Enough headroom shall be made available for easy access and maintenance of all equipment. The piping layout with respect to the compressor, intercoolers, KOD and auxiliaries location shall be subject to Purchaser's approval during detailed engineering Stage.

Components such as pressure gauges, temperature, pressure switches, filter automatic ball valves, safety valves etc., which require in-situ adjustment, maintenance and reading, shall be easily accessible.

Conduits and tubing shall be arranged in orderly and systematic manner and shall be routed neatly to enter the back of display or monitoring panels

Routing service item such as, but not limited to, oil filters, inter stage gas filters, inlet and outlets gas filters and drive belt shall be located to facilitate easy one-man servicing.

One person should be able to access 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.

11.1 Painting and protection:

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

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

12.0 INSPECTION & TESTING

- a) Inspection shall be carried out as per Quality Control Table/ Quality Assurance Plan approved by Owner or its representative. Supplier shall submit the Quality control table (complying to tender QCT/ QAP) for approval.
- b) The bidder has to provide 15 days advance notice prior to said inspection & test.
- c) The bidder shall be responsible for specified inspection & testing requirements including at all sub bidders.
- d) Bidder shall keep following data available for at least 5 years for examination by purchaser.
- e) All necessary certification of materials, such as mill test reports.
- f) Purchaser specification for all items on bills of materials.
- g) Test data to verify that requirement of the specification have been met
- h) Result of quality control test.
- i) Pressure retaining parts including auxiliaries shall be hydrostatically tested with water at following minimum test pressure for a minimum period of 1 hour :
 - Cylinder: 1-1/2 times maximum allowable working pressure.
 - Cylinder cooling jacket & packing case 1-1/2 times coolant pressure but not less than 8 barg effective.

12.1 Mechanical Running Test (MRT)

- a) These tests shall have mechanical operation of compressor, driver and accessories, Instruments, control system and the coolers.
- b) The MRT for the 25% compressors block of the lot shall be carried out with job or shop driver including complete job driving system i.e., job driven V-belt, job pulleys etc., for 4 hours continuously at the premises of compressor block OEM. The compressor need not be pressure loaded for MRT test. During this test following shall be recorded at agreed intervals (as applicable).

- Operational Parameter
- Vibration levels measured on cylinders and frame
- Bearing temperature
- Oil cooler inlet and outlet temp

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

- Bore & other parts by opening a valve
- Piston & cylinder clearance
- Visual examination of position rod, cylinder guide bore without dismantling

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.

12.2 Mechanical String Test

Mechanical String Test for 4 hrs. is a mandatory requirement to be performed at packager's shop before dispatch in presence of Owner's representatives (or an authorized representative of OWNER). 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. At least 25% of the package lot ordered shall be string tested. String test shall be on natural gas preferably. Air/ N2 can be used for string test purpose if natural gas is not available in the shop.

12.3 Erection, Testing & commissioning at Site

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

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

12.4 Field Trial Run

Bidder shall conduct a field trial run of each compressor package for 72 hrs. (can be in multiple runs) at CNG Station as per QAP in which satisfactory operation of complete package together with all accessories/auxiliaries controls shall be established for specified operating conditions without any major breakdown 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 i.e. only for reasons not attributable to the vendor. The Equipment shall be considered commissioned after the successful completion of Field Trial Run. All punch points raised by OWNER should be completed before performing the FTR. The bidder shall record data of field trial run.

12.5 Noise Level Test

During the field trial run, noise level test shall be carried out and bidder shall demonstrate /achieve the granted noise level. All necessary instruments /accessories required for fields trial run and noise level test shall be arranged by the bidder.

12.6 Performance Acceptance Test (PAT)

Before conducting performance acceptance test at site, Bidder is required to clear all punch points (if any) raised by OWNER / OWNER's authorized representative.

Compressor Package Performance test at sites shall be carried out as per ASME PTC9. All necessary instruments/accessories required for this test at site shall be arranged by the bidder and repatriated after successful performance test by the bidder.

All such instrument shall be pre-calibrated. Bidder to quote for performance test per compressor package separately at site inclusive of boarding, lodging office space, local transport for bidder personnel and hiring of local contractor, crane etc. bidder shall be liable to pay all local taxes, levies applicable and strictly comply with rules, laws prevailing in India.

Performance test shall be conducted at site for minimum 4 hours continuous duration at guaranteed parameters as quoted by the bidder (PAT procedure shall be in accordance with ASME-PTC-09).

However, if load is not available at site intermittent running for 4 hours shall be permitted with maintaining minimum continuous operation of ½ hour. Bidder to submit PG test procedure for review / approval. Complete package shall be performance tested as a module whereby along with motor & compressor performance bidder shall demonstrate all controls, shutdown, trips/alarms etc.

The test shall be the basis of, acceptance/rejection of the package thereon. Bidder shall submit the detail test procedure for the same, which shall be approved by OWNER. The test for the package shall be witnessed by OWNER/ OWNER's representatives.

13.0 GUARANTEE, LOADING AND PENALTY CRITERIA

This section described the guarantee parameters, which the booster 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.

For loading and compensation purpose, power consumption with suction pressure of 30 to 200 kg/cm² and discharge pressure equal to dispensing pressure may be considered. Dispensing pressure will depend on empty vehicle pressure to be fuelled and compressor discharge pressure may not be 250 kg/cm² continuously. For power consumption purpose discharge pressure may be taken 230 kg/cm².

The bidder shall furnish the guaranteed value for the following:

Compressor Capacity: Compressor shall guarantee the capacity as mentioned in Guaranteed Parameters.

Compressor BKW: Bidder shall indicate guaranteed BKW including all losses such as mechanical, transmission etc.

Motor Power Output of the prime mover (KW)

Total power required for the package including power consumed by accessories.

13.1 Compressor Capacity

Bidder shall guarantee average capacity of 400 SCM³/H from suction pressure of 30 to 200 kg/cm² and discharge pressure of 255 Kg/cm² at discharge temperature of 52 degree centigrade with no negative tolerance for errors in instruments and measurements.

For calculation purpose 1kg of CNG =1.44 SCM

(Based on density of Gas @ 0.692 Kg/SCM)

Density of Gas = Relative Density of Gas (0.56526) X Density of Air (1.22541 Kg/m³)

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

13.2 Loading against Energy Consumption

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

Bidder shall indicate actual 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 loaded as per following formulas:

$$F = (G-20) \times H \times I \times N$$

Where,

F = Loading amount in Rs.

G = Bidder's Energy consumption rate quoted in KWH for every Average 400 SCM³/H (278 Kg) of CNG produced

(G-20) = Bidder's Energy consumption rate over and above 20 KWH

H = Cost of Energy @ INR12/Kwh

I = Factor towards lifecycle in hours @ 36500 hours i.e. (365 Days X 10 Year X 10 Hours)

N = Number of machines

Note: If bidder quotes less than 20 KWH. No advantage will be given for quoting less than 20 KWH

➤ **Penalty towards Excess Energy Consumption:**

At the start of O&M period or even at any point of time during the O&M period, cost towards excess power consumption beyond quoted figure shall be deducted from O&M bills.

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

$$F = (G-Q) \times H$$

Where,

F = Monthly Penalty in Rs.

G = Monthly Actual power consumption

Q = $\frac{\text{Guaranteed consumption rate quoted by supplier for every 278 Kg of CNG} \times \text{CNG produced during the month}}{278}$

H = Cost of power Rs 12.0/ kWh

➤ **Penalty towards Package Efficiency Loss**

This penalty shall be imposed on compressor blocks not capable of delivering rated capacity of 400 SCM³/H

Following calculations shall be used for penalty towards package efficiency loss:

$$F = 2 \times \{(400 \times H \times RD \times AD) - M\}$$

Where,

F = Penalty Amount in Rupees

H = Hours clocked 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:

- Gauge Pressure at Station Inlet shall be used as benchmark for imposition of penalties and not suction pressure being displayed at the PLC.

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

Details of Penalty for non performance of equipments

a. On normal day (i.e. the day other than the schedule maintenance day):

- i. The party has to ensure that the equipment are 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. 5,000/- per day

Beyond 12 hours : Rs. 10,000/- per day.

- iii. 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.
- iv. In case there is a continuous breakdown beyond 15 days of a calendar month, Entire Monthly Maintenance charges shall be deducted.
- v. In case there is a continuous breakdown beyond 30 days of a calendar month, Entire Monthly Maintenance and operation charges shall be deducted.

In case of daily availability is 20 hrs. but monthly average availability is below 98%. Then penalty @ of 10,000 per % or part thereof shall be applicable.

b. On schedule maintenance day:

- i. The party would be required to carry out the recommended schedule/preventive maintenance of the equipment's for which the party has to indicate the time required for each type of schedule maintenance.
- ii. 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. 5,000/- per day

Beyond 12 hours : Rs. 10,000/- per day.

- iii. Scheduled Maintenance to be notified by for every month and for the next month with downtime forecast.
- iv. 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.

- v. In case there is a continuous breakdown beyond 15 days of a calendar month, Entire Monthly Maintenance charges shall be deducted.
- vi. In case there is a continuous breakdown beyond 30 days of a calendar month, Entire Monthly Maintenance and operation charges shall be deducted.

Note:

- Further, CUGL reserves the right to suspend the Operations & CAMC with prior notice of 15 days to the vendor, due to reasons such as lockdown initiated by the Govt due to which Compressor cannot operate/ Shutdown due to the business requirement of CUGL.
- In case of major manufacturing defect observed in Booster compressor, service provider is required to replace the defective equipment for smooth operation of CNG station. In case bidder fails to do the same, recovery of defective equipment cost shall be done from service provider.
- In case any component of package is not working, maintenance is delayed from schedule and technical issues are not rectified by service provider within the 7 days from intimation given by CUGL, 10% of monthly O&M cost shall be kept hold till the rectification of problem.

14.0 SPECIAL TOOLS AND TACKLES

Special tools & tackles for erection and commissioning and for operation & maintenance are required to be arranged by successful bidder.

Vendor shall maintain sufficient spares to fulfill the warranty & subsequent two years period requirements. In case of additional requirement during the warranty period, if any spare part is taken from OWNER, the same shall be replaced to OWNER with new part supported by necessary document for its authenticity of being new & original spare part

15.0 DOCUMENTATION

- The drawings/documents to be submitted by the bidder shall be divided in three categories:
 - a. Drawing documents to be supplied with the offer
 - b. Drawing /document to be submitted for approval (After placement of order)
 - c. Drawing/document to be submitted for information (After placement of order)
- The bidder shall submit list of drawings, which shall be submitted by them in above three categories. All drawing /document shall be submitted in 6 sets.
- Title block of each drawing shall contain at least following information:
 - Name of the Owner :
 - Name of the Consultant :
 - Name of the Project :
 - Name of Bidder :
 - Descriptive title :
 - Drg. No :
 - Revision No :
- Sheet No./ Total No. of sheet in the drawing:
- Bidder shall furnish relevant calculation and protection relay setting table for the equipment /system being supplied by them, It shall also contain the manufacture’s catalogue, operation and maintenance manuals for all types of relays/components used,

- The bidder shall submit all drawing within specified time, in requisite number, for each equipment/item for approval.
- Approval of drawings by Owner.
- The bidder shall submit furnish drawings as indicated/agreed for each item for approval of the Owner/Consultant.
- Owner/Consultant will scrutinize drawing/data furnished by Bidder and comments, if any, will be communicated to the Bidder within 2 weeks from the date of receipt.
- The Bidder shall submit all the drawings/documents in two (2) sets. All the drawing of sub-bidder/bidders etc. shall be checked by Bidder for correctness and compliance with requirement of order/contract and signed before submission to Owner.
- The drawings shall be stamped in either of following category and one print shall be returned to the Bidder.
 - “APPROVED”
 - “APPROVED SUBJECT TO INCORPORATION OF COMMENTS”
 - “NOT APPROVED”
 - “FOR INFORMATION ONLY”
- Wherever drawings are returned to the Bidder with the marking “Approved subject to incorporation of comments” the bidder shall make the necessary modifications/corrections and resubmit the revised drawings and data for final approval.
- Bidder shall be responsible for correctly incorporating all the points conveyed to him and resubmit the drawings to the Owner for final approval. Specified number of copies of approval drawing and reproducible of specified quality shall be submitted after the final approval of drawings.
- Approval of drawing by owner shall not relieve the suppliers of his contractual obligations and responsibility for engineering design, workmanship, materials and performance of equipment, Work shall be carried out exactly as indicated on the approved drawings and data and no alterations shall be made without the written approval of the Owner,
- If any subsequent alterations are found necessary and approved by the Owner, all drawings and data affected by such alterations shall be duly revised and re-submitted for the approval.
- Bidder shall incorporate/cause to incorporate all change made in the drawings from approval stage to the handing over of equipment and submit as built drawings in the requisite sets (these will be in addition to the sets submitted at the time of approval/for information and up to commissioning). The drawing to be submitted shall include all the drawings submitted for approval, information as also the drawings required for normal operations, trouble shooting repair, and maintenance and testing of equipment etc.
- Bidder shall submit the following drawings/data/document in bound volume prior to submission of final bill to the Owner in soft and hard copies (2 Sets).
- All drawings submitted to Owner for approval information
- Equipment manufacturing drawings submitted for information of Owner.
- Equipment drawings required for operation and maintenance.
- Fault calculations, protection relay setting calculations and recommended settings.
- Inspection reports, factory and site test certificates in bounded volume.
- As built drawings incorporating all site modifications.
- Instruction manuals, Operation and maintenance procedures for individual equipment and total system.
- List of spares for two years operation and maintenance. The list of spares should include ordering specification and manufacture’s catalogues.

