



GUJARAT ENERGY

SCOPE OF WORK

**FOR SUPPLY, ERECTION, TESTING AND COMMISSIONING OF LNG
STORAGE, DISPENSING REGASIFICATION FACILITIES INCLUDING
COMPREHENSIVE OPERATION & MAINTENANCE OF THE SYSTEM**

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1. INTRODUCTION

Gujarat Energy Ltd, a Group Company of Gujarat State Petroleum Corporation Ltd., (Gujarat State Government Undertaking), is in business of distribution Natural Gas to Industrial/ Commercial/ Domestic Customers and CNG Stations in the State of Gujarat, Maharashtra, Punjab, Haryana, Rajasthan, Madhya Pradesh and Union Territory of DNH etc.

Gujarat Energy Limited is committed to reach out to every possible natural gas user in its expanded geographical area. The size and scale of the combined entity gives it the ability to achieve efficiencies and effectively manage the transformational changes in the sector.

GEL is intended to set up small scale LNG storage, LNG dispensing and regasification facility with provision for dispensing LNG, PNG & CNG by using RLNG.

This document covers generic scope of work for supply, erection, testing and commissioning of LNG storage, LNG dispensing and regasification facilities to supply LNG, PNG / CNG by using RLNG station. Bidder to read the scope given below along with the Annexures and other relevant tender documents while quoting for the job to be executed.

2. DEFINATIONS

Definitions of the terms used in. this bid document, (unless the context otherwise requires), shall have the same meaning as respectively assigned hereunder:

- **"Client"/ "Owner"** shall mean the mean GUJARAT ENERGY LTD / GEL, who has invited quote for the job to execute the project.
- **"Bidder"** designates the individual or legal entity which has made a proposal, a tender or a bid with the aim of concluding a Contract with the Owner.
- **"Consultant" / "Architect"** shall mean the person or firm or body corporate appointed by the Owner for the purpose of providing services as determined by him in connection with this project.
- **"Contractor / Vendor"** shall mean the person or persons, firm or company, who as a successful Bidder has agreed to carry out the job as mentioned herein to Owner and includes its legal representative(s), its successors(s) and assign(s).
- **"Contract" / "Work Order" / "Service Order"** shall mean the agreement and all other documents between the Owner and the Vendor for providing the services mentioned herein
- **"Drawing"** shall mean and include Engineering drawings, sketches showing plans, sections and elevations in relation to the Contract together with modifications and/or revisions thereto.
- **"Engineer-in-Charge"** (EIC) shall mean the person designated from time to time by Owner/GEL and shall include those who are expressly authorized by him to act for and on his behalf for operation of this contract.
- **"Goods"** shall mean articles, materials, equipment, design and drawings, data and other property to be supplied by Vendor to complete the contract.
- **"LNG System"** shall mean all the equipment starting from unloading pump, LNG storage tank, High Pressure and/or Low Pressure cryogenic pump, Vaporizers / Regasification (HP and/or LP) system, odorant system, Measuring system (MFMs), LNG Dispensers, LNG fueling pump skid as applicable as per finalized site requirements and all associated facilities like valves, gauges, piping & fittings.

3. GENERAL SCOPE OF WORK

The scope includes supply and installation of equipment and material as required for setting up LNG storage tank, regasification facilities (High Pressure & Low Pressure Vaporizers), Odorant system, unloading pump (for unloading/transfer LNG from truck to Storage tank), High Pressure and Low Pressure cryogenic pump, LNG Dispenser and including all associated field instrumentations like valves, gauges, piping & fittings, fire-fighting system etc. at GEL operating area. The scope shall include manufacturing, fabrication, packaging, loading – unloading, transportation, erection, installation, testing and commissioning of LNG storage tank, Re-gasification facility, Cryo Pumps, LNG dispenser, Odorant system and other associate equipment, the

scope includes supply / hiring required equipment's, tools & tackles, manpower as required and sampling & testing of material as required in connection with the scope of work mentioned in this scope of work. The brief details of the scope of works are as under. For further details, please refer the detailed specifications in the subsequent sections.

PHASE-1:

The Scope of Work includes design, engineering, manufacturing, inspection and testing at factory; supply at site (FOT site basis) including packing & forwarding, transportation from Bidder works to site including sea/air freight, transit insurances, land freight, land transit insurance; unloading and safe storage at site, erection, installation, testing, 72 hours field / site trial run tests, site acceptance test, commissioning, handing over, training to owner's personnel, guarantee/ warrantee and operations & maintenance during the defect liability period of 12 months including spares, oil and consumables etc. Comprehensive of entire LNG storage and re-gasification facility with odorant system & their interconnecting piping/accessories and PLC system, Fire-fighting system & equipment. Each training module of engineers at Gujarat Energy Ltd. shall cover the equipment constructional features, operational and maintenance procedures, practical hands on experience on assembling, dismantling etc.

Gujarat Energy Ltd. intends to integrate entire LNG storage, re-gasification & LNG Dispensing system to a central control station through hub stations across the GEL operation areas. Although setting up of central control station including hub stations shall be handled through a separate contract, the control system and its necessary features, software and hardware of entire LNG storage, LNG dispensing and regasification system, shall be selected and provided to ensure their compatibility with each other and the central control station.

PHASE-2:

The scope of work also includes comprehensive Operations & Maintenance (O & M) on man-month basis for 48 months from the date of completion of mandatory defect liability period. The work shall be handled through a separate O & M Contract. Bidder to furnish the rate separately for each year of O & M.

The complete work is to be carried out on 'Turnkey' lump-sum basis and total contract value shall be inclusive of all applicable charges for insurances, taxes, duties, levies etc.

Various parts of this specification shall be read in conjunction with each other and in case of differences, the more stringent requirement shall govern.

Any additional work/equipment or technical requirement not mentioned in the specification but required to make the offered system complete in accordance with the specification or required for safe operation, shall be deemed to be included in the offer and provided by the bidder, without any additional payment.

The brief details of the scope of works are as under. For further details, please refer the detailed specifications in the subsequent sections.

3.1 DESIGN ENGINEERING

Vendor to provide design concept along with station P&ID diagrams and facilitation plan for various agreed capacity of LNG storage and regasification process for dispensing of LNG & gas at controlled set pressure & flow for end users.

The entire LNG storage , LNG dispensing and re-gasification system should be designed as per the latest version of major Regulation with their latest amendments and other applicable Standard, which required for setup and operate proposed LNG storage, LNG dispensing and regasification facility.

- SMPV Rules
- GCR Rules
- PNGRB Codes (T4S for Retail Outlets, CGD Network, ERDMP etc.)
- PESO guidelines
- Legal & Metrology Act

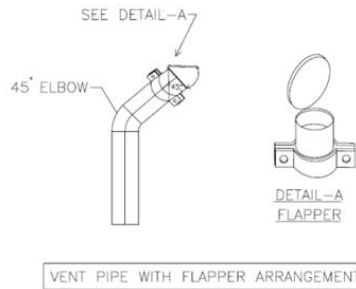
The selection of the equipment like LNG unloading pumps, LNG storage tank, LNG HP and LP cryogenic Pump, vaporizers, pressure reduction skid, Odorizing, LNG dispenser, panel and PLC/ SCADA etc. should be such that their service support arrangement shall be available in India for any service requirement.

3.2 SUPPLY OF EQUIPMENT / FACILITIES

All the LNG storing / controlling equipment and materials used for regasification and distribution / dispensing of LNG/ gas shall have type approval of PESO and any other statutory authority as applicable for LNG storing and regasification facility as applicable in SOR. For PNGRB Regulation, Approved T4S Regulations to be follow. Strengthen clause need to follow in case of any contradiction between SMPV Rules & PNGRB Rules

- 3.2.1 LNG Unloading pump & its accessories.
- 3.2.2 LNG Storage Tank – min 56 KL capacity (Vacuum Insulated Cryogenic Tank)
- 3.2.3 High Pressure cryogenic reciprocating Pump
- 3.2.4 High Pressure Regasification system / Vaporizer : Ambient Air Heated
- 3.2.5 Pump Control Panels
- 3.2.6 PLC Panel for entire LNG system
- 3.2.7 Low Pressure cryogenic reciprocating Pump (if required as per SOR)
- 3.2.8 Low Pressure Re-gasification system / Vaporizer : Ambient Air Heated (if required as per SOR)
- 3.2.9 Pressure, temperature, Level and flow sensors and alarm & control system
- 3.2.10 Control Valves/ Temp. Safety Valves/ Pressure Safety Valves/Relief Valves
- 3.2.11 Piping / Fittings /Tubing - All PNG Natural Gas piping, fittings, valves, vent (MS/CS) shall be or Golden yellow color as per relevant latest codes IS 2379) and identification marking shall be done on piping and accessories as per GEL Standard Operating Procedure.
- 3.2.12 Gas detection devices and alarm system.
- 3.2.13 Flame Detection devices and alarm system
- 3.2.14 Gas Odorizing System with first filling of odorant for 80% tank capacity
- 3.2.15 Priority Panel along with tubing outside the dyke area and integration of priority panel with SCADA (To be supplied along with High pressure regasification system). Tube, Tube fitting and valve material shall be SS316 for High Pressure stream
- 3.2.16 LNG Fueling Pump Skid and On The Fly Saturation Vaporizer/Skid
- 3.2.17 LNG Dispenser (Flow Rate – 190 LPM)
- 3.2.18 Fire extinguishers & sand buckets as per this scope of Work with compliance to latest SMPV Rules, GCR Rules & PNGRB regulations.
- 3.2.19 Fire hydrant system (FHS) along with their accessories
- 3.2.20 Pneumatically operated Water evacuation pump in line with SMPV with provision of cut-off in case of LNG leakage sensing.
- 3.2.21 SCADA system with remote monitoring and control facility
- 3.2.22 All valves and emergency systems (loose supply)
- 3.2.23 All related instrumentation and electrical systems (loose supply)
- 3.2.24 All safety valves/ relief valve. (loose supply)

- 3.2.25 Vent manifolds. Vent shall be provided with brass flapper as per GEL design
- 3.2.26 Cable gland for motors, control panel & any other connections as per hazardous area classifications
- 3.2.27 Supply and installation of all instrumentation, data and electrical cables for LNG Storage and regasification equipment as required.
- 3.2.28 Junction boxes (instrument and electrical) for connection of field devices.
- 3.2.29 Instruments for monitoring vibration (if required as per OEM recommendations), temperature, pressure, liquid level (loose supply).
- 3.2.30 Bidder shall provide vibration monitoring instruments (if required) as per respective OEM Recommendation for continuous and trouble free operation and maintenance of LNG storage, LNG dispensing and regasification system.
- 3.2.31 Any special tool required for erection, commissioning and maintenance of LNG dispenser station and accessory.
- 3.2.32 r
- 3.2.33
- 3.2.34 One set of non-sparking tool kit (with all necessary) should be available at all times on the site.
- 3.2.35 Equipment/control system for control room for LNG storage, LNG dispensing and regasification and supply system.
- 3.2.36 Each station shall contain 1 No. of Mass Flow Meter after LNG unloading pump, 1 No. of MFM at low pressure vaporizer discharge (if low pressure vaporizer supplied with contract), 1 No. of Mass Flow Meter after high pressure vaporizer discharge (if high pressure vaporizer supplied with contract) and 1 No. of Mass Flow Meter in LNG dispenser (if LNG Dispenser supplied with contract).
- 3.2.37 Smart ground detector for LNG tanker shall be flameproof as per zone classification area and approved by PESO
- 3.2.38 Min 02 sets of Cryo PPEs set shall be provide by Bidder at each site. Each set of Cryo PPEs shall consist
- Face shield against splash protection of LNG – 01 No.
 - Cryogenic Hand gloves – 01 No.
 - Cryogenic Apron - 1 No.
 - Full covered Cryogenic suit – 01 No.
- 3.2.39 Supply and installation of 01 set of Combined Unit – Head Safety Shower and Eye Washer shall be in bidder's scope
- 3.2.40 Supply of 01 set of LNG Spillage kit shall be in bidder's scope (LNG spillage kit may contain SS Tray to minimize spillage at leakage point with best industrial practice).
- 3.2.41 Air Compressor for Instrument Air for Actuators with working pressure of 4-10 barg.
- 3.2.42 Provision with valves for LNG Dispensing facility
- 3.2.43 Recovery System for BOG of Tank and/or Low Pressure system (If Low Pressure regassification system available).
- Note: If BOG recovery required for HP stream system where only HP Stream is installed, GEL may take care for installation of BOG compressor on case to case basis. However, bidder shall provide sufficient interlock and alarms for monitoring of Tank Pressure.
- 3.2.44 Bidder need to ensure to provide pressure of Natural Gas at battery limit @6-8 Barg without LP pumps and @ 24-26 Barg with LP Pumps and @250 bar with HP pump.
- 3.2.45 Supply of suitable MS fabricated Platform, Stairs, any crossovers platforms (if any) inside the dyke area are in scope of Bidder.
- 3.2.46 All vent excluding vent on LNG tank shall be provided with brass flapper as per GEL design.