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ANNEXURES

(BIDDER TO SUBMIT FILLED UP ANNEXURES FOR 400 SCM³/H)

ANNEXURE – I : GUARANTEED PARAMETERS

(400 SCMH ELECTRICAL Motor Driven RECIPROCATING BOOSTER COMPRESSORS)

| Sr No. | Parameter | Bidder's data | Unit |
|---|---|---------------|--------------|
| For Basis of loading and penalty | | | |
| 1 | Average flow capacity (over range of suction pressure from 200 to 30 kg / cm ² at varying on continuous basis). Bidder to confirm 400SCMH. | 400 | SCMH |
| 2 | Electrical power consumption in KWH with no (+) tolerance with overall full range of suction pressure (from 200kg/cm ² to 30 kg/cm ² varying on continuous basis to compress 400 SM ³ gas per hour with no (-) tolerance without air compressor and exhaust fan for loading and penalty purpose. | | KWH |
| 3 | Minimum flow capacity in SM ³ /h corresponding to suction pressure of 200 kg/cm ² | | |
| 4 | Minimum flow capacity in SM ³ /h corresponding to suction pressure of 30 kg/cm ² | | |
| Guaranteed General Package Data | | | |
| 5 | Compressor BKW in KW @ Rated Conditions (No + ve tolerance) | | KW |
| 6 | Compressor BKW in KW @ RV Set Conditions (No + ve tolerance) | | KW |
| 7 | Net of all auxiliaries/package ventilation loads in KW | | KW |
| 8 | Site rated BKW of Electric Motor (No – ve tolerance) | | KW |
| 9 | Noise level 75 ± 3 DBA @ 1 meter from enclosure | | db |
| 10 | Footprint area of compressor package quoted | | mtxmt |

NOTE:

1. Parameters under Sl. No. 3, 4 are for reference only.
2. Bidder to quote the data in the unit as asked for in the above table.
3. Sl.No.2 Bidder must indicate the guaranteed KWH including all losses such as mechanical transmission power absorbed by compressor auxiliary like cooler fan etc. but excluding air compressor.
4. Power consumption and capacity should be indicated corresponding average discharge pressure 250 Kg/cm²
5. Bidder has to fill all rows in above table. If any row is not filled by bidder or above tables are modified in any manner, bid will be rejected summarily
6. Conversion factor for Kg to SCM is 1 kg = 1.44 SCM
7. Bidder has to guarantee that offered compressor package will deliver minimum average flow of 400 SCM³/h under the condition described above. Delivery of less than 400 SCM³/h average flow is not acceptable and will be summarily rejected.



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ANNEXURE – II : COMPRESSOR DATA SHEET FOR 400 SM³/HR

| 1.0 | PROJECT: CNG Expansion Project | | DATA SHEET NO: | |
|------------|--|---|---|---|
| 1.1 | NO. OF UNITS | : | As per SOR | DRIVE: Electrical Motor |
| 1.2 | DUTY | : | Continuous | LOCATION: As per SOR |
| 2.0 | OPERATING CONDITIONS | | | |
| 2.1 | Service/Stage | : | Compressor for CNG Stations/ Two | |
| 2.2 | Gas Handled | : | Natural Gas | |
| 2.3 | Composition (%) | : | Natural Gas | |
| 2.4 | Corrosive due to: | : | | |
| 2.5 | Molecular Weight at Intake (Avg.) | : | | |
| 2.6 | Cp/Cv at intake/compressibility Factor | : | | |
| 2.7 | Relative Humidity | : | | |
| 2.8 | Suction Temperature (°C) | : | 40-45°C max | |
| 2.9 | Suction Pressure (Kg/cm ² , Gauge) | : | 200 to 25 varying | |
| 2.10 | Discharge Temperature (°C) | : | Maximum 52 °C After Cooler | |
| 2.11 | Discharge Pressure (Kg/cm ² , G) | : | 255Kg/cm ² (Gauge) | |
| 2.12 | Required Capacity (SM ³ /hr.) : 400 | : | | Driver Motor Rating: KW |
| 2.13 | Drive arrangement Direct Coupling/V-belt | : | | |
| 2.14 | Standard Conditions referred to | : | Standard Atmospheric pressure (1.033 Kg/cm ² abs) and Temperature of 15.6°C | |
| 3.0 | SITE CONDITIONS | | | |
| 3.1 | Place | : | | Installation: Outdoor |
| 3.2 | Site Ambient Temp. (°C) | : | Min : 2 °C Max : 47.5 °C | Max. Relative Humidity (%) : 90% |
| 3.3 | MSL – 205 m | : | | |
| 3.4 | Area Classification | : | Class1 Div1 Group D or Zone 1 Div1 Group IIA Group IIB | |
| 4.0 | APPLICABLE CODES & SPECIFICATIONS | | | |
| 4.1 | Compressor | : | As per tender | Piping: ASME/ANSI B 31.3 |
| 4.2 | Driver | : | Electrical Motor Data Sheet | |
| 4.3 | Air Cooled Exchangers | : | API 661 | Water cooled exchangers : TEMA 'C' |
| 4.4 | Pressure Vessel | : | ASME Sec. VIII Div.1/2 | Control Panel : Refer Tech Specs |
| 5.0 | MANUFACTURER'S SPECIFICATION | | | |
| 5.1 | Name | : | | Model: |
| 5.2 | No. Off | : | | Compressor RPM/Stroke (mm): |
| 5.3 | Type | : | | Drive Arrangement: |
| 5.4 | Service/Stage | : | | |
| 5.5 | Mol. Wt. At Intake (Avg.) (Gas Composition) | : | | Cp/Cv Value/ Compressibility Factor at Intake |
| 5.6 | Adiabatic Power (KW) | : | | Shaft Power @ RV set pressure (KW) |
| 5.7 | Driver Rating & Speed (KW/RPM) | : | | Noise level: |



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|------------|--|---|---|-----------------------------------|
| 5.8 | Suction Line (Size/ Rating) | : | | Discharge Nozzle (Size/Rating) |
| 5.9 | Direction of Rotation from Driving End: | | | |
| 5.10 | Compressor Weight : | Max. Erection Weight: | Max. Maintenance Weight:: | |
| 5.11 | Diff. Pr. In Suc. Strainer, Piping, puls Dampener: | | Diff. Pr. In after Cooler | |
| 5.12 | PERFORMANCE DATA OF PACKAGE | | | |
| | Gas | Suction Pr (200 to 25 kg/cm ²) | | |
| | | Ist Stage | IInd Stage | |
| | Mol. Wt at intake | | | |
| | Specific Gravity | | | |
| | Cp/Cv Value / compressibility Factor at intake | | | |
| | Cp/Cv Value / compressibility Factor at discharge | | | |
| | Suction Pressure, kg/cm ² g | | | |
| | Suction Temp. °C | 35 | | |
| | Suction capacity, SM ³ / Hr | | | |
| | Discharge pressure, kg/cm ² g | | | |
| | Discharge Temp. Adiabatic °C | | | |
| | Discharge Temp. Actual, °C | | | |
| | shaft power, Kw | | | |
| | V-belt / coupling losses, kW | | | |
| | Shaft power at RV set pressure including | | | |
| | V-belt / coupling losses, kW | | | |
| | Volumetric Efficiency, % | | | |
| | Valve lift | | | |
| | Valve lift area | | | |
| | Valve velocity (Average) M/sec | | | |
| 5.13 | DESIGN DATA | | Suction Pressure (200 to 25 kg/cm ²) | |
| | | Ist Stage | IInd Stage | |
| | Mol. Wt at intake | | | |
| | Specific Gravity | | | |
| | Cp/Cv Value / compressibility Factor at intake | | | |
| | Cp/Cv Value / compressibility Factor at discharge | | | |
| | Suction Pressure, kg/cm ² g | | | |
| | Suction Temp. °C | 35 | | |
| | Suction capacity, SM ³ / Hr | | | |
| | Discharge pressure, kg/cm ² g | | | |
| | Discharge Temp. Adiabatic °C | | | |
| | Discharge Temp. Actual, °C | | | |
| | Shaft power, kW | | | |
| | V-belt / coupling losses, kW | | | |
| | Shaft power at RV set pressure including | | | |
| | V-belt / coupling losses, kW | | | |
| | Volumetric Efficiency, % | | | |
| | Valve lift | | | |
| | Valve lift area | | | |
| | Valve velocity (Average) M/sec | | | |
| 6.0 | CYLINDER & PACKAGING DATA | | | |
| 6.1 | Service / stage | Ist Stage | IInd Stage | |

| | | | |
|------------|---|---|--|
| 6.2 | Cylinder bore (mm/No. off) | | |
| 6.3 | Single / Double Acting | | |
| 6.4 | Liner (yes/ No.) | | |
| 6.5 | Type of Valves | | |
| 6.6 | Piston Displacement (M ³ /Hr) | | |
| 6.7 | Volumetric Efficiency (%) Min/ Nor/max | | |
| 6.8 | Mean Piston Speed(m/sec) [<3.5 m/sec] | | |
| 6.9 | Suction / discharge valve gas velocity (m/sec) | | |
| 6.10 | Relief valve setting (kg/cm ² g) | | |
| 6.11 | Max. allowable cylinder pressure (kg/cm ² g) | | |
| 6.12 | Max. allowable cylinder temperature (°C) | | |
| 6.13 | Pneumatic Test By (kg/cm ² g) | | |
| 6.14 | Hydrostatic test (kg/cm ² g) | | |
| 6.15 | Hydrostatic test water jacket (kg/cm ² g) | | |
| 6.16 | Suction / discharge nozzle orientation | | |
| 6.17 | No.of suction / discharge valves | | |
| 6.18 | Piston Rod Dia (mm) | | |
| 6.19 | Piston Load | | |
| | -Max. Rod load gas compression, Kg | | |
| | -Max. Rod load gas tension, Kg | | |
| | - Rod load (Inertia alone) compression, Kg | | |
| | - Rod load (Inertia alone) tension, Kg | | |
| | -Rod load rated Pr. (gas + inertia) compression, Kg | | |
| | -Rod load rated Pr. (gas + inertia) tension, Kg | | |
| | -Rod load at R.V set Pr. (gas + inertia) compression, Kg | | |
| | -Rod load at R.V. set Pr. (gas + inertia) tension, Kg | | |
| 6.20 | Max. Permissible Piston Rod loads (kg) | | |
| 6.21 | Rod packing cooling by liquid (yes/No.) | | |
| 6.22 | Rod packing lubrication (Yes/No) | | |
| 6.23 | Rod packing vent to | | |
| 6.24 | distance piece type | | |
| 6.25 | Cylinder jacket cooling by | | |
| 7.0 | LUBRICATION SYSTEM | | |
| 7.1 | | | |
| | <input type="checkbox"/> Splash | <input type="checkbox"/> Force feed Lubricated | |
| | <input type="checkbox"/> Pressure lubrication including piping, valves and | <input type="checkbox"/> Mini Lubricated | |
| | <input type="checkbox"/> Oil filter : single | <input type="checkbox"/> Non Lubricated | |
| | Degree of filtration | <input type="checkbox"/> Lubricator Driven by | |
| | <input type="checkbox"/> Oil cooler | <input type="checkbox"/> Compressor shaft | |
| | <input type="checkbox"/> Oil pump driven by compressor shaft | <input type="checkbox"/> Electric Motor (kW) | |
| | <input type="checkbox"/> Auxiliary oil pumps, if reqd, | <input type="checkbox"/> Lubricator equipped with sight flow indicator for each point storage tank with level gauge | |
| | <input type="checkbox"/> Pre-lube Motor driven pump, in case of splash system | | |
| | Grade / viscosity of lube oil | Grade / viscosity of lube oil | |
| | Oil sump capacity | Oil sump capacity (For 500 hrs) | |
| | Lube oil consumption (Lt/100 Hr.) | Lube oil Consumption(Lt./100 hr) | |
| | Change lube oil after | Hours | |
| | Type of bearing : Main Big End: | Small End: | |
| 8.0 | COMPRESSOR CONTROLS | | |
| 8.1 | <input type="checkbox"/> Automatic start / stop on storage pressure level and manual start stop | <input type="checkbox"/> Actuators (To be included in supply) | |
| 8.2 | <input type="checkbox"/> Automatic drain of separators | <input type="checkbox"/> Manual on machine | |