- 3.2.47 Supply, Installation, Testing, commissioning and their comprehensive Operation & Maintenance of UPS System, Air compressor, odorant System, Earthing system, Priority Panel, Fire Extinguishers including FHS, Lighting and other accessories supplied by bidders are in the scope of Bidder
- 3.2.48 Bidder shall comply all requirement of PNGRB T4S retail outlet.
- 3.2.49 Supply of Electrical, Mechanical & Instruments related items for LNG storage, LNG dispensing and regasification system which includes but not limited to air compressor, UPS, All interconnecting tubing/Piping for suitable for LNG/NG, Instrument air along with all required fittings and supporting structures, all required field instrumentations i.e valves, gauges, transmitters, gas detectors, flame detectors, temp. detectors, ground detector, all required electrical and control cabling along with cable trays with their accessories, power distribution panel, earthing system, Lighting system, water evacuation pump in dyke area, Hose Trolleys and other material to complete LNG/ LCNG regasification facility.
- 3.2.50 Bidder shall provide storage tank having PESO Model Approval and for vaporizer having Fabrication approval from PESO along with compliance of scope of work provided with this tender during detailed engineering phase.

3.3 ERECTION AND INSTALLATION

- 3.3.1 Erection and installation of equipment for setting up LNG storage, LNG dispensing and regasification facility are in scope of Vendor.
- 3.3.2 Vendor to provide installation plan and to take necessary approvals prior to installation.
- 3.3.3 The installation of all the equipment like Unloading pump, LNG Storage tank, HP/LP pump, vaporizers, PB Coil, Odorizers, LNG Fueling Pump Skid and On The Fly Saturation Vaporizer/Skid, LNG dispenser, PRS & any other required equipment, piping, foundation bolts, grouting material, template etc. shall be in the scope of the vendor.
- 3.3.4 Required necessary grouting/civil work for installation of Pipe / Cable Tray Supports inside dyke area/pump room and LNG Dispensing Facility in scope of bidder.
- 3.3.5 Vendor to do site visit to inspect readiness for installation prior to moving equipment / start erection work.
- 3.3.6 Scope shall include supply / hiring of Crain / hydra, manpower, necessary tools-tackles, scaffolding, staging, support etc. and to make any temporary arrangement for support / lifting etc. all complete as required and directed by EIC for safe installation at site.
- 3.3.7 Vendor to follow GEL standard HSE process and procedure for erection & installation work.
- 3.3.8 Erection & Installation work, Piping / Tubing work up to Priority panel (including outside the dyke area) is in the scope of Bidder. Priority panel needs to be integrated with SCADA system supplied along with LNG System, it in the scope of a bidder.
- 3.3.9 Bidder shall make necessary provision for inclusion/installation of heater (If Required) inside HP and LP stream.

3.4 MECHANICAL INSTALLATION

- 3.4.1 Installation of any other allied equipment for LNG storage, LNG dispensing and regasification for supply of NG to battery limit are in scope of Vendor.
- 3.4.2 Supply and installation of mechanical piping and tubing work for LNG storage with pumps and

regasification facility and other station piping / tubing for LNG Fueling Pump Skid, On the Fly Saturation Vaporizer/Skid & LNG dispenser. Scope shall include pipe welding, tube bending, tube connectors /fixtures supply and fitting, providing and installation of support structures / members etc. as required.

- 3.4.3 Vendor to provide arrangement including piping, tubing, spool piece etc. for meter proving for all flow meters (meter for unloading, HP & LP System)
- 3.4.4 All the interconnecting pipelines normal or cold insulated or vacuum jacketed are in the scope of the vendor.
- 3.4.5 Interconnecting welded joints with radiography testing should be done at site.
- 3.4.6 Supply and installation of fire hydrant system.

3.5 ELECTRICAL WORK: CABELING & CONTROL PANEL

- 3.5.1 Supply and laying of electrical cables, Control panels and other electrical items for LNG storage, LNG dispensing and regasification facility are in scope of vendor.
- 3.5.2 Cables to be laid in Trench / pipe / enclosed tray as per station design. Thickness of GI tray sheet shall be equal to or more than 2 mm.
- 3.5.3 All the control air tubing, Electrical cabling work etc. shall be under the scope of vendor.
- 3.5.4 Vendor to supply FRLS cables of required size and rating.
- 3.5.5 Vendor to design and provide equipment configured with SCADA for operation and monitoring of the system.
- 3.5.6 The system shall be designed for automatic operation with provision for manual intervention.
- 3.5.7 Vendor to design and provide control panel having Electrical controls and PLC installation for operation and control of the LNG storage, LNG dispensing and regasification system.
- 3.5.8 Supply and installation of Flame Detection and alarm system as applicable.
- 3.5.9 Vendor to provide sufficient number of copper and GI earthlings (free maintenance type) to protect all the equipment as per Indian electricity rules.
- 3.5.10 Fitting inside the Ex zone should be flame proof as per SMPV & PESO requirements.
- 3.5.11 The Panel shall be designed for automatic operation with provision for manual intervention.
- 3.5.12 The power distribution panel for electrical supply to LNG Equipment shall be suitable to installed in control room located out of Ex. Zone.
- 3.5.13 The control room should have Electrical controls and PLC installation for operation of the unloading of the LNG from LNG tanker, Control of various parameters like low level, High level, High pressure, flow etc.
- 3.5.14 The controls should be there for various pneumatic lines for valve automation & operations, controls & emergency signaling, Operation of Emergency Shutdown system, Data recording and remote operation. The system should be connected to the internet for reporting. The control panel of safety gadgets like Methane detection, flame detections, level monitor, pressure monitoring, temp monitoring etc. shall be housed in the control room.
- 3.5.15 GEL will provide main transformer, main panel and shall provide single cable at bidders electrical panel in control room with 415V, 3Phase supply and Bidder shall carry out further distribution upto all Equipment and valves

3.6 SAFETY INTERLOCKS

- 3.6.1 All the safety interlocks required for the safe operation of the facility must be ensured. Safety interlocks like temperature cut off, Pressure cut off, ESD, High tank level warning and cut off, Low tank level warning etc. must be incorporated in the system as per the regulations.
- 3.6.2 The relief valve should be provided in every line where possibility of LNG trapping is possible. All the relief valve discharge connection shall be connected to the common vent stack as per the regulations.
- 3.6.3 Vendor to design and provide fire safety and alarm system.
- 3.6.4 All the Methane Detection, Flame detection, ESD etc. should be installed and made operational as per the SMPV rules and any other applicable statutory norms of Government of India. Refer www.peso.gov.in

- 3.6.5 Methane detection, flame detection, ESD etc, shall be in the scope of bidder and this needs to be integrated with SCADA system for local annunciation and automatic shut down of LNG system
- 3.6.6 Installation of ground detector shall have interlock with operation of LNG Transfer pump.
- 3.6.7 All the Methane Detection, Flame detection, ESD etc. should be installed and made operational as per the SMPV rules of Petroleum & Explosives Safety Organization, any other applicable statutory norms of Government of India.

3.7 TESTING, PRE-COMMISSIONING AND COMMISSIONING

- 3.7.1 A successful facility commissioning is in the scope of the vendor. Including testing and pre-commissioning check for any mechanical and electrical instruments / equipment, station piping and other installed assemblies / facility for LNG storage, LNG dispensing and regasification.
- 3.7.2 Prior to commissioning Vendor to keep ready and make available all material and its capacity test certificates for all the assembly & fittings used and that to be noted in pre-commissioning check list of the assembly /system.
- 3.7.3 Pre-commissioning testing and purging including supply of sufficient quantity of N2 or LN2 shall be in vendor's scope.
- 3.7.4 Supply of LNG for final commissioning will be provided by client
- 3.7.5 Equipment Run Test (ERT) of pumps / skid / LNG Fueling Pump Skid/LNG dispenser or any associated assembly shall be carried out at Vendor's shop. ERT at Vendor's work shop shall be witnessed by Owner / Third party. However, ERT of Cryo shall be performed as part of commissioning.
- 3.7.6 Performance testing of equipment shall be carried out at site as per desired operating parameters. Vendor shall provide reasonable assistance as required by Owner in this regard.

3.8 DOCUMENTATION

All the equipment like Pumps, Tank, Vaporizers, Odorant system, LNG Fueling Pump Skid, LNG dispenser, valves, Gauges etc. and Flame proof electrical items/equipment should be PESO type testing approval in place where ever required.

- 3.8.1 All the necessary design, drawings, quality and manufacturing documentation of each equipment for our records and statutory inspection.
- 3.8.2 Rule 33, Rule18, Rule 19 Certificate by competent person as per SMPV rules shall be submit by bidder. Required inspection /site visit of competent person shall be carry out bidder
- 3.8.3 Operation & Maintenance manual to be provided.
- 3.8.4 HAZOP study & QRA will be done by GEL. Bidder has to attend the QRA & HAZOP conducted by GEL. Bidder has to incorporate all the recommendations resulting from mentioned safety engineering studies.
- 3.8.5 LNG storage, LNG dispensing and re-gasification facility with all accessories P&ID chart.
- 3.8.6 Commissioning report and pre-commissioning check report.
- 3.8.7 Equipment type approvals from applicable statutory authorities.
- 3.8.8 Design documents for SS hose pipe
- 3.8.9 Do's & Don'ts of Equipment
- 3.8.10 AS build drawings of Mechanical, Electrical system for LNG Dispensing Facility
- 3.8.11 Standard Operating procedure (English & Local Languages) to be provided for all the operation. Also defining process steps in brief for safe refueling to be displayed on /nearby dispensing facility.
- 3.8.12 Equipment type approvals from applicable statutory authorities for LNG dispensing facility.

3.9 OPERATION & MAINTENANCE

- 3.9.1 Vendor shall provide comprehensive maintenance service for the LNG storage, LNG dispensing and regasification system at least 5 years (1 year warranty period + 4 year maintenance) along with spares, material and manpower as required.

- 3.9.2 Vendor shall maintain mandatory spares and consumables of the LNG storage, LNG dispensing and regasification assemblies with 24X7 availability.
- 3.9.3 Vendor shall maintain consumable spares on site like gaskets etc.
- 3.9.4 In-case of any major breakdown in LNG storage, LNG dispensing and regasification station, Vendor shall repair the same with a period of 48 hours or 2 days.
- 3.9.5 Vendor shall carryout minor repair works with 24 hours or 1 day of fault arising in regasification and pressure reduction.
- 3.9.6 Vendor shall appoint a technician cum in-charge 24x7 to provide support/assistance to GEL operator/maintenance contractor personal for operation of LNG station & repair works.
- 3.9.7 Vendor shall supply nitrogen cylinders as and when required during entire contract period for pre-cooling of cryo equipment.
- 3.9.8 Vendor shall operate (start/stop) DG set if required in case of power failure to operate LNG facility DG set and all related switchgears in GEL's electrical panel for mains supply changeover will be supplied and maintained by GEL.
- 3.9.9 Refilling of U/G water tank shall be done by GEL forecourt operator. However, required level sensors to be provide by bidder and it should be link with PLC/ SCADA system for Fire Hydrant System operation.
- 3.9.10 Load & Performance test of complete fire hydrant system to be carried out by bidder as per GEL AOMP
- 3.9.11 Electrical power, Drinking water, Internet (If Available), Diesel for DG Set for operation of LNG System during O&M Phase shall be provide by GEL.
- 3.9.12 Diesel for operation of engine driven fire pump shall be provide by GEL. However, bidder has to ensure level of diesel for smooth and uninterrupted operation of equipment.
- 3.9.13 First filling of Odorant as per requirement of SOW shall be in scope of bidder and subsequent filling shall be done by GEL. However, necessary supports shall be provided by bidder during odorant filling activity.
- 3.9.14 Required stationary for operation of LNG facility shall be in scope of bidder.
- 3.9.15 Housekeeping of Control room, dyke area and LNG area is in the scope of GEL. However, Bidder need to ensure to get it done by GEL operation staff.
- 3.9.16 Minimum requirement of Manpower for Operation of LNG facility is as below:
- | | |
|-----------------------------|---|
| Operator (24 Hrs. X 7 days) | : 3 Nos. (One in each shift) + 1 No. Reliever |
| Station In-charge | : 1 No. (In General Shift) |
| Fireman (24 Hrs. X 7 days) | : 3 Nos. (One in each shift) + 1 No. Reliever |
| Maintenance Team | : As and when required. |

- 3.9.17 Qualification and experience of deployed manpower shall be as follows:

Manpower Type	Qualification
Station In charge	Graduate with Relevant experience of 2 years or Diploma (Mechanical/ Instrumentation/ Process/ Mechatronics) with relevant 5 years' experience in operations of LNG terminal/ LNG station/ LCNG Station or CGD
Operator	Graduate with Relevant experience of 1 years or Diploma (Mechanical/ Instrumentation/ Process/ Mechatronics) with relevant 2 years' experience in operations of LNG terminal/ LNG station/ LCNG Station or CGD
Fireman	Fireman should be HSC and should be a diploma holder in fire-fighting training from reputed institute. Work experience as a fireman for at least 2-3 yrs. in Oil and Gas Industry or any chemical industry.

- 3.9.18 Odorant Spillage Kit with sufficient quantity shall be provided by the bidder, which includes material like Odorant Neutraliser Agent (Like Oscent) and Odorant absorbent powder.
- 3.9.19 Thickness testing of Air compressor tank & Odorant system is the scope of bidder & submit Form-11 (Report of Examination or Test of a Pressure Vessel), from competent authority is the scope of bidder as per GEL AOMP and applicable code/standard.

- 3.9.20 Pneumatic test of LNG storage tank as per SMPV rules including supply of medium for testing (e.g. Nitrogen) is in the scope of bidder. Bidder to get approval from GEL EIC for method/process steps for pneumatic testing.

3.10 SITE OFFICE AND STORE AT SITE

- 3.10.1 Vendor has to set up their own temporary site office during project phase at their own cost for use of their employees and to store site documents and tools and tackles etc. as required. Office shall be located such that it shall not obstruct/ affect work of any other associate agency/ vendor.
- 3.10.2 Vendor to take care and liable for their material, tools, tackles, documents etc. till that are handed over to client with project completion report.
- 3.10.3 Owner will provide workplace space inside their temporary/ permanent office building for operator for monitoring and documentation purpose.

3.11 ARRANGEMENT OF WATER AND ELECTRICITY

- 3.11.1 Vendor to make their own arrangement for drinking water for their use during project work.
- 3.11.2 Vendor to make their own arrangement for electrical power required for any installation work and project execution phase. however, GEL make their best effort to avail permanent electricity supply from respective electricity board.
- 3.11.3 If water and electricity available at site and provided by client/ any associated other vendor of GEL that may be provided on chargeable basis and applicable charges may be recovered from the vendor.
- 3.11.4 After completion of installation and start of operation of the system, required electricity and water shall provide by GEL.

3.12 TOOLS & TACKLES

- 3.12.1 Vendor to arrange and supply required tools, tackles and equipment required for installation / erection work. that to include any hired equipment's
- 3.12.2 Vendor to arrange any required hired Crane/ Hydra/ any transportation vehicle as and when required for installation/ erection/ transportation required at their own cost and liability.

3.13 PROGRESS REPORT / MIS

Vendor to keep records and report:

- 3.13.1 To submit project mile stone plan before start of work
- 3.13.2 Daily progress report
- 3.13.3 Weekly progress report.
- 3.13.4 To take Daily photographs and report to GEL EIC.
- 3.13.5 Quality assurance and test report submission against QAP.

3.14 BILLING AND PROJECT COMPLETION / CLOSE OUT

- 3.14.1 Vendor shall submit all required documents, test certificates, etc. as asked by GUJARAT ENERGY at various stages along with Bills.
- 3.14.2 The final bill shall be accompanied by all Q.C. Check sheets / ED Forms and all test reports and As Built drawings for all installation, utilities, other documents for the various work carried out by the Vendor.
- 3.14.3 The Vendor's final bill shall be accompanied with a 'No Claim Certificate' stating that no further claims will be raised by the Vendor.

Any other installation works not mentioned in SOR or not specifically indicated in the scope of work but are necessary for the LNG storage, LNG dispensing and regasification facility setup shall also be deemed to be included in the Vendor's scope of work.

The Scope of Work" shall not limited to above described points but shall include subsequent other Tender documents attachment.

4. OWNER'S SCOPE OF WORK

- 4.1 Owner shall get done design engineering for civil construction work for equipment foundation and station building and other facilitation based on the seismic loads data/ soil survey /site survey data provided by vendor.
- 4.2 Owner shall get done civil construction work for equipment foundation including fire water tank construction and other forecourt development through their other associated contractor based on basic data provided by LNG supplier vendor.
- 4.3 Owner shall obtain PESO approval and license for the facility by their own or Owner may request bidder to obtain PESO approval. All Required supporting document shall be submit to bidder. If PESO approval obtain by the bidder, Payment shall be made as per schedule of rates. Layout to be jointly finalize by vendor, consultant and client. Vendor to give required support for the same.
- 4.4 Owner shall provide buying confirmation from LNG supplier and also transportation of the LNG till GEL premises. However, unloading of LNG is in the scope of Bidder. Supply of necessary piping, installation, Commissioning, Operation and Maintenance under warranty and post warranty also is in Bidder's scope.
- 4.5 Owner shall provide furniture required inside control room such as AC, Tables etc.
- 4.6 Soil survey and seismic survey (if required) will be performed by the GEL.
- 4.7 DM/ Police Commissioner No objection certificate is in Owner Scope. Bidder will provide all necessary documents to GEL, which ever required for DM/ Police Commissioner No objection certificate, without any additional cost.
- 4.8 Security officer will be provided by the GEL. And also, LCV fill points/ post and CNG dispenser will be supplied by GEL. And also, Necessary connection from Priority panel to Cascade & Dispensers, MCV fill post shall be done by GEL
- 4.9 Supply and AMC of CCTV system is in GEL scope.
- 4.10 Required lighting for CNG Forecourt area shall be done by GEL. However, required numbers of FLP lighting for LNG Facility shall be in scope of bidders.
- 4.11 Commercial CNG dispensing and LCV filling operation is performed by forecourt operator appointed by GEL.
- 4.12 SITC of Pressure regulating skid (i.e. DRS) post battery limit of bidder shall be in GEL scope.
- 4.13 Large canopy/ structure above dispensers shall be performed by Gujarat Energy Limited.
- 4.14 GEL will install DG Set (If Required) to Operate Complete Facility/Station.
- 4.15 GEL will installed their LT panel with Changeover Switch to Switch source of supply from DISCOM to DG.

5. WARRANTY

Seller assures the supply of new and free from any defects equipment with good aesthetics to the Purchaser, fully complying with the specifications mentioned in the SOW/ Technical specifications. Seller also warrants that such Equipment will, under normal and reasonable operation, be free from defects in material and workmanship and will operate as per the parameters agreed upon. This warranty shall be valid for a period of 12 months from the date of commissioning or 18 months from the date of delivery, whichever is earlier.

6. PENALTY

PROJECT PHASE

6.1 Material: Supply Delay:

Delay in Supply LNG Equipment: - Without prejudice to the OWNER's other rights available under the CONTRACT and/or Law, in case the CONTRACTOR fails to meet the Delivery and/or Completion Schedule as specified in the CONTRACT and/or as intimated by OWNER REPRESENTATIVE, for the reasons other than Force Majeure and/or reasons attributable to OWNER alone, the OWNER shall, unless otherwise specified differently in the Special Terms of Contract, recover, as ascertained and agreed, Liquidated

Damages , and not by way of penalty, a sum equivalent to half percent (0.5%) of the value of delayed GOODS / SERVICES per week of delay or part thereof, on basic value of delayed GOODS / SERVICES, subject to maximum of 5% of the basic value of the delayed portion of the GOODS/SERVICES. The decision of the OWNER in regard to the actual delay shall be final and binding on the CONTRACTOR.

6.2 Service: Erection and installation Delay:

Delay in installation of equipment and material: - Without prejudice to the OWNER's other rights available under the CONTRACT and/or Law, in case the CONTRACTOR fails to meet the Erection & installation Schedule as specified in the CONTRACT and/or as intimated by OWNER REPRESENTATIVE, for the reasons other than Force Majeure and/or reasons attributable to OWNER alone, the OWNER shall, unless otherwise specified differently in the Special Terms of Contract, recover, as ascertained and agreed, Liquidated Damages , and not by way of penalty, a sum equivalent to half percent (0.5%) of the value of delayed GOODS / SERVICES per week of delay or part thereof, on basic value of delayed GOODS / SERVICES, subject to maximum of 5% of the basic value of the delayed portion of the GOODS/SERVICES. The decision of the OWNER in regard to the actual delay shall be final and binding on the CONTRACTOR.

6.3 Service: Commissioning:

Delay in commissioning: - Without prejudice to the OWNER's other rights available under the CONTRACT and/or Law, in case the CONTRACTOR fails to meet the commissioning Schedule as specified in the CONTRACT and/or as intimated by OWNER REPRESENTATIVE, for the reasons other than Force Majeure and/or reasons attributable to OWNER alone, the OWNER shall, unless otherwise specified differently in the Special Terms of Contract, recover, as ascertained and agreed, Liquidated Damages , and not by way of penalty, a sum equivalent to half percent (0.5%) of the value of delayed GOODS / SERVICES per week of delay or part thereof, on basic value of delayed GOODS / SERVICES, subject to maximum of 5% of the basic value of the delayed portion of the GOODS/SERVICES. The decision of the OWNER in regard to the actual delay shall be final and binding on the CONTRACTOR.