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| | | | | | |
|-----------------------------|--|---|---------------|---------------|---------------------------------|
| 8.3 | <input type="checkbox"/> Compressor to start automatically after power interruption with 10 seconds delay. | <input type="checkbox"/> Intermediate devices (to be included in supply) | | | |
| 8.4 | <input type="checkbox"/> Automatic recovery of gas form gas recovery vessel | <input type="checkbox"/> Solenoid valves | | | |
| 8.5 | <input type="checkbox"/> Automatic closing of suction isolating valve on compressor trip | <input type="checkbox"/> Manual -mounted in a local panel. | | | |
| | | <input type="checkbox"/> Controller(For auto control) | | | |
| | | <input type="checkbox"/> Pressure switches (For auto control) | | | |
| 8.6 | Compressor shall unload on Power failure/ stoppage through (Vendor to indicate) <input type="checkbox"/> Automatically <input type="checkbox"/> Manually | <input type="checkbox"/> Any other instrument required. | | | |
| 8.7 | Compressor shall load on start through (Vendor to indicate) | <input type="checkbox"/> Automatically <input type="checkbox"/> Manually | | | |
| 8.8 | Recommended time duration for compressor operation @ 0% capacity (minutes) | | | | |
| 8.9 | Recommended number of starts/ stops for the Motor : Per Hours | | | | |
| AUXILIARIES | | | | | |
| 9.0 | COOLERS | | | | |
| 9.1.1 | | Oil Cooler (Required) | After cooler | Inter coolers | |
| 9.1.2 | Cooler Type | | | | |
| 9.1.3 | Tube Material | | | | |
| 9.1.4 | Tube sheet material shell Material | | | | |
| 9.1.5 | Shell Material | | | | |
| 9.1.6 | ASME / IBR CODE STAMP/TPIA | Yes | Yes | Yes | |
| 9.2 | Suction Strainer | Temporary | Mesh Size | | |
| 9.3 | Volume Bottles / Pulsation Dampers | 1st Stage | | 2nd Stage | |
| 9.3.1 | Type at Suction /Discharge | | | | |
| 9.3.2 | Residual Pulse Amplitude (peak to peak) | 3% / 3% | | | |
| 9.3.3 | Maximum Allowable Working Pressure (kg/cm2g) | | | | |
| 9.3.4 | Capacity (M3) | | | | |
| 9.3.5 | ASME / IBR CODE STAMP/TPIA | Yes | Yes | Yes | Yes |
| 9.4 | Separator | 1st Suction | 1st Discharge | 2nd Discharge | Final Discharge |
| 9.4.1 | Type | | | | |
| 9.4.2 | Max allowable Pr (kg/ cm2g) | | | | |
| 9.4.3 | Capacity (M3) | | | | |
| 9.4.4 | ASME / IBR CODE STAMP/TPIA | Yes | Yes | Yes | Yes |
| 9.5 | Oil Mist separator at final discharge to limit oil carry over to 5 PPM | | | | |
| 9.5.1 | Type | | | | Capacity: |
| 9.5.2 | Max allowable Pr (kg/ cm2g) | | | | ASME / IBR CODE STAMP/TPIA: Yes |
| 9.6 | Gas Recovery vessel | | | | Capacity: |
| 9.6.1 | Max allowable Pr (kg/cm2g) | | | | |
| 9.6.2 | ASME / IBR CODE STAMP/TPIA | | | | Yes |
| 10.0 INSTRUMENTATION | | | | | |
| 10.1 | PRESSURE INDICATION | | | | |
| | Gas At inlet | | | | |
| | Gas at discharge (each stage) | | | | |
| | Frame oil Header | | | | |
| | Frame oil filter (Differential local) | | | | |
| | Gas at after cooler exit (local) | | | | |
| | Hydraulic Oil Pr. (each stage) | | | | |



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| | | |
|--------------|---|--|
| 10.2 | PRESSURE SWITCHES | |
| | Frame oil header (1 no. For trip on low pressure.) | |
| | Jacket water system failure | |
| | Compressor discharge Pr high (Each stage) | |
| | Compressor discharge Pr Low (Final stage) | |
| | Compressor suction pressure low | |
| | Compressor suction pressure high | |
| 10.3 | TEMPERATURE INDICATION | |
| | Gas at suction to compressor | |
| | Gas at Discharge of Comp (Each stage before cooler) | |
| | Gas at after cooler | |
| | Oil cooler oil outlet | |
| 10.4 | Temperature Switch | |
| | Temperature after compressor discharge before cool (each stage) | |
| 10.5 | Level Switch | |
| | Oil tank level low | |
| 10.6 | OTHER INSTRUMENTS | |
| | Junction Box with interconnecting wiring | |
| | Pressure Relief Valve at discharge each stage | |
| | Pressure Relief Valve at suction to compressor | |
| | Instruments for closed circuit cooling water system | |
| | Hour meter | |
| | Gas detection system | |
| | Flame detection system | |
| | Forced feed lubrication failure to stop comp. | |
| | Priority fill panel | |
| | Emergency shut down system | |
| 10.7 | LEVEL GAUGE AND INDICATORS | |
| | Frame oil (Bull's eye type) | |
| | Packing / cylinder lubrication oil | |
| | Make up water tank | |
| 10.8 | SIGHT FLOW INDICATORS | |
| | As reqd. in close ckt. cooling system | |
| | Sight flow indicators, cylinder and packing lubrication oil lines | |
| 10.9 | Other instrument for safe running of compressor | |
| | Note : 1. Each pressure gauges and pressure switch with an isolating valve and a drain valve. Switch contacts to open under fault conditions Switch / junction box enclosure (As per the electrical area classification) | |
| 11.0 | INSTRUMENT PANEL | |
| 11.1 | PNEUMATIC CONTROLS FOR | TRIP CIRCUIT TO BE CONNECTED TO MAIN DRIVER CONTROL SWITCH |
| 11.2 | Capacity Indication | Cause of shut down |
| 11.3 | Pressure Regulator | Frame Oil Pressure-Low |
| 11.4 | | Low Cooling Water Flow |
| 11.5 | PUSH BUTTONS AND SIGNAL LIGHTS FOR | |
| 11.6 | Main Motor & Aux.Motors | Compressor discharge PR.(Each stage) |
| 11.7 | Ammeters for main and Aux. Motors | Compressor suction Pr. Low |
| 11.8 | ESD | Compressor suction Pr. |
| 11.9 | Common machine trip-alarm | |
| 11.10 | Following to be included in vendor's scope of supply : | |
| 11.11 | All interconnecting oil gas water piping & tubing as per schematic attached. | |
| 11.12 | All electrical power distribution and interconnection as specified. | |
| 11.13 | Intrinsically safe system for trips (Ref. Inst. specs) | |
| 11.14 | Electrical circuits to be housed in Explosion Proof Cabinet (Refer Elect. & inst. Specs) | |
| 11.15 | Electrical circuits to be provided for repeating pre alarm and trip alarm on the local panel. | |



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| | | | | |
|-------------|--|-------------------------|------------------|----------------|
| 11.16 | Annunciation system with test / acknowledgement push buttons & sole first off sequences | | | |
| 11.17 | Motor Interlock against loaded start | | | |
| 11.18 | Motor Interlock against start without air cooler fan running | | | |
| 11.19 | Motor interlock against start without pre-lubrication | | | |
| 11.20 | Provision shall be made for common alarm and trip alarm | | | |
| 11.21 | Any additional instruments & controls required for safe operation of compressor (as recommended by compressor vendor) | | | |
| 12.0 | MATERIAL OF CONSTRUCTION & GRADES | | | |
| 12.1 | Stage | 1st | 2nd | Remarks |
| 12.2 | Cylinder & Head | | | |
| 12.3 | Liner | | | |
| 12.4 | Piston | | | |
| 12.5 | Piston Ring | | | |
| 12.6 | Piston Shoe (Wear Band) | | | |
| 12.7 | Valve seat | | | |
| 12.8 | Valve stop | | | |
| 12.9 | Valve / plate / Ring | | | |
| 12.10 | Valve spring | | | |
| 12.11 | Cylinder Packing Ring | | | |
| 12.12 | Crank Shaft F.S (Forged steel) | Connecting Rod (CR) F.S | CR cap. Bolts FS | |
| 12.13 | Main bearing: | Big End Beating: | Small end bush: | |
| 12.14 | Piston Rod | Yield strength | Hardness(RC) | Surface Finish |
| 12.15 | Pulsation Dampers / Volume Bottles | Suction/Discharge KOD | | |
| 12.16 | Non Return Valve- Shall be compressor Discharge valve type | | | |
| 13.0 | INSPECTION AND TESTING | | | |
| 13.1 | X-ray examination for welded joints for heat exch./ Press. Vessel / gas Piping (Certificate to be furnished) | | NO only TC | |
| 13.2 | Ultrasonic testing for piston rod, connecting rod, crank shaft, big end bolts, main brg. studs. | | NA | |
| 13.3 | Magnaflux testing for crankshaft, piston rod, connecting rod | | NA | |
| 13.4 | Dye penetrant testing for cylinder liners , piston | | YES | |
| 13.5 | Shop inspection by purchaser during construction | | YES | |
| 13.6 | Barring over to check clearance | | YES | |
| 13.7 | Mechanical running test with shop job driver at compressor vendor's works | | YES | |
| 13.8 | Stripping check and internal inspection | | for one comp | |
| 13.9 | Hydrostatic test of Cylinders, Pressure Vessels | | Yes | |
| 13.10 | Leak proof test of crank case (min 24 hrs with With kerosene) | | NA | |
| 13.11 | Fit up test at compressor packager's | | Yes | |
| 13.12 | Performance Acceptance Test | | YES | |
| 13.13 | Field noise level test | | YES | |
| 13.14 | Field trial run at site for 12 hours | | YES | |
| 13.15 | Functional / continuity tests - control panel (At sub vendor's works) | | YES | |
| 13.16 | Inspection and tests of compressor vessels | | | |
| | Piston | Piston Rod | | |
| | Cylinder and liner | Connecting Rod | Crank case | |
| | Crank shaft | Heat Exchangers | Valve components | |



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| | | |
|-------------------------------|------------------------------------|--------------------------|
| Pressure vessels | | |
| Test Certificate required for | | |
| Auxiliary Motor & Pumps | Safety Relief Valves (Temp / F) | Capacity control devices |
| Safety switches | Solenoid valves | All instruments |

Note : 1. For electrical / instrument items, vendor shall provide certificates issued by statutory inspection authority confirming suitability of design / construction for specified Hazardous area classification.

| | | | | | | | | | |
|--|------------------------------|------------------|--|---------------|-----|-------------------|-----|---------------|-----|
| Service | | | | | | | | | |
| Size Type (Induced Force) | | | | | | Craft/No. of Bays | | | |
| Surface per Unit-Finned Tube (m2) | | | | | | Bare Tube (m2) | | | |
| Heat Exchanged (KW) | | | | | | MTD. Eff °C | | | |
| Transfer Rate * Finned Tube : Bare Tube, Service Clean W/m2 °C | | | | | | | | | |
| PERFORMANCE DATA-TUBE SIDE | | | | | | | | | |
| | | | | Min. Suc. Pr. | | Normal. Suc. Pr. | | Max. Suc. Pr. | |
| | | | | In | Out | In | Out | In | Out |
| Gas Composition | Inter Cooler 1st Stage | Flow Kg/s | | | | | | | |
| | | Temp °C | | | | | | | |
| | | Pr. Kg/cm2 | | | | | | | |
| | | Total Heat KJ/Kg | | | | | | | |
| | Inter Cooler 2nd Stage | Flow Kg/s | | | | | | | |
| | | Temp °C | | | | | | | |
| | | Pr. Kg/cm2 | | | | | | | |
| | | Total Heat KJ/Kg | | | | | | | |
| | After Cooler Stage | Flow Kg/s | | | | | | | |
| | | Temp °C | | | | | | | |
| | | Pr. Kg/cm2 | | | | | | | |
| | | Total Heat KJ/Kg | | | | | | | |

| | | | | | | | |
|--|------------------|--|--|--|--|--|--|
| Oil Cooler Stage | Flow Kg/s | | | | | | |
| | Temp °C | | | | | | |
| | Pr. Kg/cm2 | | | | | | |
| | Total Heat KJ/Kg | | | | | | |
| Water/Air Cooler Stage | Flow Kg/s | | | | | | |
| | Temp °C | | | | | | |
| | Pr. Kg/cm2 | | | | | | |
| | Total Heat KJ/Kg | | | | | | |
| Total Heat all streams KJ | | | | | | | |
| Pressure Drop Allow/Calc. Kg/cm2 g | | | | | | | |
| Soft Starter(if applicable) Data Sheet to be provided by the Compressor. | | | | | | | |
| Performance –Data –Air Side | | | | | | | |
| Air Quantity (Total Kgs.) | | | | | | | |



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ANNEXURE - III - DATA SHEET FOR ELECTRIC MOTOR

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

| | | |
|-----|--|--|
| | Type | |
| | Fault Withstand | |
| | No. of Terminals | 6 Nos. |
| | Side of Terminal Box seen from the Driven End | RHS |
| ii) | Auxiliary Terminal Box | -- |
| | 1. Separate Terminal Box for | |
| | Space Heaters | If Required |
| | Thermistors | -- |
| G. | TESTS TO BE WITNESSED | |
| | Type Tests | CMRS test certificate to be furnished |
| | Routine Tests | As per IS:325 |
| H. | ACCESSORIES | |
| | Anti-condensation Heaters | Yes |
| | PTC Thermistors | NA |
| | Voltage Rating of Space Heaters | 230V, If applicable |
| | Foundation Bolt | Yes |
| | Cable Glands | Required |
| | Earthing Terminals | Body & T. Box |
| | Motor peak Amplitude Vibration at no Load at Bearing should not exceed | 40 Microns for 1500 RPM 15 Microns for 3000 RPM |
| | Max. Motor Noise Level Measured at a Distance of 1. Mts. from Motor | 75 dB |
| I. | CABLES | |
| | 1. Type & Size | |
| | - Motor | Vender to furnish |
| | - Space Heater | Vender to furnish, if Required |
| | - Thermister | NA |
| | 2. Cable Lugs | |
| | - For Motor | Copper |
| | - Space Heater | Copper, if Required |
| | - Control Cables | NA |
| | 3. Cable Glands – Type Material | |
| | - Motor | FLS-Double Compression, Ni-Cd Plated |
| | - Space Heater | FLS-Double Compression, Ni-Cd Plated, If required |
| | - Control Cables | FLS – Double Compression Ni-Cd Plated |
| | J. PAINTING | |
| | TYPE | Epoxy |
| | SHADE (AS PER IS:5) | 692 (Smoke Grey) |

Note: Certificate from Compressor block manufacturer towards guaranteed shaft power calculation at 400 SCMH per hour compression (on given parameter) and from Motor manufacturer towards their KWh consumption (KWh on guaranteed parameters) on above guaranteed shaft power to be submitted by bidders along with bid.