O&M PHASE

6.4 Breakdown of LNG system:

- a. In the event of breakdown in the Low Pressure regasification system/ associate major equipment for Low Pressure Regassification System (i.e. any of LP Pump/s , Vaporizer, Piping system etc.), the vendor has to resume the normal operation within 12 hours' time, failing which a penalty will be imposed at a rate of Rs. 5000 for every next 4 hrs (On prorated basis).
- b. In the event of breakdown in the High Pressure regasification system/ associate equipment for High Pressure Regassification System (i.e. any of HP Pump/s, Vaporizer, Piping System, etc.), and LNG Unloading & Storage facility / Associated equipment of LNG Unloading & Storage Facility (i.e. LNG Unloading Skid, LNG Storage Tank, Piping System etc), the vendor has to resume the normal operation within 24 hours' time, failing which a penalty will be imposed at a rate of Rs. 5000 for every next 4 hrs (On prorated basis).
- c. In the event of breakdown in the Fire Hydrant system, Odorant Unit, Tubing System, Field Instruments, PLC, Air Compressor, Priority Panel or any other equipment, the vendor has to resume the normal operation within 8 hours' time, failing which a penalty will be imposed at a rate of Rs. 5000 for every next 4 hrs. (On prorated basis).
- d. In the event of breakdown in the LNG dispenser /associate equipment for LNG dispensing system (i.e. saturation pump skid, Interconnecting Piping etc.), Vendor has to resume the normal operation within 12 hours' time, failing which a penalty will be imposed at a rate of Rs. 5,000 for every 4 hrs. (On prorated basis).

6.5 Preventive Maintenance:

Bidder shall carry out recommended schedule/preventive maintenance of equipment's through OEM/SERVICE PROVIDER. Bidder has to submit time required for each type of scheduled maintenance as per O&M manual and get one time approval from EIC-Gujarat Energy Ltd.

Parameters	Service Level Agreement	Penalty
Preventive Maintenance during Warranty Period & AMC Period	within 15 days from the due date of preventive maintenance	Delay in executing the maintenance as per schedule penalty of 10,000 INR will be levied by Gujarat Energy limited. Any further delay of 7 days beyond 15 days is liable for additional penalty of 500 INR/day.

6.6 Uptime (Availability) of LNG system:

Vendor has to ensure that LNG System including LNG Storage, LNG Dispenser, Low Pressure Regassification System and High Pressure regassification system is available for operation for a minimum of 96% of the working hours in a month.

Note:

1. This penalty against uptime of the LNG System and will not be applicable in case, if the station is non-operational due to reasons not attributed to the Bidder.
2. System availability to be calculated, if overall plant/facility is under breakdown or shutdown or not operational due to reasons attributable to Bidder.

- 6.6.1 Penalty for LNG system shall be applicable either for breakdown time or for availability of LNG system; whichever is higher.

% Availability of the LNG storage and regasification system = $(T-B1)/T$

Where

B1 = Total no. of breakdown hours recorded in log book for LNG storage and regasification system.

T = Total number of hours in a Month to be calculated by considering 24 Hours of running of the LNG station per day

If the LNG system availability is less than 96% in a Month, then penalty shall be applicable as follows:

Sr. No.	LNG system Availability for Entire Month	% of Penalty to be levied against basic value of invoice for comprehensive O&M for LNG system
1	96 % to 100%	0%
2	91% to less than 96%	5%
3	85% to less than 91%	10%
4	81% to less than 85%	20%
5	75% to less than 81%	30%
6	71% to less than 75%	40%
7	0% to less than 71%	50%

NOTE:

- Bidder can get approval for waiver of penalty from GA s Head by giving proper justification for the delay in attending the breakdown or on categorization of type of breakdown if it is not covered in list given above.

6.7 Penalty for Gas Loss:

Vendor shall ensure the product loss shall not exceed 1% for whole LNG system.

In case, the product loss increases beyond the specified limit; during period of contracted Operation & Maintenance; the penalty shall be charged and the below calculation for penalty shall be followed for arriving the amount of penalty:

The limit for Gas loss of LCNG station is specified as 1%, this limit is arrived after considering the accuracy of the meters.

Penalty for Other Gas Loss is calculated based on the following formula:

A : Total Received LNG (In Kg) measured through Mass Flow Meter installed upstream of LNG Storage Tank/s

C_{Total} : Total Gas measured (In Kg), through Mass Flow Meter installed for CNG Application

$$C_{Total} = C1 + C2 + C3....$$

C1 : Gas measured (In Kg), through Mass Flow Meter installed for CNG Application – FM1

C2 : Gas measured (In Kg), through Mass Flow Meter installed for CNG Application – FM2 and so on

P_{Total} : Total Gas measured (In Kg), through Mass Flow Meter installed for PNG Application

$$P_{Total} = P1 + P2 + P3....$$

P1 : Gas measured (In Kg), through Mass Flow Meter installed for PNG Application – FM1

P2 : Gas measured (In Kg), through Mass Flow Meter installed for PNG Application – FM2 and so on

L_{Total} : Total LNG Dispensed through LNG Dispensers (In Kg),

$$L_{Total} = L1 + L2 + L3....$$

L1 : LNG Dispensed by LNG Dispenser - 01 (In Kg)

L2 : LNG Dispensed by LNG Dispenser - 02 (In Kg) and so on

OS_{Total} : Total Opening Stock / Inventory of LNG available in Tank/s

$$OS_{Total} = OS1 + OS2$$

OS1 : Opening Stock (In Kg) of LNG in Storage Tank 1 for First Day of Month

OS2 : Opening Stock (In Kg) of LNG in Storage Tank 2 for First Day of Month

CS_{Total} : Total Closing Stock / Inventory of LNG available in Tank/s

$$CS_{Total} = CS1 + CS2$$

CS1 : Closing Stock (In Kg) of Storage Tank 1 for Last Day of Month

CS2 : Closing Stock (In Kg) of Storage Tank 2 for Last Day of Month

$$\text{LNG Loss (In Kg)} = (OS_{Total} + A - CS_{Total}) - (C_{Total} + P_{Total} + L_{Total})$$

$$\text{LNG Loss (In \%)} = [(OS_{Total} + A - CS_{Total}) - (C_{Total} + P_{Total} + L_{Total})] / (A)$$

Gas loss monitoring is within the scope of OEM/SERVICE PROVIDER and systems should be in place by OEM/SERVICE PROVIDER for taking necessary action immediately on observing gas loss beyond the limit specified below for the month.

EIC may Penalize OEM/SERVICE PROVIDER by considering monthly average loss of 1% as the specified

limit. OEM/SERVICE PROVIDER can get approval for waiver of penalty from Operation Head by giving proper justification for gas loss beyond the specified limit.

Gas Loss shall be calculated on monthly basis.

Amount to be penalized should be arrived at by reducing Excise duty & VAT from the applicable "Retail Selling Price" (RSP):

Retail Selling Price (RSP) = A1

Applicable VAT in Rs. (B1) = $A1 - (A1 / (1 + VAT/100))$

(Where VAT is Value Added Tax in %)

Gas price in Rs. without VAT (C1) = $A1 - B1$

Applicable Excise Duty in Rs. (D1) = $C1 - (C1 / (1 + ED/100))$

(Where ED is Excise Duty in %)

Gas price in Rs. without ED (E1) = $C1 - D1$

So net Gas price to be considered for debiting towards gas loss is "E1" given above.

In case of gas is gain in two consecutive month above 2% written justification to be provide by vendor.

6.8 LNG spillage/Leakage:

In case of if any spillage of LNG occurs during transfer of LNG in GEL premise then the Vendor will be penalized Rs. 10000/- per instance.

6.9 Operator / Station In-charge Unavailability:

If the operator is not available for any of the working shift, the vendor will be penalized Rs.1000 per instance.

If the station In-charge is not available in general shift vendor will be penalized Rs.5,000 per instance.

However, levying of penalty does not relieve vendor from ensuring that the absence of manpower does not affect the operation of the LNG system.

6.10 Housekeeping:

If found poor housekeeping is found in dyke area. Rs. 500 penalty will be imposed for Non-compliance to Housekeeping after Two warning (Per instance).

6.11 General:

Penalty amount raised for a LNG system due to any reasons excluding penalty levied against Product loss should not be carried forward to other months or to the other LNG systems being handled by Vendor.

In any case, the maximum penalty imposed in a month as per the tender clauses other than penalty for Gas loss & Injury Incident related penalties shall be limited to 50% of the basic value of the monthly invoice (excluding taxes). Monthly invoice shall include Operations and maintenance charges. Gas loss penalty will be levied as per actual as specified above. Retention against penalty shall be considered initially on basic contract value.

However, final settlement shall be done upon actual executed final work and accordingly penalty amount shall be finalized. In case additional penalty amount is retained, the same shall be settled / released based on actual executed basic order value as certified by Engineer in charge of the order.

Cap limit of penalty shall be considered to maximum of 10% of the total basic executed contract value- Exclusive of GST

7. QUALITY ASSURANCE

Bidder shall have to arrange for Third Party Inspection Agency for Factory Acceptance Tests and other stage wise inspections as applicable at their expenses. TPIA shall be PNGRB Approved and also must have experience of at least 3 assignments of LNG Projects. Bidder shall also inform GEL well in advance for FAT and other stage wise inspection plans - so that GEL may also deploy representatives for inspection/witness.

- 7.1 Testing (i.e. Hydrotest & Pneumatic) of the equipment shall be carried out as per GEL approved QAP.
- 7.2 Bidder shall provide TPIA for inspection of complete LNG system including issuing of IRN by TPIA.
- 7.3 All test certificates shall be signed and approved by TPIA.
- 7.4 Deployment of TPIA for E&C at Site along with SAT is in bidder scope.
- 7.5 TPIA inspection is applicable for all the major applicable equipment i.e. Tank, Vaporizers, LP Pump, HP Pump, Odorant system, changeover skid, LNG dispenser, LNG Fueling Pump Skid, Priority Panel, MFM, Unloading Pump, Heating skid, PLC Panel, Power distribution Panel. Bidder shall submit QAP for all the materials applicable for inspection by TPIA. List of TPIA has been already provided with CNG vendor list.

8. SECTION – I: MAJOR EQUIPMENT DATA SHEET

8.1 VERTICAL CRYOGENIC LNG STORAGE TANK

Equipment	Inner Vessel	Outer Vessel
Stored fluid	LNG	Vacuum
Installation	Vertical	
Approx. Capacity (Gross)	56000 Litres (+/- 3%)	
Approx. Capacity (Net)	90% of Gross Capacity	
Empty Weight	As per PESO approval	
Diameter	-	-
Total Height	-	-
Material of construction	X5CrNi1810 (1.4301) /SA 240 TYPE 304	CARBON STEEL
Piping Material	X5CrNi1810 (1.4301) / SA 312 TP 304	
Valve Material	Stainless Steel / Bronze	
Design temperature in deg.C	- 196 °C to +37 °C	- 20 °C to + 50 °C
Design, fabrication, inspection and testing	EN13458-2 + ANNEX – C.	EN13458-2
MAWP	10 bar	Vacuum
Insulation (Interspaced)	PERLITE Under Vacuum	
Valves and Instruments	Process isolation valves, ESD valve on filling and delivery line, Pressure gauge, level gauge, Pr transmitter, Level transmitter, Safety valves with diverter valve.	
Surface Treatment (Outer Vessel)	Shot Blast – SA 2 ½ Precoat – Inorganic Zinc Intermediate Coat – Epoxy Finish Coat – Polyurethane	

8.2 LOW PRESSURE VAPORIZER

Type	Ambient Air Vaporizer (Low pressure)
Flow rate	2500 SCMH
Configuration	Vertical
Service	Product Vaporizer
Fluid	LNG
Design Temperature	(-) 196°C to + 65°C
Outlet Temperature	Maximum 10°C below ambient
Design Pressure	40 Kg/Cm ²
Qty. per station	As per SOR
Cleaning duty	Oxygen
Duty Cycle for each Unit	8 hrs.
Defrosting Time	4-6 hrs.
Pneumatic/Hydrotest Test Pressure	44 Kg/Cm ²
Empty Weight of Unit	Approx. 6650 Kgs.
Operating Weight of Unit	Approx. 13500 Kgs.
Overall dimensions	2.5 m x 2.5m x 10.2m
Vaporizer Switching Systems	Automatic Switching System between vaporizers (due to frost build-up)
Vaporizer Inlet Flange	300# Aluminum RF Flange to ASME B16.5 Size – Vendor to design
Vaporizer Outlet Flange	300# Aluminum RF Flange to ASME B16.5 Size – Vendor to design
Design Code	ASME Sec VIII-Div-I, Latest Edition,
Cleaning Specification	IWI 38A
Welding Standard	IWI W48
MATERIAL OF CONSTRUCTION	
Fins	Aluminum A 6063 T5
Bends & Headers	Aluminum A 6063 T5
Flanges	Aluminum A 6063 T6/ SS 304
Structural & Frame	Aluminum A 6061 T6/ SS 304

Note:-

- Cleaning specification and welding standard, Bidder can follow requirements of ASME Boiler and Pressure Vessel Code, Section VIII Div.1 or any other equivalent code acceptable to Chief Controller.
- Material of construction of low pressure vaporizer shall be subject to minimum 300# pressure rating.
- Minimum 10oC temperature to be maintained at the outlet. Provision for pre-heater shall be provided by the bidder.
- Empty Weight of Unit, Operating Weight of Unit is provided for bidder calculation purpose only. Bidder shall actual empty weight of unit and Operating Weight of Unit during detailed engineering.
- Bidder provided new dimension of vaporizer is acceptable, if bidder is offering better dimension with more horizontal space saving during detail engineering.

8.3 HIGH PRESSURE VAPORIZER

Type	Ambient Air Vaporizer (High Pressure)
Flow rate	750 SCMH
Configuration	Vertical
Service	Product Vaporizer
Fluid	LNG @ 250 kg/cm ²
Design Temperature	(-) 196°C to + 65°C
Outlet Temperature	Maximum 10°C below ambient
Design Pressure	275 Kg/Cm ²
Qty. per station	as per SOR
Cleaning duty	Oxygen.
Duty Cycle for each Unit	16 hrs.
Defrosting Time	4 hrs.
Pneumatic/Hydrotest Test Pressure	358 Kg/Cm ²
Empty Weight of Unit	Approx. 8050 Kgs
Operating Weight of Unit	Approx. 15500 Kgs.
Overall dimensions	2.5 m x 2.5m x 10.2m
Vaporizer Switching Systems	Trips and Alarms for each vaporizer on Temperature Parameter (due to frost build-up)
Vaporizer Inlet Flange	½" SS Weldable Pipe.
Vaporizer Outlet Flange	1" SS Weldable Pipe.
Design Code	ASME Sec VIII-Div-I, Latest Edition
Cleaning Specification	IWI 38A
Welding Standard	IWI W48
Outlet Isolation	Separate Manual Isolation Valve for vaporizer
MATERIAL OF CONSTRUCTION	
Fins	Aluminum A 6063 T5
Bends & Headers	SA 213 TP 304
Flange	SS 304
Structural & Frame	Aluminium A 6061 T6

Note:-

- HP Vaporizer shall be provided with trips and Alarms for each stream on Temperature Parameter.
- Empty Weight of Unit, Operating Weight of Unit is provided for bidder calculation purpose only. Bidder shall actual empty weight of unit and Operating Weight of Unit during detailed engineering.
- Bidder provided new dimension of vaporizer is acceptable, if bidder is offering better dimension with more horizontal space saving during detail engineering.

8.4 LNG UNLOADING PUMP

Type of Pump	Submerged electric motor LNG Pump
Duty	Unloading of LNG from LNG tanker to storage tank
Seal	Mechanical/LNG liquid seal
Flow rate	Min. 350 lpm
Suction port	65Nb
Discharge port	40NB
Drive	Direct
Absorbed power:	Approx. 14-22 KW
Motor	Ex proof suitable for Haz area.
Pump Speed	Upto 6500 rpm
Input voltage	440V, 3 Ph, 50 Hz
Inlet Temperature	-162 degree C
Design Pressure	Upto 7 bar
Impeller Diameter	Upto 152 mm
Pump safety instruments/interlocks	Precooling sensor, dry run temp sensor, Dry run DP sensor.
Accessories	Isolation valves, Pressure gauges, Local Temperature Transmitter with display, Temp sensors for safe operations, vibration eliminators etc.
Control Panel	Control Panel located in safe area inside control room shall be IP 42. If in Hazardous area it shall be IP 55.START and STOP PB located near pump in Ex proof enclosure Standard accessories such as meters and indicators
Electrical Monitoring device	Digital multi-function meter
Make	Cryostar/ ACD/ Vanzetti/ Cryomech/ Indian Compressors Limited

8.5 HIGH PRESSURE CRYOGENIC RECIPROCATING PUMP

Type of Pump	Reciprocating Pump
Duty	Pump LNG from Storage tank to Vaporizer @250 bar
Seal	Mechanical
Flow rate	20-22 LPM(750 SCMH)
Suction port	65Nb
Discharge port	40NB
Drive	Belt driven by electric drive motor allows for extended pump duty
Absorbed power:	Approx. 32 KW
Motor	Ex proof suitable for Haz area.
Pump Speed	Upto 450 rpm
Input voltage	440V, 3 Ph, 50 Hz
Inlet Temperature	-162 degree C
Suction Pressure	4-20 bar
Discharge Pressure	250 bar
Design Pressure	Upto 414 bar
Pump safety instruments/interlocks	Precooling sensor, dry run temp sensor, Dry run DP sensor.
Accessories	Isolation valves, Pressure gauges, Temperature Transmitter with local display for safe operations, vibration eliminators etc.
Control Panel	Control Panel located in safe area inside control room shall be IP 42. If in Hazardous area it shall be IP 55.START and STOP PB located near pump in Ex proof enclosure Standard accessories such as meters and indicators
Electrical Monitoring device	Digital multi-function meter
Make	Cryostar/ ACD/ Vanzetti/ Indian Compressors Limited/ Equivalent make which meets requirement of scope of work

8.6 LOW PRESSURE CRYOGENIC RECIPROCATING PUMP

Type of Pump	Reciprocating Pump
Duty	Pump LNG from Storage tank to Vaporizer @26 bar
Seal	Mechanical
Flow rate	66-67 LPM (2500 SCMH)
Suction port	Vendor to provide
Discharge port	Vendor to provide
Drive	Belt driven by electric drive motor allows for extended pump duty
Absorbed power:	Approx. 22 KW
Motor	Ex proof suitable for Haz area.
Pump Speed	Upto 450 rpm
Input voltage	415V, 3 Ph, 50 Hz
Inlet Temperature	-162 degree C
Suction Pressure	15 barg max
Discharge Pressure	26 bar
Design Pressure	Upto 49 bar
Pump safety instruments/interlocks	Precooling sensor, dry run temp sensor, Dry run DP sensor.
Accessories	Isolation valves (manual and SOV), Pressure gauges, Temperature Transmitter with local display for safe operations, vibration eliminators etc.
Control Panel	Control Panel located in safe area inside control room shall be IP 42. If in Hazardous area it shall be IP 55. START and STOP PB located near pump in Ex proof enclosure Standard accessories such as meters and indicators
Electrical Monitoring device	Digital multi-function meter
Make	Cryostar/ ACD/ Vanzetti/ Indian Compressors Limited/ Equivalent make which meets requirement of scope of work

8.7 SPECIFICATION AND TYPICAL DRAWING OF PRIORITY PANEL:

a. **Content**

Seven bank priority fill system including inlet and outlet valves, non-return valves and by-pass valves with all interconnecting piping/tubing shall consist of following but not limited to:

- (a) Free standing welded and powder coated (0.03 mm to 0.05mm thick epoxy) steel frame structure.
- (b) Interconnected SS tubing and manifold
- (c) Isolation valves, Bleed valves, Non return valves and vent system
- (d) Connections of all isolation valves with the emergency switch for closure of isolation valves in case of emergency
- (e) Pressure gauges
- (f) Actuators for control of flow to dispensers / cascade / LCV point
- (g) Solenoid Valves
- (h) Clamps to fit the pipes & valve to the main frame
- (i) Any accessories which Bidder feels necessary for better performance.

b. **Specific requirements**

- (a) The priority panel allocates gas from the High Pressure Vaporizer to the storage or dispenser in the optimum sequence. It may also have pump "top off" facility so that gas may be pumped direct from the vaporizer to the dispenser.
- (b) The gas must flow from the storage cascade to dispenser through the priority panel. The direct flow from the cascade, by-passing, the priority panel shall not be allowed.
- (c) Priority Panel shall be located outside the package to avoid gas leakages due to high operating frequency of actuator and for ease of operations and supervision.
- (d) Priority panel shall be provided with weather proof, IP-55, GI powder coated enclosure (0.03 mm to 0.05 mm thick epoxy) and the same shall be attached to the main enclosure of the compressor package.
- (e) When the pump first starts and the storage system is empty, the priority fill system diverts the Vaporizer discharge gas to the first on priority to the high bank of the dispenser. Once the pressure of the high bank of dispenser is ensured above 200 kg/cm²(g), the gas is diverted to the high bank of the cascade. As soon as the high bank of the cascade is filled to a pressure > 220 kg/cm²(g), the gas is diverted to the medium bank of the cascade ensuring that during this period the high bank of cascade and dispenser are always above 220 kg/cm²(g). Now, when the medium bank of cascade reaches to predetermined pressure of 220 kg/cm²(g), the low bank of the cascade starts receiving the gas till the discharge pressure reaches 250 kg/cm²(g). Once the pressure in the low bank reaches to 250 kg/cm² (g), the gas is diverted to mobile cascade filling (LCV point). As soon as the pressure in the mobile cascade reaches 250 kg/cm² (g) or auto shut down pressure of pump, the pump stops. With the directions of the NRV of priority panel, so configured that all banks of the cascades reaches 250 kg/cm² (g) or auto shut down, before the pump goes to standby state.
- (f) In short, priority sequence would be 1st to high bank of dispenser, 2nd to high bank of cascade, 3rd to medium bank of cascade, 4th to low bank of cascade and finally to mobile cascade. Before the compressors goes to shut down state, it ensures that all the cascade banks are filled upto a pressure of 250 kg/cm²(g).
- (g) Actuator ball valves (Gas/Air actuated) shall be provided between priority panel and dispenser as well as stationary and mobile cascade to control flow.
- (h) When a vehicle is connected to the dispenser for refueling, the dispenser auto sequencing system allocates gas from the cascade to the vehicle cylinder in the reverse sequence to which it is filled. The dispenser sequencing system is instigated by flow rate drop off which indicates equalization between each bank of the cascade and the vehicle cylinder. In this manner the gas from the largest