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ANNEXURE – IV: LIST OF MOTORS

| S.No. | DESCRIPTION | KW | DUTY | QTY. |
|-------|-------------|----|------|------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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

ANNEXURE – V: SPECIFICATIONS OF INSTRUMENTS

SPECIFICATION OF CORIOLIS MASS FLOW METER (SUCTION)

| Sl. No. | PARAMETER | REQUIREMENT |
|---------|--|--|
| 1. | Fluid | Compressed Natural Gas |
| 2. | Measuring Principle | Coriolis Principle |
| 3. | Operating Pressure | 250 (max.) Kg/cm² and 8 (min.) Kg/cm² |
| 4. | Molecular Weight | 17 – 22 |
| 5. | Ambient Temperature | 0 – 6 °C |
| 6. | Hazardous area classification | Class I, Div I, Gas Group D as per NEC or Zone1, Group IIA/ IIB as per IS/IEC specifications |
| 7. | Range of operation | 250 – 400 SCM/HR (174 - 300 KG/HR) for 400 SCM/H |
| 8. | Accuracy | ± 0.5% of indicated flow accepted (over the whole operating range on gas) |
| 9. | Rangeability for specified accuracy (Min.) | 50:1 |
| 10. | Line Size | 2.0 "(Flange type), 300# WNRF (Material: 316 L) |
| 11. | Pressure drop at max. flow | < 0.2 Kg/cm ² g |
| 12. | Repeatability | ± 0.25% or better |
| 13. | Material - Tube | SS 316 or Better |
| 14. | End Connection | To suit the line size(2.0") , Flange connections |
| 15. | Power supply (nominal) | 230±10% V, 50±2 Hz, 1 Φ |
| 16. | Outputs (Active) | |
| 16.1. | 4 – 20 mA dc | Reqd. |
| 16.2. | Frequency | Reqd. |
| 16.3. | RS 485 | Reqd. |
| 17. | Outputs Informations | <input type="checkbox"/> |
| 17.1. | Mass Flow rate | Reqd. |
| 17.2. | Mass totalizer, non-resettable | Reqd. |
| 17.3. | Temperature | Reqd. |
| 17.4. | Integral Display | Display all outputs with specified accuracy, programmable and sequential with password protection, Touch screen or touch keypad type |
| 18. | Communication | MODBUS with RS485 |
| 19. | Mounting | Field mounting |
| 20. | Certification | Hazardous area compatibility, Weather proof certification i.e. IP 67 ,Material Test, Manufacturer's certification, Custody Transfer approval, AGA 11 Conformance certification and Calibration Certificate on water and Natural Gas from accredited test labs with traceability acceptable internationally |

SPECIFICATION OF CORIOLIS MASS FLOW METER (DISCHARGE)

| Sl. No. | PARAMETER | REQUIREMENT |
|---------|--|--|
| 1. | Fluid | Compressed Natural Gas |
| 2. | Measuring Principle | Coriolis Principle |
| 3. | Operating Pressure | 300 (max.) Kg/cm² ,250 (Normal) Kg/cm², 100 (min.) Kg/cm² |
| 4. | Molecular Weight | 17 – 22 |
| 5. | Ambient Temperature | 0 – 60 °C |
| 6. | Hazardous area classification | Class I, Div I, Gas Group D as per NEC or Zone I, Group IIA/ IIB as per IS/IEC specifications |
| 7. | Range of operation | 250 – 400 SCM/HR (174 - 300 KG/HR) for 400 SCM ³ /HR |
| 8. | Accuracy | ± 0.5% of indicated flow accepted (over the whole operating range on gas) |
| 9. | Rangeability for specified accuracy (Min.) | 50:1 |
| 10. | Line Size | 0.5 "(TUBE END) |
| 11. | Pressure drop at max. flow | < 0.2 Kg/cm ² g |
| 12. | Repeatability | ± 0.25% or better |
| 13. | Material – Tube | SS 316 or Better |
| 14. | End Connection | To suit the line size(0.5") |
| 15. | Power supply (nominal) | 230±10% V, 50±2 Hz, 1 Φ |
| 16. | Outputs (Active) | |
| 16.1. | 4 – 20 mA dc | Reqd. |
| 16.2. | Frequency | Reqd. |
| 16.3. | RS 485 | Reqd. |
| 17. | Outputs Information | <input type="checkbox"/> |
| 17.1. | Mass Flow rate | Reqd. |
| 17.2. | Mass totalizer, non-resettable | Reqd. |
| 17.3. | Temperature | Reqd. |
| 17.4. | Integral Display | Display all outputs with specified accuracy, programmable and sequential with password protection, Touch screen or touch keypad type |
| 18. | Communication | MODBUS with RS485 |
| 19. | Mounting | Field mounting |
| 20. | Certification | Hazardous area compatibility, Weather proof certification i.e. IP 67 ,Material Test, Manufacturer's certification, Custody Transfer approval, AGA 11 Conformance certification and Calibration Certificate on water and Natural Gas from accredited test labs with traceability acceptable internationally |






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COMPRESSOR**




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SPECIFICATION SHEET FOR FLAME DETECTORS

| | |
|--|---|
| Flame detector Type: | UV and IR Detector |
| Wave Length | UV radiation over the range of 185 to 260 nanometers (1850 to 2600 angstroms) |
| | IR radiation in the 4.35 micron range |
| Field of View | 120° cone of vision (or) Better. |
| Sensitivity | Approved Performance Specification-50 feet (15.2m) distance for a 1 sq. ft (0.092m ²)heptane fire. |
| Response Time: | Less than 5 seconds |
| Status Indicator: | LEDs indicate status of Healthy, fault, and alarm conditions |
| Operating Medium | Natural Gas. |
| Nominal supply voltage: | 24 VDC |
| Supply voltage range: | 20 to 36 VDC |
| Maximum supply current: | 400 mA during COPM only |
| Typical current: | 80 to 150 mA Depend on relays ETC |
| Maximum output signal load: | 600 Ohms |
| Electrical Specifications [OUTPUT: mA, Relay, Hart] | |
| (all 3 below mentioned outputs must be available in separate connectors/ ports) | |
| 1. Analog (mA): | |
| Output signal range: | 0 to 20 mA * |
| FAULT signal: | 0 to 0.2 mA * |
| COPM fault signal: | 2.0 ± 0.2 mA * |
| Ready signal: | 4.0± 0.2 Ma |
| IR only signal: | 8.0 ± 0.2 Ma |
| UV only signal : | 12.0 ±0.2 mA |
| WARN signal: | 16.0 ±0.2 Ma |
| ALARM signal: | 20.0 ± 0.2 mA |
| 2.Relay Contacts: (Alarm, Fault and Auxiliary) | Fire relay (alarm)- Both Contact output NO and NC required. Fault relay - Contact output NO and NC required. Contact rating 30 VDC, 2 A or 125 VAC, 1 A |
| 3. HART | |
| Protocol | HART protocol |
| | External HART Port connector (without opening of Housing cover of Flame Detector) is required in transmitter for calibration and parameter accessing. |
| Vibration | As the detector shall be vibrations arising mounted inside CNG compressor canopy, the same shall be capable of withstanding from reciprocating compressor. |
| Approvals (sensor, Transmitter and Terminal box / Junction Box) | CCOE,CSA, FM, ATEX, HART Registered, and AMS Aware |
| | Class 1, Div 1, groups B, C, and D (-40°C to +65°C),Type 4X, Exd iic,T5 |
| CCOE | CCOE approval Must |
| | IP54 |
| Reliability | IEC 61508 |
| AMS Aware: | Certified by AMS |




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|    | PTS - ELECTRIC MOTOR DRIVEN RECIPROCATING 400 SCMH BOOSTER COMPRESSOR | P.014714 M 11077 R 018 |
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| | |
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| RFI/EMI Protection: | Complies with EN 50130-4, EN 61000-6-4 |
| WARRANTY | four year warranty against sensor and electronics for the supplied product. |
| | ONSITE SERVICE TO BE PROVIDED DURING WARRANTY PERIOD |
| ACCESSORIES | Housing: Anodized aluminum with powder coated finish or equivalent (Explosion proof enclosure) Mounting: Roof mounted or wall mounted. For threaded type detectors suitable termination box (approved for use inside hazardous area) shall be provided. The detector shall be supplied with suitable Sunshade/ Deluge protection, Strombaffle, Weather protection, Dust barrier, Gassing Cap, etc as applicable protection against dust particles. |
| | 2 No's Cable Glands(3/4" Double compression) |
| FLAME DETECTOR BUILT-IN TEST | AUTOMATIC AND MANUAL TEST |
| FLAME DETECTOR IMMUNITY | False alarm sources like Arc welding, X-Ray's or hot vibrating object, lightening. |
| Manuals (soft and Hard Form) | Operation, Maintenance, Calibration and Troubleshooting |
| Software (soft and Hard Form) | Software or additional device, cables required for calibration or troubleshooting of instrument shall be supplied free of cost with instrument. |
| FLAME DETECTOR CALIBRATION | must be inbuilt or else calibration device must be supplied along with FD at free of cost. |
| CALIBRATION PROCEDURE | (BOTH ZERO AND SPAN) FOR THE MODEL QUOTED TO BE PROVIDED IN DETAIL |

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SPECIFICATION SHEET FOR GAS DETECTORS

| | |
|--|--|
| Type | Infrared sensor with Transmitter, with Local Display or Indicator |
| Measurement Range | 0-100% LEL |
| Operating Medium | Natural Gas. |
| Operational and Certified Temperature Range | 65 °C Maximum |
| Power Supply | 18 to 32Vdc(24Vdc nominal) |
| Power Consumption | < 4.5W max |
| Current Demand | < 235 mA at 18V |
| | < 190 mA at 24V |
| | < 155 mA at 32V |
| Output Signals :- | mA, Relay, Hart |
| (all 3 below mentioned outputs must be available in separate connectors/ ports) | |
| 1.Analog (mA): | 4-20mA,Non-Isolated,Current Source or Sink.(Default Configuration is Current Source). |
| Maximum 4-20mA Loop Resistance | 600 Ohms |
| Measuring Range (0-100% FSD) | 4-20 mA |
| Inhibit | 1 to 3mA(Default 2mA) |
| Warning | 0 to 6mA(Default 3mA) |
| Fault | 0mA |
| Over-Range | 20 to 21.5mA(Default 21 mA) |
| 2.Contact output: | Relay output: (High alarm, Low alarm,Trip, Fault) Contact rating: 2 A, 230 VAC/24 VDC |
| 3. HART | |
| protocol | HART protocol |
| | External HART Port connector (without opening of Housing cover of Gas Detector) is required in transmitter for calibration and parameter accessing. |
| Status Indicator: | Status indication: LED indication OR Local Display. Separate indication for No gas leak, Low alarm, High alarm, optics failure and calibration in progress shall be available |
| Vibration | As the detector shall be vibrations arising mounted inside CNG compressor canopy, the same shall be capable of withstanding from reciprocating compressor. |
| Accuracy | ± 5 % LEL through-out the range |
| Response Time | Less than 5 seconds |
| ACCESSORIES | <p>Housing: Anodized aluminum with powder coated finish or equivalent (Explosion proof enclosure)</p> <p>Mounting: Roof mounted or wall mounted. For threaded type detectors suitable termination box (approved for use inside hazardous area) shall be provided.</p> <p>The detector shall be supplied with suitable Sunshade/ Deluge protection, Strombaffle, Weather protection, Dust barrier, Gassing Cap, etc. as applicable protection against dust particles.</p> <p>2 No's Cable Glands(3/4" Double compression)</p> |

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| | |
|--------------------------------------|---|
| WARRANTY | 4 year warranty against sensor and electronics for the supplied product. Onsite Service To Be Provided During Warranty Period |
| Safety Approval / Certificate | For both sensor, Transmitter and Terminal box / Junction Box |
| ATEX/UT/UT/CSA/FM/CCOE | ATEX: BAS992259X II 2GD EEx d IIC T100°C (Tamb -40°C to +55°C) T135°C (Tamb -40°C to +65°C) |
| | UL / CSA Class 1, Div 1, groups B, C, and D (-40°C to +65°C) GOST and SAA |
| | CE,IEC,EEC,EMC, CENELEC AND Eexd. |
| | IP66/67, NEMA 4 |
| CCOE | CCOE approval Must |
| Performance Approval | EN61779 EXAM, BVS 03 ATEX G 016 X, CSA,FM C22.2 152 |
| EMC COMPLIANCE SOFTWARE | EN 50270 ; EN 50271 |
| Manuals (soft and Hard Form) | Operation, Maintenance, Calibration and Troubleshooting |
| Software (soft and Hard Form) | Software or additional device, cables required for calibration or troubleshooting of instrument shall be supplied free of cost with instrument. |
| GAS DETECTOR CALIBRATION | must be inbuilt or else calibration device must be supplied along with GD at free of cost. |
| CALIBRATION PROCEDURE | (BOTH ZERO AND SPAN) FOR THE MODEL QUOTED TO BE PROVIDED IN DETAIL |

SPECIFICATION FOR KWH METER

| | | |
|----|-------------------------------------|--|
| 1 | Meter type | 3Phase 4 wire Static Energy meter |
| 2 | Accuracy class | 0.5 S as per IS14697 |
| 3 | Connection | Transformer Operated |
| 4 | Rated Voltage | 240V(P-N), 415V(P-P) \pm 10% |
| 5 | Rated Basic current | 5A |
| 6 | Rated maximum current | 10A |
| 7 | Rated Frequency | 50 HZ |
| 8 | Power Factor range | Zero lag- Unity- Zero lead |
| 9 | Standards compliance | IS 14697, IEC 62052-11, IEC 62053-21, IS 15959 |
| 10 | Calibration | Meter shall be calibrated at factory and no modifications should be permissible |
| 11 | Energy Audit Data | <ul style="list-style-type: none"> a. Meter serial number b. Date and time c. Cumulative forwarded active energy d. Cumulative reactive energy - Lag e. Cumulative reactive energy - Lead f. Cumulative forwarded apparent energy g. Cumulative Maximum Demand in kW and kVA with date and time |
| 12 | Metering philosophy | Metering should be 2 quadrant lag only and programmed accordingly |
| 13 | Auto/Manual Scroll mode | <ul style="list-style-type: none"> a. LCD test b. Date c. Time d. Cumulative Active Energy e. Cumulative Apparent Energy f. Cumulative Reactive Energy – Lag g. Cumulative Reactive Energy – Lead h. Active Maximum demand with date and time i. Apparent Maximum demand with date and time j. Active load k. Reactive load l. Apparent load m. Phase wise power factor n. Average power factor o. R phase voltage p. Y phase voltage q. B phase voltage r. R phase current (line) s. Y phase current (line) t. B phase current (line) u. Instantaneous average power factor with sign for lag/lead v. Frequency reading |
| 14 | Maximum demand Registration | Meter should store and display maximum demand in kW/kVA with date and time. Demand integration period should be 30 minutes. It is preferred that MD is computed using separate counter rather than by difference of initial and final energy counter. |
| 15 | Auto Reset of Maximum Demand | Meter should reset to zero and date should be customisable date |

SPECIFICATIONS FOR DISCHARGE FILTER

SUPER FINE FILTER (Coalescing Filter)

Super fine filter for removal of liquid (e.g. water & oil)and solid particles down to 0.01 microns out of compressed natural gas

Residual Oil Contents less than 0.01 mg/m3.

Filter Designed :

Paint Compatible
CE mark in accordance with European Directive for Pressure Equipment, PED (97 / 23 / EC)
Are Designed to meet the ATEX European Directive for Explosion Protection , (94 / 9 / EC)
All natural gas filters in accordance to CE Eex 2GD IIB T6.

Standard equipment:

Complete filter including manual drain.

Specification Filter Elements.

Filter Fabric : Borosilicate Microfibre Fabric coated with polypropylene homopolymer support - fabric.

Drainage Layer: Parafil - Fibre fabric incorporated in the filter fabric.(Without Foam Sock)

Rib Mesh : Stainless Steel VA 1.4306

Temperature : + 1 ° C to + 80 ° C

Direction Of Flow : From Inside to Outside.

NOTE : Bidder to get the inspection done by TPIA accordance with European Directive for Pressure Equipment, PED (97 / 23 / EC) if CE marks are not available.



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ANNEXURE – VI: RECOMMENDED VENDOR LIST

| Item code / Description | AIR FILTER REGULATORS |
|--|----------------------------------|
| VENDOR NAME | Remark |
| 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 | |
| Item code / Description | COALESCENT FILTER / REGULATORS |
| VENDOR NAME | Remark |
| 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 | |
| ITEM CODE / DESCRIPTION | FIELD INSTRUMENTS (P, DP, F,L,T) |
| VENDOR NAME | REMARKS |
| ABB AUTOMATION LTD. | |
| ASHCROFT | |
| MURPHY | |
| CCS | |
| WAREE | |
| FISHER ROSEMOUNT INDIA LIMITED | |
| FUJI ELECTRIC CO. LTD. | |
| HONEYWELL INC. | |
| TATA HONEYWELL | |
| YOKOGAWA ELECTRIC CORPORATION | |
| YOKOGAWA BLUE STAR LTD. | |
| WIKA | |
| DRUCK | |



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| | |
|-------------------------------------|-------------------------------------|
| BEKO | |
| FILTRATION TECHNIQUE | |
| ITEM CODE / DESCRIPTION | PRESSURE GAUGES |
| VENDOR NAME | REMARKS |
| AN INSTRUMENTS PVT. LTD. | |
| 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 | |
| BEKO | |
| FILTRATION TECHNIQUE | |
| ITEM CODE / DESCRIPTION | TEMPERATURE GAUGES |
| VENDOR NAME | REMARKS |
| AN INSTRUMENTS PVT. LTD. | |
| GENERAL INSTRUMENTS LTD | |
| WIKA | |
| ASCHCROFT | |
| BAUMER | |
| ITEM CODE / DESCRIPTION | PRESSURE RELIEF/SAFETY VALVE |
| VENDOR NAME | REMARKS |
| ALSTHOM FLUIDS SAPAG | |
| ANDERSON GREENWOOD CROSBY | |
| BHEL (TRICHY) | |
| ASPRO | |
| DRESSER INC. | |
| FUKUI SEISAKUSHO CO. LTD. | |
| INSTRUMENTATION LTD. (PALGHAT) | |
| NAKAKITA SEISAKUSHO CO LTD. | |



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| | |
|---|---------------------------------------|
| NUOVO PIGNONE SPA (ITALY) | |
| PARCOL SPA | |
| SAFETY SYSTEMS UR LTD. | |
| SARASIN RSBD | |
| SEBIN VALVES INDIA PVT. LTD. | |
| TAI MILANO SPA | |
| TYCO SANMAR LTD. | |
| TYCO VALVES & CONTROLS INDIA PVT. LTD | |
| SWAGELOK | |
| PARKER | |
| COMPAC NEWZEALAND | |
| FARINOSLA | |
| FAINGER LASER | |
| MERCER | |
| FISHER ROSEMOUNT (EMERSON) | |
| OFE & OE GROUP KEYSTONE VALVES PVT. LTD | |
| BARODA SEBIM VALVES PVT. LTD. HALOL | |
| HALOL | |
| STAUFF | |
| ITEM CODE / DESCRIPTION | SUCTION & DISCHARGE FILTER |
| VENDOR NAME | REMARKS |
| BEKO FILTER | |
| ULTRA FILTER | |
| PARKER | |
| FILTRATION TECHNIQUE | |
| ITEM CODE / DESCRIPTION | VIBRATION SWITCH |
| VENDOR NAME | REMARKS |
| MURPHY | |
| METRIX | |
| ROBERTSHAW CONTROL | |
| ITEM CODE / DESCRIPTION | CARTRIDGE FILTERS |
| VENDOR NAME | REMARKS |
| BEKO FILTER | |
| ULTRA FILTER | |
| FILTRATION TECHNIQUES | |
| ZANDER GMBH (GERMANY) | |
| GRAND PRIX FAB (PVT.) LTD., NEW DELHI | |
| MULTITEX FILTRATION ENERGY PVT. LTD., | |
| ITEM CODE / DESCRIPTION | AIR COMPRESSOR |



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| VENDOR NAME | REMARKS |
|--|---------------------------------|
| INGERSOL RAND (IR) | |
| ELGI | |
| ANESTA IWATA MOTHERSON | |
| EMTEX | |
| KPCL | |
| CHICAGO PNEUMATICS | |
| ITEM CODE / DESCRIPTION | SELF ACTUATED PR. CONTROL VALVE |
| VENDOR NAME | REMARK |
| DANIEL INDUSTRIES INC | |
| DRESSER PRODUCTS 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. | |
| ITEM CODE / DESCRIPTION | SOLENOID VALVES/ACTUATOR |
| VENDOR NAME | REMARK |
| ALCON ALEXANDER CONTROLS LIMITED | |
| ASCO (INDIA) LIMITED | |
| JEFFERSONS | |
| ASCO JOUCOMATIC LTD. | |
| ASCO JOUCOMATIC SA | |
| AVCON CONTROLS PVT. LTD. | |
| BARKSDALE INC. | |
| BLUE STAR LTD. | |
| HERION WERKE | |
| SCHRADER SCOVILL DUNCAN LIMITED | |
| SEITZ AG | |
| ROTEX AUTOMATION LIMITED | |



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| | |
|--|---|
| <u>OPERATED VALVES ASCO</u> | |
| PARKER HANIFEN | |
| HABONIM VASS | |
| <u>FESTO</u> | |
| COMPAC NEW ZEALAND | |
| MICROMECHANICA | |
| ITEM CODE /DESCRIPTION | SPECIAL CONTROL VALVES |
| VENDOR NAME | REMARK |
| FISHER ROSEMOUNT SIGAPORE PTE. LTD. | |
| FLOWERVE 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 | |
| ITEM CODE /DESCRIPTION | TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES |
| VENDOR NAME | REMARK |
| SWAGELOK | |
| PARKER | |
| COMPAC | |
| HAMLET | |
| HYLOCK | |
| SEALEXCEL | |
| OSASIS | |
| STAUFF | |
| SSP | |
| ITEM CODE /DESCRIPTION | FLAME DETECTOR/SURGE PROTECTORS |
| MAKE | REMARK |
| MEGGITT AVIONICS | |
| GENERAL MONITORS/ MSA | |
| SPECTREX | |
| DETRONICS | |
| HONEYWELL | |
| NET SAFETY | |
| <u>CROW ON</u> | |
| SIEGER | |
| ISOLATORS | |
| BARRIERS | |



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| | |
|-------------------------------|-------------------------------|
| ESP SAFETY | |
| PHOENIX | |
| P&F | |
| MTL | |
| ASPRO | |
| ITEM CODE /DESCRIPTION | GAS DETECTOR (IR TYPE) |
| MAKE | REMARK |
| DETRONICS | |
| SENSITRON | |
| HONEYWELL | |
| NET SAFETY | |
| GENERAL MONITORS/ MSA | |
| <u>CROW ON</u> | |
| <u>SIEGER</u> | |
| ESP SAFETY | |
| ITEM CODE /DESCRIPTION | PLC |
| MAKE | REMARK |
| SIEMENS | |
| SCHNEIDER | |
| ALLAN BRADLEY, ROCKWELL | |
| ROCKWELL AUTOMATION | |
| LHP | |
| ABB | |
| PHOENIX | |
| ITEM CODE /DESCRIPTION | COMPRESSOR MAIN MOTOR |
| MAKE | REMARK |
| CROMPTON GREAVES | |
| SIEMENS | |
| WEG | |
| ABB | |
| LHP | |
| <u>KIRLOSKAR</u> | |
| <u>BHARAT BIJLEE</u> | |
| ITEM CODE /DESCRIPTION | MAIN MOTOR VFD STARTER |
| MAKE | REMARK |
| SIEMENS | |
| SCHNEIDER | |
| FUJI | |
| ABB | |



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| ITEM CODE /DESCRIPTION | SOFT STARTER |
|---------------------------------|---|
| MAKE | REMARK |
| SIEMENS | |
| SCHNEIDER | |
| ABB | |
| FUJI | |
| ITEM CODE /DESCRIPTION | CO2 CYLINDER VALVE WITH ACTUATOR FOR CO2 FLOODING SYSTEM |
| MAKE | REMARK |
| GINGEKERR | |
| CEODUEX (ROTAREX) | |
| KIDDE | |
| FIKE | |
| ANSUL | |
| LPG | |
| VTI | |
| ROTEX | |
| KEW | |
| ITEM CODE / DESCRIPTION | SS TUBING |
| VENDOR NAME | REMARK |
| SANDVIK | |
| FAE | |
| TUBACEX (SCHOELLER-BLECKMNN) | |
| PARKER | |
| RATNAMANI | |
| ITEM CODE / DESCRIPTION | SS FITTINGS & VALVES |
| VENDOR NAME | REMARK |
| SWAGELOK | |
| PARKER | |
| ABAC | |
| VOSS | |
| SSP | |
| STAUFF | |
| ITEM CODE / DESCRIPTION | MASS FLOW METERS |
| VENDOR NAME | REMARK |
| EMERSON PROCESS MANAGEMENT | CORIOLIS TYPE |
| ENDRESS & HAUSER CMBH & COMPANY | CORIOLIS TYPE |
| ITEM CODE / DESCRIPTION | FLP SWITCH |
| VENDOR NAME | VENDOR NAME |
| BALIGA | |