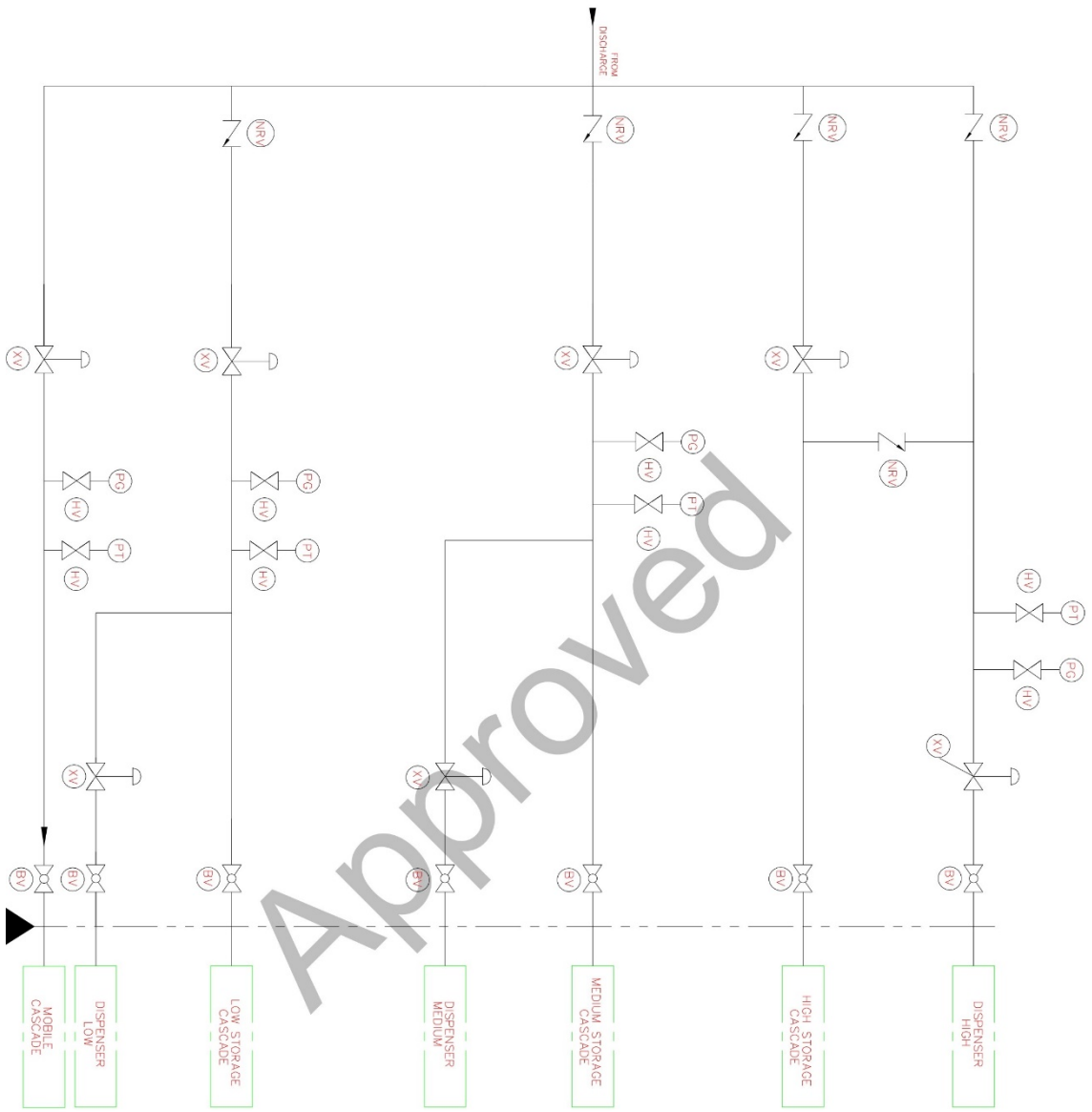
storage volume, which may have already been drawn off to a pressure less than its initial fill pressure, fills the vehicle cylinder from its low pressure. Power is not wasted in compressing gas to high storage pressure and then reducing it again to match an empty or near empty vehicle cylinder, which is already at a low pressure.

- (i) Likewise the medium and high-pressure storage banks only top off the vehicle cylinder above certain pressures; the stored gas does not have to be unnecessarily reduced in pressure. This system is known as multi-refueling. To minimize the station power consumption, multi-line systems are nearly always used. In practice it has been preferred to go for 3 line dispenser system for high efficiency of 60%

c. Basic datasheet

*: Indicates data to be furnished/ confirmed by the supplier/ Bidder

Sr. No.	Description	Specification/ detail
1	Priority sequence for transfer / allocation of the gas shall be as under. Fore-court high bank dispenser Fore-court medium bank dispenser Fore-court low bank dispenser Stationary cascade high bank line Stationary cascade medium bank line Stationary cascade low bank line Mobile cascade (Vehicle mounted)	
2	Control System	PLC/ SCADA Based
3	Location of priority panel	Outside LNG Dike area
4	Set Pressure for Bank filling	250 kg/cm ² (g) (must be settable)
5	Flow Rating Cv	*
6	Maximum Flow Rate	*
7	Priority Valve Type	Solenoid operated actuator ball valve
8	Inlet / Outlet Connection	¾" (0.095" thk) OD SS 316 Tube Or Sufficient to cater total gas flow at battery limit
9	Size of inter connecting tubes, valves and fittings	¾" or Sufficient to cater total gas flow at battery limit
10	Mounting Type	Anchored / Grouted on Civil Foundation. Outside of LNG dike area
11	Material of Construction	SS 316 seamless and annealed (tubing, fittings).
12	Actuator	One between priority panel & each dispenser, one between priority panel and each bank of stationary cascade and each bank of mobile filling line.
13	Enclosure	GI - Powder coated (0.03 mm to 0.05mm thick powder coated

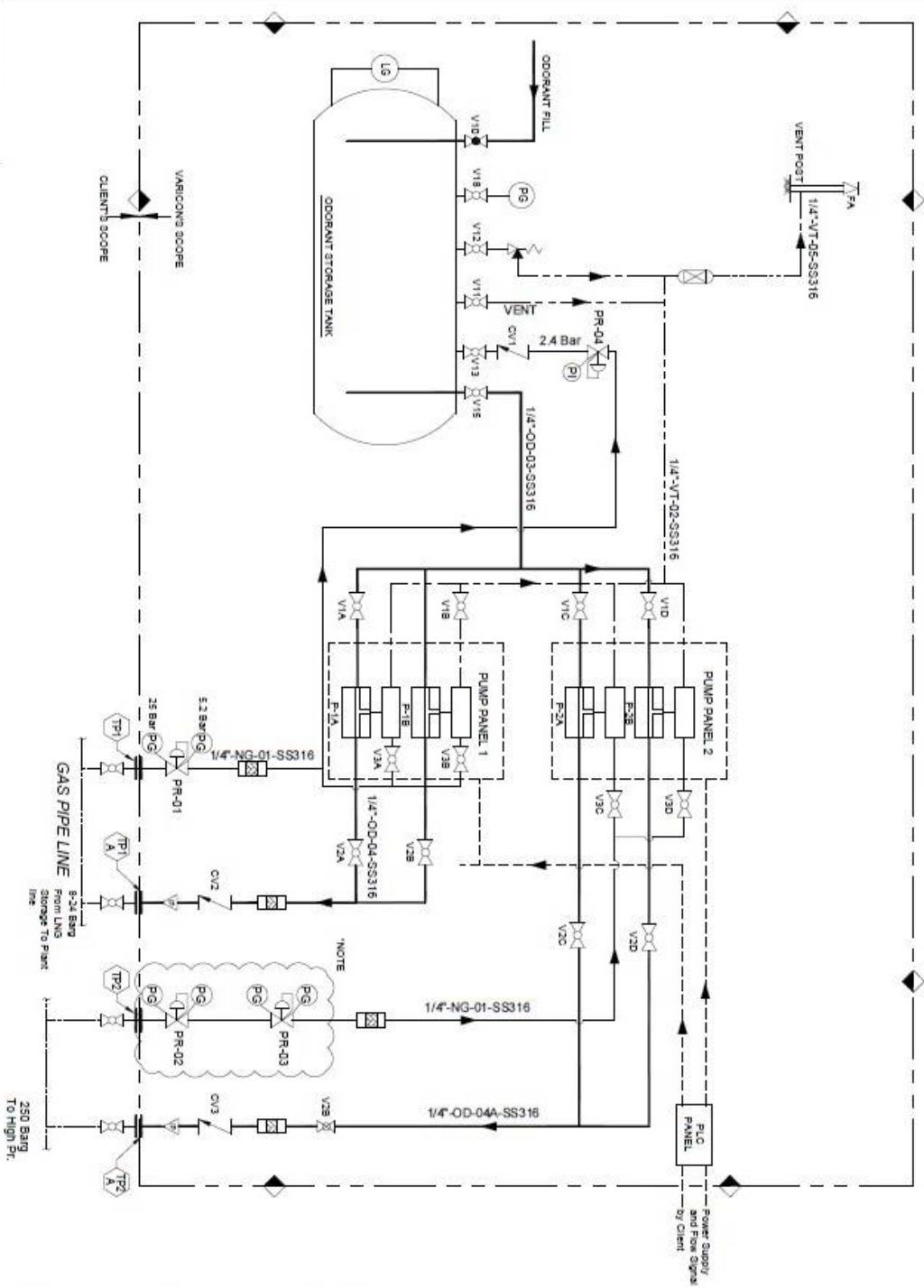


8.8 TECHNICAL SPECIFICATION FOR ODORIZING SYSTEM

ITEM	DESCRIPTION
Operating Fluid	Natural Gas in LP & HP Stream
Fluid Operating Temperature	+5 deg C to 60 deg C.
No. Of Stream	2 Nos. (HP + LP)
Gas Odorant	Ethyl Mercaptan
Mode of Operation	Flow based according to data signal (4-20mA) from flow meter
Natural Gas Flow Rate (LP Stream)	low pressure (2500/5000 SCMH), as applicable
Line Operating Pressure (LP Stream)	6 – 26 bar(g).
Natural Gas Flow Rate (HP Stream)	High pressure (750/1500/2250/3000 SCMH), as applicable
Line Operating Pressure (HP Stream)	250 bar(g)
Odorant Dosing Intensity	6-12 PPM
Hazardous Area Classification	Complete system shall be suitable for Hazardous area.
Odorization tank	Qty 1 no's Tank Net Capacity 500 Liters Tank MOC:- Stainless steel Design Code :- ASME Section VIII Div 1 Nozzle with valves shall be provided on tank for odorant inlet/Outlet, Pressure gauge, vent. Tank shall have the provision for easily refilling. Tank shall be fitted with, PRV. Tank Vent line shall be fitted with vent scrubber to remove the odorant from the vent gases. Vent shall be fitted with Flame arrestor. Tank Shall be fitted with magnetic Level gauge and Level transmitter, Pressure Transmitter, Temperature Transmitter.
Electronic Controller	Common PLC installed for operation of entire LNG storage, LNG dispensing and regasification system
MODBUS TCP Connection	RS 485
Pressure Gauge	Pressure Gauge Installed in the unit shall have marking in bar g
Odorant Pump	Qty 2 no's (01 Working + 01 Stand By in each Stream) MOC SS 316 Pneumatically operated Positive Displacement pump Injection Pressure shall be suitable up to 250 bar for HP and for 25bar for LP Natural gas line pressure. Non-Return Valve shall be fitted on the outlet of odorant pump. Pressure Regulator required for the operation of pneumatic pump & tank
Pneumatic Supply	5-10 Kg/cm² dry gas shall supplied to the system for the operation of pneumatic pump. Tap of Point provision to be provided in the Gas line for tank Blanketing
Injector	Injection probe shall be provided to inject the chemical in the pipeline