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| | |
|--------------------------------|-----------------------------------|
| FCG | |
| FPE | |
| FLEXPRO | |
| ITEM CODE / DESCRIPTION | SWITCHES/FUSES/CONTRACTORS |
| VENDOR NAME | REMARK |
| L&T | |
| GEC | |
| SIEMENS | |
| ITEM CODE / DESCRIPTION | CABLES & WIRES |
| VENDOR NAME | REMARK |
| INCAB | |
| CORDS CABLES INDUSTRIES | |
| ASSOCIATED CABLES | |
| UNIVERSAL | |
| ASEAN | |
| CCI | |
| FORT GLOSTER | |
| FINOLEX | |
| KEI | |
| POLYCAB | |
| HAVELLS | |
| ITEM CODE / DESCRIPTION | PRESSURE TRANSMITTERS |
| VENDOR NAME | REMARK |
| DRUCK | |
| WIKA | |
| HONEY WELL | |
| ABB | |
| ROSMOUNT | |
| WAREE | |
| ITEM CODE / DESCRIPTION | RTDs |
| VENDOR NAME | REMARK |
| GENERAL INSTRUMENTS PVT LTD | |
| NAGMAN SENSORS PVT LTD | |
| PYRO ELECTRIC | |
| WIKA | |
| SIEMENS | |
| BAUMER | |
| WAREE | |
| ALTOP | |



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| ITEM CODE / DESCRIPTION | PLUG VALVE |
|--|-------------------------------|
| VENDOR NAME | REMARK |
| AIR & NORDSTROM VALVES INC | |
| XOMOX | |
| SANMAR INDIA LTD, NEW DELHI | |
| SERCK AUDCO VALVES | |
| SUMITOMO CORPORATION | |
| FISHER XOMOX SANMAR | |
| L&T (AUDCO INDIA LTD, CHENNAI) | |
| PARKER | |
| STAUFF | |
| ITEM CODE / DESCRIPTION | ON OFF BALL/NEEDLE VALVE |
| VENDOR NAME | REMARK |
| PARKER | |
| SWAGELOK | |
| ABAC | |
| SPIRAX SARCO | |
| WORCESTER | |
| WAREE | |
| BAUMER | |
| STAUFF | |
| SSP | |
| L&T | |
| SANKEY CONTROLS | |
| ROTEX | |
| AUDCO | |
| ITEM CODE / DESCRIPTION | PRESSURE & TEMPERATURE SWITCH |
| VENDOR NAME | REMARK |
| INFOS | |
| SWITZER | |
| CCS | |
| ITEM CODE / DESCRIPTION | REGULATORS |
| VENDOR NAME | REMARK |
| COMPAC IND. LTD. | |
| FISHER ROSEMOUNT SIGAPORE PTE. LTD. | |
| FLOWSERVE PTE. LTD. (FORMERLY DURIRON) | |

| | | |
|---|---|--|
|    | <p>PTS - ELECTRIC MOTOR DRIVEN RECIPROCATING 400 SCM³/H BOOSTER COMPRESSOR</p> | <p>P.014714 M 11077 R 018</p> |
|---|---|--|

Notes:

1. Above vendor list is indicative only and any other vendor(s) apart from as mentioned above may be accepted subject to approval by Owner/Owners representative based on past track record.
2. For the vendors of items not covered in above vendor list, but required for completion of project successfully, supplier shall take approval from Owner/Owners representative for the same during project execution. Bidder shall submit the required certifications, documents, PTR and Performance letters from clients for the same.



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ANNEXURE – VII : VENDOR DATA REQUIRED

| S. NO | DESCRIPTION | PRINTS WITH BID | CERTIFIED INFORMATION REQUIRED AFTER PURCHASE ORDER | |
|----------|---|-----------------|---|-------------|
| | | | FOR REVIEW | FOR RECORDS |
| A | GENERAL | | | |
| 1 | PROJECT SCHEDULE | | | |
| 2 | DULY FILLED-IN "CHECKLIST FOR COMPLETENESS OF BID" | YES | | |
| 3 | DULY FILLED-IN "CHECKLIST FOR SCOPE OF SUPPLY" | YES | | |
| 4 | DEVIATION LIST (IF ANY) TO THE APPLICABLE SPEC., DATASHEETS | | | |
| 5 | UTILITIES REQUIREMENT SUMMARY | YES | | YES |
| 6 | FLANGE DETAILS OF PIPING CONNECTION WITH CONNECTION AT BATTERY LIMIT | | YES | |
| 7 | DULY FILLED IN EXPERIENCE RECORD PROFORMA | YES | | |
| 8 | GUARANTEE PARAMETERS AS SPECIFIED | YES | | YES |
| 9 | TENTATIVE LOAD DATA FOR FOUNDATION DESIGN | | | YES |
| 10 | LIST OF SUB-VENDORS FOR ALL BOUGHT OUT ITEMS INCLUDING ELECTRICAL & INSTRUMENTATION ITEMS | | YES | |
| 11 | LEAFLET, CATALOGUES FOR ALL ITEMS | | YES | |
| 12 | O & M MANUAL | | YES | |
| B | COMPRESSOR | | | |
| 1 | DATASHEETS FOR THE FOLLOWING | YES | | YES |
| A | - COMPRESSOR | YES | | YES |
| B | - HEAT EXCHANGERS | | | YES |
| C | - PRESSURE VESSELS | | | YES |
| D | - ELECTRIC MOTOR | YES | | YES |
| 2 | CATALOGUE FOR COMPRESSOR | | | YES |
| 3 | TYPICAL CROSS SECTIONAL DRAWING AND LITERATURE TO FULLY DESCRIBE THE DETAILS OF OFFERING | | | YES |
| A | - COMPRESSOR | | | YES |
| B | - SUCTION VALVE | | | YES |



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| S. NO | DESCRIPTION | PRINTS WITH BID | CERTIFIED INFORMATION REQUIRED AFTER PURCHASE ORDER | |
|-------|---|-----------------|---|-------------|
| | | | FOR REVIEW | FOR RECORDS |
| C | - DISCHARGE VALVE | | | YES |
| D | - PISTON ROD GLAND PACKING & PISTON RINGS | | | YES |
| E | - LUBE OIL PUMP | | | YES |
| 4 | V-BELT & PULLEY WITH SELECTION CHART & CALCULATION | | | YES |
| 5 | COOLER DATA / DRG WITH THERMAL & MECH DESIGN CALCULATION | | YES | |
| 6 | DESIGN CALCULATION, GA DRGS FOR PULSATION DAMPNER | | YES | |
| 7 | PIPING & INSTRUMENTATION DIAGRAMS FOR THE FOLLOWING | YES | YES | |
| A | - PROCESS GAS | | YES | |
| B | - LUBE OIL | | YES | |
| C | - COOLING SYSTEM | | YES | |
| 8 | TORQUE ANGLE DIAGRAM, PISTON ROD LOAD VS CRANK ANGLE | | NA | |
| 9 | TORQUE SPEED CHARACTERISTICS | | YES | |
| 10 | ACOUSTIC / MECHANICAL EVALUATION REPORT | | YES | |
| 11 | ITEMIZED PRICE LIST OF ESSENTIAL SPARES | | YES | |
| 12 | ITEM LIST OF SPARES WITH PRICE FOR 3 YEARS | | YES | |
| 13 | DRG. FOR TESTING ARRANGEMENT & TEST PROCEDURE TO BE ADOPTED | | YES | |
| 14 | CERTIFICATE FOR FOLLOWING: | | YES | |
| A | HYDRAULIC TESTING | | YES | |
| B | NON DESTRUCTIVE TESTING | | YES | |
| C | MATERIAL COMPOSITION & PHYSICAL PROPERTIES | | YES | |
| D | LEAK PROOFNESS TEST OF FRAME | | YES | |
| E | LUBE PUMP, FRAME OIL PUMP, HYD OIL PUMP | | YES | |
| 15 | DESIGN / ACTUAL ASSEMBLY CLEARANCE CHART | | YES | |
| 16 | TEST RECORDS OF FOLLOWING | | | |
| A | MECHANICAL RUNNING S | | YES | |



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| S. NO | DESCRIPTION | PRINTS WITH BID | CERTIFIED INFORMATION REQUIRED AFTER PURCHASE ORDER | |
|-------|--|-----------------|---|-------------|
| | | | FOR REVIEW | FOR RECORDS |
| B | PERFORMANCE TEST / PACKAGE TEST | | YES | |
| C | NOISE LEVEL TEST YES | | YES | |
| 17 | LIST OF SPECIAL TOOLS & TACKLES FOR INSTALLATION & MAINTENANCE | YES | | YES |
| C | ELECTRIC MOTOR | | | |
| 1 | MOTOR DATA SHEET | YES | YES | |
| 2 | TECHNICAL LITERATURE / CATALOGUE, SELECTION CHARTS, NOMOGRAPHS ETC. | YES | YES | YES |
| 3 | GA DRAWING | YES | YES | |
| 4 | TERMINAL BOX ARRANGEMENT DRAWING | | YES | |
| 5 | MOTOR CHARACTERISTIC CURVES | | YES | |
| 6 | TORQUE SPEED CURVES | | YES | |
| 7 | CURRENT TIME CURVES | | YES | |
| 8 | P.F AND EFFICIENCY | | YES | |
| 9 | TYPE TEST CERTIFICATES | | YES | |
| 10 | CERTIFICATE FROM THE RELEVANT STATUTORY AUTHORITY (BASED ON THE COUNTRY OF MANUFACTURE) FOR SUITABILITY OF THE OFFERED MOTOR FOR INSTALLATION IN THE SPECIFIED AREA CLASSIFICATION | | YES | |
| 11 | PRE-COMMISSIONING AND COMMISSIONING PROCEDURE | | YES | |
| D | INSTRUMENTATION | | | |
| 1 | G.A. OF INSTRUMENT PANEL WITH BILL OF MATERIAL & WIRING DIG. FOR LCP | | YES | |
| 2 | INSTRUMENT DATASHEET | | YES | |
| 3 | LOGIC DIAGRAM / LADDER DIAGRAM / FUNCTIONAL DIAGRAM | | YES | |
| 4 | LOOP SCHEMATIC | | YES | |
| 5 | INTER CONNECTING DIAGRAM | | YES | |
| 6 | OPERATING / CONTROL WRITE UP | | YES | |
| 7 | ALARM / SHUT DOWN LIST | | YES | |
| 8 | WIRING DIAGRAM / INTER CONNECTING PIPING | | YES | |



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| S. NO | DESCRIPTION | PRINTS WITH BID | CERTIFIED INFORMATION REQUIRED AFTER PURCHASE ORDER | |
|-------|--|-----------------|---|-------------|
| | | | FOR REVIEW | FOR RECORDS |
| 9 | START UP AND SHUT DOWN WRITE UP | | YES | |
| 10 | START UP AND SHUT DOWN INLET LOCK DIAGRAM | | YES | |
| 11 | ALARM AND SHUTDOWN LIST WITH SET POINT | | YES | |
| 12 | LOAD CONTROL PANEL LAYOUT | | YES | |
| 13 | TERMINATION DIAGRAM, PANEL WIRING DETAIL | | YES | |
| 14 | LOOP SCHEMATIC | | YES | |
| 15 | INTER CONNECTING DIAGRAM | | YES | |
| 16 | CABLE SCHEMATIC | | YES | |
| 17 | BILL OF MATERIAL | | YES | |
| 18 | TEST / INSPECTION CERTIFICATE | | YES | |
| 19 | LIST OF RELIEF VALVES WITH SETTINGS | | YES | |
| 20 | CERTIFICATE FROM THE RELEVANT STATUTORY AUTHORITY (BASED ON THE COUNTRY OF MANUFACTURE) FOR SUITABILITY OF THE OFFERED INSTRUMENTS FOR INSTALLATION IN THE SPECIFIED AREA CLASSIFICATION | | YES | |

1. DOCUMENT DISTRIBUTION SCHEDULE

- 1.1. Documents and drawings under column no. 3 shall be submitted with each copy of the bid.
- 1.2. Documents listed under column 4 are to be submitted in 4 copies
- 1.3. Documents listed in column 5 are to be submitted as hard bound indexed book containing the following details in Two (2) copies and to be submitted within 4 weeks of release note/dispatch of materials/ equipment from vendor's works.

2. DETAILS TO BE INCLUDED IN FINAL DOCUMENTS BOOKS

- 2.1. Copy of P.O. and all amendments.
- 2.2. Copy of Purchase Requisition and all amendments.
- 2.3. Manufacturing Data Book containing all test certificates of components, raw materials, stage manufacturing tests and inspections, final tests & inspection documents including welders' qualification & welding procedure qualification, repairs & reworking carried out in shops. All raw material test certificates must be correlated to the P.O. Item No. & component to which they relate by clear noting on the certificates.
- 2.4. Spares details including assembly drawings, part numbers, delivery, prices and ordering information.
- 2.5. All design calculations carried out by the vendor.