Sight Flow Indicator SS 316	For viewing of odorant injection in the pipeline
System Enclosure	Complete system shall be weather proof, Pneumatic pump enclosure shall Protection Class IP 65 and covered with canopy for protection of complete skid.
Odorant Filter	Suction line Shall be fitted with ~60 micron odorant filter.
Pressure Regulator	Two Stage pressure reduction (for pump actuation from high pressure line 250 bar to 10 bar)
Documents (In English language)	P & ID and GA diagram of system. Bill of Materials, Test Certificates, MTC etc. Operation and Maintenance manual of Odorization system. Data Sheet of all major components including pneumatic pump
Containment skid	Bidder shall provide containment skid for entire odorant system. With Min. Capacity 110% of tank Capacity Containment skid is metallic (SS) tray to be used as secondary containment of chemical in case of any spill/leak.
Additional hook-up	Necessary provisions like flow rate signal hook up from Mass flow meter (PNG and CNG both), Tapping for Odorant injection, mechanical and electrical installation is in the scope of Bidder.
Make	Varicon/ SV Gas
Inspection Calibration & Maintenance of odorant system	As per GEL Annual Operation & Maintenance Plan (AOMP)

TYPICAL P&ID FOR GAS ODORIZING SYSTEM



ODORANT STORAGE TANK		PUMP PANEL 1 (P-1A-P-1B)		PUMP PANEL 2 (P-2A-P-2B)		TIE-IN POINT	
Capacity	500 lbs	TYPE		TYPE		TP-1	
MOC	SS304	PLUNGER		PLUNGER		TP-1 A	
Type	HORIZONTAL	Max. Flow Rate		Max. Flow Rate		TP-2	
Design	ASME SEC VIII	OPER. Pr. Max.		OPER. Pr. Max.		Injection Line	
DIV-1		Max. Actuation Pressure		Max. Actuation Pressure		TP-2 B	
		6.89 Bar		6.89 Bar			

NOTE:
1. In high pressure line for pump actuation, two-stage pressure regulation system should be used, 250 barg to 10 barg.
2. The pressure reduction range will be confirmed later.

LEGEND :

	PRESSURE REGULATOR (PRV)
	BALL VALVE (OPEN)
	BALL VALVE (CLOSED)
	PRESSURE GAUGE
	LEVEL GAUGE
	FLAME ARRESTER (FA)
	SCRUBBER
	THREE SOLENOID VALVE (COV)
	CHECK VALVE
	DIELECTRIC UNION
	VENT LINE
	CABLE
	EXISTING LINE
	NATURAL GAS
	ODORANT
	VENT
	SAFETY RELIEF VALVE
	JB JUNCTION BOX
	Pump Station Valve
	Odorant Discharge Valve
	Pump Actuation Valve
	Odorant Fill Valve
	Vapor Return Valve
	Blanking Gas Valve
	Odorant Supply Valve
	PG Isolation Valve
	P-1A Main pump of panel 1
	P-1B Standby pump of panel 1
	P-2A Main pump of panel 2
	P-2B Standby pump of panel 2
	PRV Pressure Relief Valve
	CVT Blanking Check Valve
	CVS Pump-1 Outlet
	CVS Pump-2 Outlet

CLIENT: Gujarat Gas Limited

TITLE: P&ID FOR GAS ODORIZING SYSTEM

8.9 LNG Dispenser

All the LNG equipment and materials used for dispensing of LNG shall have type approval of PESO and any other statutory authority as applicable for LNG dispensing facility as applicable.

Type of Dispenser	Saturated LNG
Operating temperature	-196°C to 55°C, handling both cryogenic LNG and ambient conditions.
Operating Pressure & Design Pressure	16 bar & 20 bar
Measurement Precision	< ± 1 %
Power Supply	230 Volt AC
Mass Flow Meter	High-accuracy Coriolis (e.g., W&M approved) for mass LNG dispensed
Control System	Controller/PLC & SCADA based
Display	LED display for real time information of fuel qty., Unit rate, Total Price, and other critical parameters
Dispenser Flow rate	190 LPM
Dispensing Hose/Dispenser	01 no.
Filling Nozzle	Flow rate 50 GPM / Up to 190 LPM for safe & leak free dispensing
Vent Nozzle	15 GPM / 57 LPM
Length of dispensing hose	Minimum 4.5 meters
Accessories	1. Air Hose for Dry Frost/ Dust removal from Nozzle prior to Connection to customer's LNG tank and post filling
ESD	a. Emergency shut down -One mounted on dispenser itself, another for remote operation from station's office to shutoff valve for stopping liquid supply and shutting down of the transfer equipment.
Other safety features	Warnings for Leak detection, hose-break, over pressure etc.
Communication interface	ports for communication with the fueling station management system,
Dispenser Body	Fully stainless-steel construction is common to withstand cryogenic temperatures and prevent corrosion
Refueling Records	save and query refueling records up to last 1000 records)
Breakaway device	breakaway device to be provided to minimize release of liquid and vapor in the event that a vehicle pulls away while the hose remains connected

8.10 LNG FUELING PUMP SKID AND ON THE FLY SATURATION VAPORIZER:

Sub merged motor type LNG fueling pump for longer duty hours and less maintenance with flow rate of 300-325 LPM at 7 to 8 Bar (g) differential pressure for LNG fueling in Auto Mode under manual supervision.

- Differential Pressure Transmitter for auto shut off at end of LNG fueling.
- Necessary Cryogenic compatible valves and instruments for LNG fueling process.
- Interconnecting piping as per ASME B31.3 with Vacuum Insulated Piping for less or no transfer losses

- Ambient Air vaporizer designed as per ASME SEC VIII, Div-I for on-the-fly saturation of LNG being fueled at required temperature.

8.11 SATURATED LNG FUEL DISPENSER WITH FLOW RATE UPTO 150-190 LPM:

Each LNG Dispenser consists of following Major Equipment's:

- Coriolis flow and density meter with approval for Weights and Measures for custody transfer applications from
 - MID OIML R117/R137
 - National Type Evaluation Program (NTEP)
 - Measurement Canada
 - INMETRO Brazil
- Dispenser should have requisite approvals like weights and measures, ATEX Certification, PESO | file no: GEL/CNG Projects/2025/4/114834 approval and any other approval required for safe usage of the Facility.
- Bidder shall supply LNG Dispenser as per PESO Model Approval with 1 No. of flow meter for LNG delivery line and 1 No. of flow meter for return line
- 1 No. Saturated LNG Dispensing Hose of 4.5 meter length with Armor guard at both ends. 1 No. Up to 50 GPM / Up to 190 LPM Filling Nozzle
- 1 No. Vent Hose of 4.5 meter length • 1 No. 15 GPM / 57 LPM Vent Nozzle • Earthing Cable Connectivity
- 1 No. Air Hose for Dry Frost/ Dust removal from Nozzle prior to Connection/ Disconnection from Customer LNG fuel tank
- Emergency shutdown button.
- Dispenser shall have features to record and store flow meter data and each fill data, various abnormal conditions or errors etc. for last one/two months. Fill data shall include total kg of LNG filled, total Rs of LNG per fill, Time duration for that fill, cumulative Totalizer reading, cumulative MFM reading and pressure.

8.12 FIELD INSTALLATION EQUIPMENT

- Vacuum Jacketed stainless-steel piping and interconnecting stainless steel piping for connectivity from LNG Storage Tank to LNG fueling pump skids, saturation vaporizers and Saturated LNG fuel dispenser including return line / recirculation line from LNG Dispenser to pump skid and/or LNG Storage Tank.
- Field Junction Boxes for connection field instruments i.e. Gas detectors, Temperature sensors, buttons etc. as per applicable standards.
- Connectivity of Instrument Air Piping from Existing Piping of Air Compressor to LNG Dispensing Facility components including required piping supports
- Interconnection/interface with stations PLC/SCADA to operate LNG Dispensing Facility as stand alone system
- Instrument and Power cables between field equipment to control room including cable trays, supports etc.

9. SECTION – II: LNG STORAGE FACILITY INSTALLATIONS SCOPE

9.1 INSTALLATION DESIGN:

For LNG cryogenic pressure vessels storage installation, the minimum safety distances between the vessel and to the nearest building or line of adjoining property shall be in accordance with the distances specified in applicable Statutory Norms. The maximum aggregate capacity of each such LNG installation shall not exceed 1060 m³

For non-pressurized LNG storage installation, the minimum safety distances specified in NFPA 59A or any other recognized standard as amended from time to time and accepted by Chief Controller may be followed.

- 9.1.1 The LNG installation shall be designed to withstand the following without loss of structural or functional integrity.
 - (a) The direct effect of wind forces;
 - (b) Loading due to seismic effect.
 - (c) Erosive action from a spill.
 - (d) Effect of the temperature, any thermal gradient, and any other anticipated degradation resulting from sudden or localized contact with LNG.
- 9.1.2 The structural members of the impoundment system must be designed and constructed to prevent impairment of the impoundments reliability and structural integrity as a result of the following:
 - (a) Imposed loading from full hydrostatic head of impounded LNG.
 - (b) Hydro dynamic action from injected material.
- 9.1.3 Impoundment/Dike areas must be designed so that all areas drain completely to prevent water collection. Drainage pumps and piping may be provided to remove water from collecting in the impoundment area. Where automatically controlled drainage pumps are used they shall be provided with cut off devices that prevent their operation when exposed to LNG temperature.
- 9.1.4 The impounding system for LNG storage vessel must have a minimum volumetric liquid capacity of :
 - (a) Maximum liquid capacity of vessel for an impoundment serving a single vessel;
 - (b) 100% of the largest vessel of maximum liquid capacity.
- 9.1.5 The height of the impoundment wall shall be adequate to contain spillage of any LNG. A height of the impounding/ dyke wall from ground is recommended from 0.6 meter to 1.0 meter. Height of the foundation of the vessel shall be minimum 0.4 meter or designed in such a way to prevent exposure of carbon steel material to the spilled LNG.
- 9.1.6 No other flammable liquid or storage vessel shall be located within an LNG impounding area.
- 9.1.7 A clear space of at least 0.9 mtrs. shall be provided for access to all isolation valves serving multiple vessels. The isolation valve of LNG vessel piping shall be as close to outer vessel as possible.
- 9.1.8 LNG vessels, cold boxes, piping and pipe supports and other cryogenic apparatus installed within dike shall be designed and constructed in a manner to prevent damage to these structures and equipment due to freezing or frost heaving in the soil.
- 9.1.9 Proper flame proof lighting arrangement inside the LNG premises for lighting of dike area is in the scope of bidder.
- 9.1.10 Proper lighting arrangement shall be done for facilities transferring LNG during night.
- 9.1.11 Design, Installation, inspection & Maintenance of Electrical Grounding and bonding shall be provided as per requirements of Indian Electricity rules, and in line with latest IS 3043.

9.2 LNG STORAGE VESSEL:

General design requirements:

- 9.2.1 Foundation :
 - (a) LNG vessels foundations shall be designed by a qualified engineer and constructed in accordance

with recognized structural engineering practices. Prior to the start of design and construction of the foundation, a subsurface investigation shall be conducted by a qualified soils engineer to determine the stratigraphy and physical properties of the soils underlying the site.

- (b) The design of saddles and legs for the LNG vessel shall include erection load, wind loads and thermal loads.
- (c) Foundation and support shall have a fire resistance rating of not less than 2 hrs. Support up to 0.4 meter may not need fire proofing.
- (d) LNG vessels installed in areas subject to flooding shall be secured to prevent release of LNG or floatation of the vessel in the event of a flood.
- (e) LNG vessels installed in areas subject to seismic activity the foundation, grouting, erection, securing shall be designed to withstand critical ground motions based on seismic hazard zone.