- 2.6. Final Drawing Index and all as-built drawings reduced to A3/ A4 size and wherever reduction is not possible, full size copies duly folded and placed in plastic pockets.
- 2.7. Catalogues/leaflets of sub-vendors/suppliers of various bought out components highlighting the components actually supplied correlated to P.O. Item Numbers.
- 2.8. Operating and maintenance instructions including lubrication schedules with details of suppliers for procurement by OWNER for subsequent needs.
- 2.9. Release Note and Packing List.
- 2.10. Any other documents asked for in the Purchase Requisition.
- 2.11. All final drawings shall also be given to purchaser in digitized form on CD-ROM compatible to AUTOCAD software.
- 2.12. Final documents including operation and maintenance manual should be submitted, one copy per package plus one original.
- 2.13. Operation and maintenance manual shall include assembly and disassembly, specification (torque chart), parts manual, complete list of bill of material, bought out spares and accessories. One original plus individual copies for the no. of compressor packages supplied.

3. SPECIAL INSTRUCTIONS FOR SUBMISSION OF DWGS./DOCUMENTS:

- 3.1. Fold all prints to 216 MM x 279 MM size.
- 3.2. Contractor to forward the drawings and documentation to OWNER (Attention vendor prints control department) clearly specifying purchasers Job no. & Req. No.
- 3.3. The drawing/Document no. with Rev. No. is essential. The number may be upto a maximum of 28 characters in length.
- 3.4. Each Drawing/Document submitted to OWNER must be checked and signed/stamped by contractor before it is submitted to OWNER.
- 3.5. Revision number must change during subsequent submission of vendor document.
- 3.6. Multi-sheet documents other than drawings must be submitted in their entirety in the event of a re-submission even if only a few sheets are revised.
- 3.7. Final submission in bound volumes shall necessarily have a cover page giving project title, Item name, P.O. No. particulars of owner, consultant & vendor and an index giving list of drawings & documents included (with revision no.).
- 3.8. All vendor drawings to be provided with a blank space measuring 75 mm W x 38 mm H for marking of review codes etc. by OWNER.
- 3.9. The review of the vendor drawings shall be done by OWNER, as applicable, under the following review codes:

| | |
|---------------|---|
| Review Code 1 | No comments. |
| Review Code 2 | Proceed with manufacture/fabrication as per commented drawings. Revise drawings required |
| Review Code 3 | Document does not conform to basic requirements. |

- 3.10. Review of vendor drawings by OWNER would be only to check compatibility with basic designs & concepts & would in no way absolve the contractor/vendor of his responsibility to meet applicable codes, specifications & statutory rules/regulations.

Vendor shall submit within 10 days after placement of FOI, the complete list of drawings/ documents with submission dates against each. Critical drawings, only, the list of which will be agreed during kick-off meeting shall be reviewed jointly at OWNER's office.



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ANNEXURE – VIII: DEVIATION SCHEDULE

| Vendor: | | |
|---------|--|---|
| S.No. | Vendor to specify Specification number and clause number against which Deviation is sought | Description of Deviation and give reasons in support of Deviation |
| | -----NO DEVIATION ----- | -----NO DEVIATION ----- |



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ANNEXURE – IX : M.R. COMPLIANCE SCHEDULE

| S. No. | Requirements | Compliance By Vendor (To Be Answered By Vendor) |
|--------|--|---|
| 1.0 | Confirm compliance individually to following clauses of Job Specification. | |
| | Clause no 1.0 | |
| | Clause no 2.0 | |
| | Clause no 3.0 | |
| | Clause no 4.0 | |
| | Clause no 5.0 | |
| | Clause no 6.0 | |
| | Clause no 7.0 | |
| | Clause no 8.0 | |
| | Clause no 9.0 | |
| | Clause no 10.0 | |
| | Clause no 11.0 | |
| | Clause no 12.0 | |
| | Clause no 13.0 | |
| | Clause no 14.0 | |
| 2.0 | Confirm that you have filled-up the following Schedules/ Annexures and enclosed these with the Bid | |
| | Guarantee Parameters | |
| | Motor Datasheet | |
| | List of Motors | |
| | Specification of Instruments | |
| | Vendor List | |
| | Deviation Schedule | |
| | Experience Record | |
| | Material Requisition Compliance Schedule | |



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| | | |
|-----|--|--|
| | SCADA requirements | |
| 3.0 | Confirm that you have filled-up the Data Sheet and enclosed with the Bid. | |
| | Compressor Data Sheet | |
| | Motor Datasheet | |
| 4.0 | Confirm that following Documents have been enclosed with Bid. | |
| | List of components of CNG Compressor with Make & Specification of components alongwith Technical Catalogues of components. | |
| | Battery Limit (Interface) drawing/ information. | |
| | Process flow diagrams (PFDs) and Piping & Instrumentation diagrams (P & Ids) of sub systems and complete system with write-up on operation | |
| | Utility requirement | |
| | Detail of control wiring diagram, interlock/shutdown/control scheme with write up on operation. Sizing calculation for instrument items. | |

ANNEXURE –X: EXPERIENCE PROFORMA RECORD

| A) EXPERIENCE RECORD PROFORMA OF RECIPROCATING BOOSTER COMPRESSOR PACKAGE | | | | |
|--|---|---------------------------------------|--|---|
| SR. NO | DESCRIPTION | INFORMATION OFFERED COMPRESSOR | | INFORMATION OF EXISTING COMPRESSOR |
| | REQUIREMENT AS PER TENDER | Min.: 400 SCMH | | |
| 1 | Status of bidder | | | |
| | a) Compressor manufacturer | | | |
| | b) Electric Motor manufacturer | | | |
| | c) Packager | | | |
| 2 | COMPRESSOR | | | |
| | Name of compressor manufacturer | | | |
| | Place of compressor manufacturer | | | |
| | Compressor model | | | |
| | Anticipated Life in running hours | | | |
| | Compressor max frame BKW | | | |
| | Comp Manufacturing code | | | |
| | Lubricated or non lubricated | | | |
| | Nos of stages | | | |
| | Max stage temperature °C (150°C) | | | |
| | Compressor max RPM | | | |
| | Compressor operating RPM | | | |
| | Piston speed m/s | | | |
| | Vibrations at comp cylinders <10 mm / sec. Unfiltered peak velocity Vibration comp frame : Unfiltered peak velocity of 5 mm/sec or 200 micron unfiltered peak to peak vibration whichever is less | | | |
| | Material for all stages | | | |
| | Cylinder (C.S) | | | |
| | Piston Rings (PTFE) | | | |
| | Rider Rings (PTFE) | | | |
| | Piston Rod (Forged steel) | | | |
| | Valve (Rings / plates / spring) : (SS/SS/SS) | | | |
| | | | | |
| 3 | PERFORMANCE OF COMPRESSOR | | | |
| | GUARANTEED POINT: | | | |
| A | Average Flow capacity (overfull range of suction pressure from 25 Kg/cm ² g to 200 Kg/cm ² g varying on continuous basis) | | | |



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| A) EXPERIENCE RECORD PROFORMA OF RECIPROCATING BOOSTER COMPRESSOR PACKAGE | | | | |
|--|---|---------------------------------------|--|---|
| SR. NO | DESCRIPTION | INFORMATION OFFERED COMPRESSOR | | INFORMATION OF EXISTING COMPRESSOR |
| | REQUIREMENT AS PER TENDER | Min.: 400 SCMH | | |
| B | Minimum Flow capacity corresponding to suction pressure of 200 to 30 kg/cm ² | | | |
| C | BKW required by compressor including compressor's lube oil pump BKW | | | |
| D | Power required for all fans including radiator fan in Kw | | | |
| E | Ventilation fans for enclosure No of fans Type of fans (included or forced draft) | | | |
| F | Site Capacity of Motor (max of "B+D" 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 | | | |
| | Guaranteed gas loss through rod deals; sm ³ /h | | | |
| | Other information of compressor | | | |
| | a) Year of manufacturing of the compressor | | | |
| | b) Name and address of user with FAX no, phone no, E-mail address | | | |
| | c) Nos of hours the compressor have clocked on bid due date (Enclose certificate from user) | | | |
| 4 | ELECTRIC MOTOR | | | |
| | Make | | | |
| | Model | | | |
| | Rating | | | |
| | Speed | | | |



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| A) EXPERIENCE RECORD PROFORMA OF RECIPROCATING BOOSTER COMPRESSOR PACKAGE | | | | |
|--|--|---------------------------------------|--|---|
| SR. NO | DESCRIPTION | INFORMATION OFFERED COMPRESSOR | | INFORMATION OF EXISTING COMPRESSOR |
| | REQUIREMENT AS PER TENDER | Min.: 400 SCMH | | |
| 5 | PACKAGE | | | |
| | Name of Packager | | | |
| | Place of Packaging | | | |
| | Name of Enclosure Manufacturer | | | |
| | Palace of enclosure manufacturer | | | |
| | Sound level at 1 m distance from package in db (A) 75 | | | |
| | Skid size (LxBxH) | | | |
| | Skid Gross Weight (Comp. + Motor + Aux.) Kg | | | |
| | Make and model LEL detector – 1 no. each comp | | | |
| | Make and model fire detector – 1 no. each comp | | | |
| | 2 nos. min CO2 cylinder with online weight monitoring. | | | |
| | Volume of enclosure in m3 | | | |
| | Nos. of explosion proof tube light in each enclosure | | | |
| | Coupling Direct / V – belt | | | |
| | Other information of complete package | | | |
| | a) Year and place of manufacturing of the package | | | |
| | b) Name and address of user with FAX no, phone no, E-mail address | | | |
| | c) Nos of hours the complete package have clocked on bid date (enclose certificate from user) | | | |
| 7 | Gas recovery system | | | |
| | Gas recovery system with pr relief valve, pr regulator, pr gauge, manual & automatic drainage system | | | |
| 8 | Gas Delivery system | | | |
| | High pr piping with SS 316, tubing, compression fittings, NRV | | | |



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A) EXPERIENCE RECORD PROFORMA OF RECIPROCATING BOOSTER COMPRESSOR PACKAGE

| SR. NO | DESCRIPTION | INFORMATION OFFERED COMPRESSOR | | INFORMATION OF EXISTING COMPRESSOR |
|--------|--|-----------------------------------|--|---------------------------------------|
| | REQUIREMENT AS PER TENDER | Min.: 400 SCMH | | |
| | KOD | | | |
| | Coalescent filter | | | |
| | PLC based Priority panel with full bore ball valve | | | |
| | Final gas outlet connection from priority panel 3/4" SS valves OD SS compression fittings | | | |
| 9 | ESD system | | | |
| 10 | Volume bottles / dampers at each compressor stage of compressor | | | |
| | Vessels | | | |
| | Drainage system | | | |
| 11 | Manual double isolation valve | | | |
| 12 | Automatic valves | | | |
| 13 | Heat exchanger | | | |
| 14 | Code of construction API 661 | | | |
| 15 | Gas sections of coolers shall be as per API – 618 | | | |
| 16 | Tube material | | | |
| 17 | Piping between stages shall be continuous with flange connection | | | |
| 18 | Other tubing shall be SS 304/ 316 as per TS. | | | |
| 19 | Gas recovery vessel provided | | | |
| 20 | Area classification; “ class 1, group D, division 1 as per NEC “ OR “ Zone 1, group IIA / IIB as per IS/IEC” | | | |
| 21 | The size of the complete package | | | |
| 25 | Instrumentation as indicated in TS | | | |
| 30 | Cabling – Double compression type cable glands and copper lugs | | | |
| 31 | Junction box with metallic enclosure | | | |

ANNEXURE – XI : PARAMETERS FOR SCADA

Parameters required for SCADA

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

Hardware Details: Connector Type, Communication Standard, Communication port Pin details,

Communication Port Configuration: Baud Rate, data bits, stop bit, parity

Polling Constraints: Minimum time period between two consecutive poll cycles.

Protocol Details: Protocol name and message structure for different read / write functions.

Function codes for reading digital and Analog inputs

Function code for writing analog values in the IED registers

List of parameters available in the IED which can be accessed from the IED through serial port.

Register address of each parameter in the IED.

A Sample of the details is given below for understanding:

PROTOCOL DETAILS:

| Sr.No. | Description | Content/Details |
|--------|--|---|
| 1 | Protocol | MODBUS RTU |
| 2 | Connection Type | FCC –68 RJ45 |
| 3 | Communication standard | RS485 |
| 4 | Signals supplied | Tx, Rx, GND |
| 5 | Baud Rate(Speed) | 300, 600,1200,4800,9600,19200 |
| 6 | Format | Software configurable |
| 7 | Port Configuration | Speed : 19,200 bps Data Bits : 8 Bits Stop Bit : 1 Bit Parity : None |
| 8 | Min. Time period between consecutive Query | 2 Sec. |

➤ **Function Code & Message Structure:**

Function Code: 3 – Read Output Register

Poll Format:

Address 1 Byte

Function 1 Byte

Start Item 2 Byte

No. Item 2 Byte

Response Format:

Address 1 Byte

Function 1 Byte

Length 1 Byte

Date Item 1 4 Byte

Date Item n 4 Byte

➤ **Function Code & Message Structure:**

Function Code: 2 – Read Input Status

Poll Format:



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Address 1 Byte
Function 1 Byte
Start Item 2 Byte

No. Item 2 Byte
Response Format:
Address 1 Byte
Function 1 Byte
Length 1 Byte
Date Item 1 2 Byte
Date Item n 2 Byte

Memory Mapping, Data Type & Parameter Information:

A. Digital Parameters :

| Sr. No. | Description | Address |
|---------|---------------------------------|---------|
| 1 | Flow computer malfunction Alarm | 8247 |
| 2 | Mass Flow Low alarm | 8245 |
| 3 | Mass Flow High alarm | 8246 |

B) Analog Parameters:

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



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**Annexure – XII
QUALITY ASSURANCE PLAN**




| Sr.No | Description | Quantum of Check | Reference Document | Acceptance Norms | Format Of Records | Inspection By | | | Remarks |
|-------|---|------------------|-------------------------|-------------------------|-------------------------|---------------|------|-------------------------------|---------|
| | | | | | | Vendor | TPIA | Owner/ Owner's Representative | |
| 1.1 | Hydrotest of Cylinder, Cylinder Heads ,Press. Vessels, Heat Exchangers | | Technical Specification | Technical Specification | Test Report | W | W | R | |
| 1.2 | Leak Proof Test of Cylinder (4 Hours . with Kerosene) Refer Note :4 | | Technical Specification | Technical Specification | Test Report | W | W | R | |
| 1.3 | Radiography as Applicable - Pressure Vessels, Heat Exchanger. Gas Piping (Only 10% Joints To Be Witnessed) | | Technical Specification | Technical Specification | Test Report | R | W | R | |
| 1.4 | No Load Mechanical Run Test Of the Compr. with Rated (Or More) Speed And Shop Driver. (4 Hrs. Min.) | | Technical Specification | Technical Specification | Test Report | W | W | W | |
| 1.5 | Strip Check And Internal Inspection After "NLMRT" Of All Compressors Refer Note: 2 | | Technical Specification | Technical Specification | Test Report | W | W | R | |
| 1.6 | Electric Motor Performance Test- at Sub-Vendor's Works as per ISO Std. Refer Note: 3 | | Technical Specification | Technical Specification | Performance Test Report | R | R | R | |
| 1.7 | Material Test Certificates for :Pressure Vessels, Heat Exchanger | | Technical Specification | Technical Specification | MTC | R | R | R | |
| 1.8 | Canopy Structure Painting Inspection At Works. Surface Preparation to be Inspected after cleaning and before application of First Coat of Primer. | | Technical Specification | Technical Specification | Inspection Report | W | W | R | |
| 1.9 | Functional / HV / Continuty Test for Control Panel (at Sub Vendor's Works) | | Technical Specification | Technical Specification | Test Report | W | W | W | |



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| | | | | | | | | | |
|---|--|--------------------------------|-------------------------|-------------------------|-------------------------|---|---|---|--|
| 1.10 | Mechanical String Test for 4 Hours | 25% of Each Package Lot | Technical Specification | Technical Specification | Test Report | W | W | W | |
| 1.11 | Test Certificates For - Safety Switches, Safety Relief Valves, Solenoid Valves | | Technical Specification | Technical Specification | Test Certificate | R | R | R | |
| 1.12 | Final Mock-Up Assembly of the Package - As Per GAFD, P& I Drawings. Wiring Diagram | | Technical Specification | Technical Specification | P&ID, Wiring Diagram | W | R | R | |
| 1.13 | Performance Test at site at Guaranteed Parameters. | | Technical Specification | Technical Specification | Performance Test Report | W | W | W | |
| 1.14 | Field Trial Run for 72 Hrs. | | Technical Specification | Technical Specification | Field Trial run report | W | W | W | |
| LEGENDS : W = WITNESS, R = REVIEW OF DOCUMENTS, Y = DOC. SUBMISSION BY VENDOR / SUB-VENDOR | | | | | | | | | |
| NOTES: | | | | | | | | | |
| 1 | DB, Connecting Rod: UT / MPT shall be conducted in either in forging-OR-in finish condition | | | | | | | | |
| 2 | Strip test is limited to open Crank Case cover, Crosshead guide & Distance piece. Cover and opening of bore & other (sails. Piston one valve per cylinder). | | | | | | | | |
| 3 | Review of manufacturer's test reports/certificates of all compressor package. | | | | | | | | |
| 4 | Witness of tests by TPIA or owner/owner's representative. | | | | | | | | |
| 5 | Inspection of the components / assembly, shall be conducted as per standard Test Procedures. | | | | | | | | |
| 6 | All reference codes/ Standards, documents, P.O. copies shall be arranged by vendor/ supplier for reference of Owner / Owner's representative / TPIA at the time of inspection. | | | | | | | | |
| 7 | The owner shall submit their own detailed QAP prepared on the basis of above technical specification for approval of Owner/ Owner's representative. | | | | | | | | |
| 8 | Vendor to submit his QAP in line with above at the time of Detailed Engineering. | | | | | | | | |
| NOTE: | TPIA (THIRD PARTY INSPECTION AGENCY WILL BE APPOINTED BY SUPPLIER AFTER DUE APPROVAL FROM OWNER. | | | | | | | | |

| | | |
|---|--|---|
|    | PTS - ELECTRIC MOTOR DRIVEN RECIPROCATING 400 SCM ³ /H BOOSTER COMPRESSOR | P.014714 M 11077 R 018 |
|---|--|---|

ANNEXURE - XIII

DATA SHEET



**PTS - ELECTRIC MOTOR DRIVEN
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DATA SHEET: LOW VOLTAGE SQUIRREL CAGE INDUCTION MOTOR ELECTRICAL DESIGN DATA

| | | | | |
|--|--|---|--------------------------------|---|
| 1. | Motor tag no. | | | |
| 2. | Voltage (V) | 415V ± 10% | Phase 3 | Frequency (Hz.) 50 Hz±3% |
| 3. | Fault level (KA) | NOT APPLICABLE | | |
| 4. | Method of starting | As per Standard Practice | | |
| 5. | Phase | THREE | Connection – STAR-DELTA | No. of terminal – 6 |
| 6. | Design Ambient temp (°c) | 50 °C (IN ACCOUSTIC ENCLOSURE) | | Temp. rise (°c) 70 °C (Maximum) |
| 7. | Cable size (mm ²) | AS PER SPEC ATTACHED | | |
| 8. | Enclosure type | IP 55, Ex-d, IIA, IIB, T3 | | Type CU. COND. PVC INS. Cooling TEFC |
| 9. | Insulation class | CLASS-F with temperature rise of CLASS B | | |
| 10. | Haz. Area classification/ Gas Group | ZONE-1, GROUP-IIA, IIB, Temp Class T3 as per IS/IEC | | |
| 11. | Type of explosion protection: Ex (d) | Applicable standards: IS/IEC | | |
| Technical particulars from Driven equipment manufacturer | | | | |
| 12. | Suggested Motor Rating in KW/ Manufacturer | # / # | | |
| 13. | Shaft kw/kw at end of curve | # / # | | |
| 14. | Speed/ rotation of equipment from Coupling End | # / # | | |
| 15. | Starting/ max. Torque required (mkg) | # / # | | |
| 16. | WK ² of equipment including/ excluding flywheel (kgm ²) | # / # | | |
| 17. | Thrust up/ down (kg) | # / # | | |
| 18. | Equipment/ coupling type | # / # | | |
| 19. | Starting Condition-On no load/ Under loaded condition | # | | |
| Technical particulars from motor manufacturer | | | | |
| 20. | Manufacturer | * | | |
| 21. | KW Rating | * | No. of poles | * |
| 22. | Frame designation | * | Mounting (Horizontal) | * |
| 23. | Full load speed (Max. 1500 rpm) | * | Full load Torque (mkg) | * |
| 24. | Starting torque as % of full load torque | * | | |
| 25. | Full load current (A) | * | | |
| 26. | Starting current at 100% Voltage (A) | * | | |
| 27. | Breakdown or pull out torque % | * | | |
| 28. | Rotation viewed from coupling end | * | | |
| 29. | Starting time at 75% V | *(sec.) | Starting time at 100% V | *(sec) |
| 30. | Time (Te) for increased safety motors at 100% Voltage (secs.) | | NOT APPLICABLE | |
| 31. | Locked rotor with stand time cold/ hot at 75% V(sec) | * | At 100% V(sec) | * |
| 32. | WK ² of motor (kg m ²) | * | | |
| 33. | Power factor at 100% load | * | Power Factor at 75% load | * |
| 34. | Efficiency at 100% load | * | Efficiency at 75% load | * |
| 35. | Space heater watts/ volts | */ 240V AC | | |
| 36. | Bearing type/ no. DE | */* | Bearing type/ no. NDE | */* |
| 37. | Type of Lubrication | * | | |
| 38. | Weight of motor (kg) | * | | |
| 39. | Canopy required/ Not required | NOT REQUIRED | | |

TO BE FILLED BY BIDDER BASED ON THE PACKAGE DESIGN

* TO BE FILLED BY MOTOR MANUFACTURER

| | | |
|---|---|--|
|    | <p style="text-align: center;">PTS - ELECTRIC MOTOR DRIVEN RECIPROCATING 400 SCM³/H BOOSTER COMPRESSOR</p> | <p style="text-align: center;">P.014714 M 11077 R 018</p> |
|---|---|--|

Bidder must quote for only one make of motor. Bidder shall submit filled up data sheet for the selected make of motor only. Motor Terminal Box must be suitable for the cable size indicated on data sheet.

POWER CABLE SIZES FOR 415V MOTORS

| S.No. | Motor Rating KW | CABLE SIZE mm ² | | No. of Cores | CABLE DIAMETER - mm (APPROX) | | |
|-------|-----------------|----------------------------|----|--------------|------------------------------|--------------|-------------|
| | | CU | AL | | Overall | Under Armour | Over Armour |
| | Below 3.7 KW | 4 | | 3 | | | |
| | 3.7 | 6 | | 3 | | | |
| | 5.5 | 10 | | 3 | | | |
| | 7.5 | 10 | | 3 | | | |
| | 11.0 | 16 | | 3 | | | |
| | 15.0 | 16 | | 3 | | | |
| | 18.5 | 16 | | 3 | | | |
| | 22.0 | 16 | | 3 | | | |
| | 30.0 | 25 | | 3 | | | |
| | 37.0 | 25 | | 3 | | | |
| | 45.0 | 35 | | 3 | | | |
| | 55.0 | 50 | | 3 | | | |
| | 75.0 | 95 | | 3 | | | |
| | 90.0 | 120 | | 3 | | | |
| | 110.0 | 2x95 | | 3 | | | |
| | 125.0 | 2x120 | | 3 | | | |
| | 132.0 | 2x120 | | 3 | | | |

- NOTES:
1. Above table is valid for 2/4/6 pole motors. For low speed motors cable sizes shall be defined at the time of detail engineering.
 2. Cable size for motor space heater(if required) shall be 3x2.5 mm² with Cu Conductor.
 3. Cables will be 650/1100V, copper conductor, FRLS-XLPE insulated, FRLS-PVC extruded inner sheath armoured with overall FRLS-PVC sheath.



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DATA SHEET: PRESSURE, VESSEL

(To be filled in by the Vendor)

PROJECT

UNIT

ITEM NO.

EQUIPMENT

CLIENT

JOB NO.

PACKAGE

MR. NO.

CODE FOR DESIGN AND CONSTRUCTION ASME SEC-VIII DIV1

DESIGN CONDITION

PRESSURE (kg./ cm²g)

 TEMPERATURE (0C)

OPERATING CONDITIONS

 PRESSURE (kg./ cm²g)

 TEMPERATURE (°C)

CORROSION ALLOWANCE 3 MM

SERVICE CNG LETHAL [X] OTHERS CO₂

LIQUID LEVEL (mm)

SPECIAL SURFACE FINISH INSIDE VESSEL REQD. [] NOT REQD. []

TYPE OF VESSEL HORIZONTAL [] VERTICAL []

DIAMETER (mm)

HEIGHT TL TL (mm)

SKIRT/ LEG HEIGHT

JOINT EFFICIENCY SHELL 1.0 HEAD 1.0

RADIOGRAPHY SHELL100% HEAD 100%

POST WELD HEAT TREATMENT

MATERIALS OF CONSTRUCTION SA 516 GR 60/70



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- SHELL, REINFORCEMENT PADS
- HEADS/ CONES
- SHELL FLANGES
- NOZZLE FLANGES
- NOZZLE NECK
- MAN-WAY NECK
- PIPE FITTINGS
- GASKETS (EXTERNAL)
- GASKET (INTERNAL)
- SKIRT/ LEG SUPPORT
- INTERNAL PARTS
- EXTERNAL PARTS
- INTERNAL BOLTS/ NUTS
- CLIP ATTACHMENTS (EXTERNAL)
- ANY OTHER GENERAL REQUIREMENT

NOTE: VENDOR SHALL SUBMIT COMPLETED DATA SHEET ALONG WITH OFFER WHEREVER ENGG. DRAWING IS NOT ATTACHED FOR THE VESSEL.

 $\Sigma \quad \Sigma \quad \Sigma$

At the helm of the Energy Transition, Tractebel provides a full range of engineering and advisory services throughout the life cycle of its clients' projects, including design and project management. As one of the world's leading engineering and advisory companies and with more than 150 years of experience, it's our mission to actively shape the world of tomorrow. With about 5,000 experts and presence in more than 70 countries, we are able to offer our customers multidisciplinary solutions in energy, water and urban.

TRACTEBEL ENGINEERING PVT. LTD.

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