9.2.2 Vessel Design:

- (a) The vessel meant for storage of LNG including piping between inner and outer vessel shall be designed in accordance with ASME Section VIII /EN13458 /ASME:B.31.3, Process piping or equivalent code acceptable to Chief Controller.
- (b) Design pressure of auto LNG storage vessel shall not exceed 20.0 Kg/cm².
- (c) The inner vessel shall be designed for the most critical combination of loading resulting from internal pressure, liquid heads. The Inner vessel supports system shall be designed for shipping, seismic, and operating loads.
- (d) The outer vessel shall be equipped with a relief or other device to release internal pressure and shall have discharge area of at least 0.34mm²/lit of the water capacity of the inner vessel but not exceeding 2000 cm² (0.2 M²) and have pressure setting not exceeding 25psi.
- (e) Thermal barriers shall be provided to prevent outer vessel from falling below its design temperature.
- (f) Those parts of LNG vessels which come in contact with LNG and all materials used in contact with LNG or cold LNG vapor shall be physically and chemically compatible with LNG and intended for service at -162 Deg C.
- (g) All piping that is a part of LNG vessel including all piping internal to the container, within void space, and external piping connected to the vessel up to the first circumferential external joint of the piping shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII or ASME B 31.3 or equivalent.
- (h) LNG vessels shall be designed to accommodate both top and bottom filling unless other positive means are provided to prevent stratification.
- (i) Any portion of the outer surface area of an LNG vessel that could accidentally be exposed to low temperatures resulting from the leakage of LNG or cold vapor from flanges, valves etc. shall be intended for such temperatures or protected from the effects of such exposure.
- (j) Seismic loads shall be considered in the design of the LNG vessel support systems.

9.3 INSTALLATION:

- 9.3.1 Each LNG double walled vessel shall have at least 2 Nos. of safety relief valves capable of achieving the required relief capacity on standalone basis and shall be sized to relieve the flow capacity determined for the largest single contingency or any reasonable and probable combination of contingencies and shall include conditions resulting from operational upset, vapor displacement and flash vaporization.
- 9.3.2 Relief devices shall be vented directly to the atmosphere. Each safety relief valve for LNG vessel shall be able to be isolated from the vessel for maintenance or other purposes by means of a manual full opening stop valve or a flow diverter valve.
- 9.3.3 Safety relief valve shall be designed and installed to prevent any accumulation of water, or other

foreign matter at its end.

- 9.3.4 The minimum pressure relieving capacity in kg/hr shall not be less than 3% of the full vessel contents in 24 hrs.
- 9.3.5 All liquid connections to the LNG vessel except relief valve and instrumentation connection shall be equipped with automatic fail safe product retention valves.
- 9.3.6 The automotive shut off valves shall be designed to close on occurrence of any of the following conditions:
 - I. Fire detection
 - II. Uncontrolled flow of LNG from vessel
 - III. Manual operation from a local and remote location.
- 9.3.7 Such of the automatic shutoff valves that require excessive time to operate during emergency i.e. sizes exceeding 200mm shall be pneumatically operated and also have means of manual operation.
- 9.3.8 All LNG vessels shall have a device that prevents the vessel from becoming liquid full or from covering the inlet of the relief valve with liquid when the pressure in the vessel reaches the set pressure of relieving device under all conditions.
- 9.3.9 Every LNG vessel may be provided with one independent high liquid level alarm which may be part of the liquid level gauging devices. However, the high liquid level flow cutoff device shall not be considered as a substitute for the alarm.
- 9.3.10 Every LNG vessel shall be equipped with at least one liquid level gauging device. The devices shall be designed and installed so that they can be replaced without taking the vessel out of operation.
- 9.3.11 Each LNG vessel shall be equipped with a high liquid level flow cutoff device,
- 9.3.12 Each LNG vessel shall be equipped with pressure gauge connected to the vessel at a point above the maximum intended liquid level.
- 9.3.13 Instrumentation for storage and vaporization facilities shall be so designed so that if a power or instrument air failure occurs, the system will proceed to a failsafe condition and maintain that condition until the operator takes appropriate action to reactivate or secure the system.

9.4 EQUIPMENT:

- 9.4.1 Pumps and compressors employed in LNG source shall be provided with a pressure relieving device on the discharge to limit the pressure to the maximum safe working pressure of the casing and downstream piping and equipment.
- 9.4.2 Each pump shall be provided with adequate vent, relief valve, or both that will prevent over-pressuring the pump case during the maximum possible rate of cool down.
- 9.4.3 The discharge valve of each vaporizer and the piping components and relief valves installed upstream of each vaporizer discharge valve shall be designed for operation at LNG temperatures.
- 9.4.4 Two inlet valves shall be provided to isolate an idle, manifold vaporizer to prevent leakage of LNG into the vaporizer. A safe means of disposing of the LNG or gas that can accumulate between the valves shall be provided in case the vaporizers are of size having inlets more than 50 mm. dia.
- 9.4.5
 - (i) The ambient air vaporizers shall be installed inside the containment area.
 - (ii) Where as the heater is located 50 ft (15 m) or more from the LNG equipment
 - (iii) Any ambient air vaporizer or a heated vaporizer installed within 50 ft (15 m) of an LNG container shall be equipped with an automatic shutoff valve in the LNG liquid line.
 - a. The automatic shutoff valve shall be located at least 10 ft (3 m) from the ambient or heated vaporizer and shall close in either of the following situations :
 - b. Loss of line pressure (excess flow).
 - c. Abnormal temperature sensed in the immediate vicinity of the vaporizer (fire)
 - d. Low temperature in the vaporizer discharge line.
 - e. If the facility is attended, manual operation of the automatic shutoff valve shall be from a

point at least 50 ft (15 m) from the vaporizer, in addition to the requirement of (a).

- (iv) The above conditions shall be applicable for LNG Vaporizers for purposes other than pressure building coils or LNG -to-CNG (LCNG) systems.

9.4.6 A distance of minimum 1 mtr. shall be maintained between vaporizers.

9.4.7 Vaporizers shall be designed, fabricated and inspected as per the requirements of ASME Boiler & Pressure Vessel Code, Section VIII Div. 1. or any other equivalent acceptable code to CCoE.

9.4.8 The material of construction of LNG vaporizers shall be Stainless Steel piping with outer Aluminum fins.

9.4.9 Manifold vaporizers shall be provided with both inlet and discharge block valves for each set of vaporizer.

9.4.10 Any ambient vaporizer installed within 15 trs. of the LNG vessel shall be equipped with an automatic shutoff valve in the liquid line. This valve shall be located minimum at least 3 mtrs. from the vaporizers and shall close when loss of line pressure occurs or abnormal temperature is sensed in the immediate vicinity of the vaporizer or when low temperature in the vaporizer discharge line occurs.

9.4.11 Each set of vaporizer shall be provided with a safety relief valve(s) sized in accordance with the following requirements:

- (a) Ambient vaporizers—relief valve capacity shall allow discharge equal or greater than 150% of the rated vaporizer natural gas flow capacity without allowing the pressure to rise 10% above the vaporizer maximum allowable working pressure.
- (b) Relief valves on heated vaporizers—As above, however it shall be located such that they are not subjected to temperatures exceeding 60 Deg C. during normal operation.

9.4.12 Automation shall be provided to prevent the discharge of either LNG or vaporizer gas into a distribution system at the temperature either above or below the design temperature of the send out system.

9.4.13 Vaporizers shall be provided with outlet temperature monitors.

9.5 PIPING SYSTEM:

9.5.1 All piping system and components shall be designed :

- (a) To accommodate the effects of thermal cycling fatigue to which the systems will be subjected.
- (b) Provide for expansion and contraction of piping and piping joints due to temperature changes.

9.5.2 Piping material including gaskets and thread compounds shall be compatible throughout the range of temperature to which they are subjected.

9.5.3 The valves provided in the installation shall be of extended bonnet type with packing seals in a position that prevents leakage or malfunction due to freezing.

9.5.4 Shutoff valves shall be provided for all vessel connections except connections for liquid level alarms and connections that are blind flanged or plugged

9.5.5 All the piping section between the two valves where the liquid may be trapped shall have the thermal relief valve.

9.5.6 All piping and material in the downstream of LP vaporizers shall be designed for 300# as per GEL specifications attached with the technical scope.

9.6 TRANSFER OF LNG:

9.6.1 Isolation valves shall be installed so that each transfer system can be isolated at its extremities. Where power-operated isolation valves are installed, an analysis shall be made to determine the closure time so that it does not produce a hydraulic shock capable of causing line or equipment failure.

9.6.2 Adequate check valves shall be provided to prevent backflow and shall be located as close as practical to the point of connection to any system from which backflow might occur.

9.7 PUMP AND COMPRESSOR CONTROL:

In addition to a locally mounted device for shutdown of the pump or compressor drive, a readily accessible, remotely located device shall be provided at least 7.5 mtrs. away from the equipment to shut down the pump in an emergency.

9.8 TANK VEHICLE UNLOADING FACILITIES:

9.8.1 The tank vehicle unloading area shall be of sufficient size to accommodate the vehicles without excessive movement or turning.

9.8.2 Transfer piping, pumps, and compressors shall be located or protected by barriers so that they are safe from damage by vehicle movements.

9.8.3 Isolation valves and bleed connections shall be provided at the unloading manifold for both liquid and vapor return lines so that hoses and arms can be blocked off, drained of liquid, and depressurized before disconnecting. Bleeds or vents shall discharge in a safe area.

9.9 EMERGENCY SHUT DOWN SYSTEM (ESD System):

Instrumentation for LNG storage and fueling facilities shall be designed so that, in the event of a power or instrumentation failure, the system goes into a fail-safe condition until the operators either reactivate or shut down the system.

9.9.1 Each LNG facility shall incorporate an ESD system that when operated isolates or shuts off sources of LNG and shuts down equipment that add or sustain an emergency if continued to operate.

9.9.2 The ESD system shall be of a failsafe design and shall be installed, located, or protected from becoming inoperative during an emergency or failure at the normal control system.

9.9.3 Initiation of the ESD system shall be manual, automatic, or both manual and automatic. Manual actuators shall be located in an area accessible in an emergency and at least 15 meters away from the equipment they serve, and shall be distinctly marked with their designated function.

9.9.4 All ESDs shall be manually reset.

9.10 FIRE PROTECTION FACILITIES:

9.10.1 Each LNG storage facility shall be provided with continuously monitored low - temperature sensors and flammable gas detectors, which must activate visual and audible alarms at the plant site and at a constantly attended location if the facility is not attended continuously.

9.10.2 Flammable gas detection system shall activate an audible and a visual alarm at level no higher than 25% of the LEL of the gas being monitored.

9.10.3 Flame detectors shall activate an alarm at the plant site and at a constantly attended location if the plant site is not attended continuously. Necessary ESD system shall be activated on detection of flame by flame detectors.

9.10.4 A fire water supply and delivery system shall be provided based on the risk analysis. However as a minimum a fire water storage vessel of 10 % of total LNG storage vessels capacity (including future provision) or 14000 liter whichever is higher with pumping facilities and hose reel system away from the LNG storage facility shall be provided for dispersion of LNG vapor cloud in case of leakage or spillage.

9.10.5 Minimum firefighting system shall be made available at strategic locations as per below table.

SN	Installation / Premises / Worksite / Vehicles	Fire Alarm System	Dry Chemical Powder (DCP) Fire Extinguisher/ ABC Fire Extinguisher		CO2 Fire Extinguisher	High Expansion Foam Trolley	Foam Fire Extinguisher	Windsock	4 Nos. of Sand Buckets with Stand & canopy	Fire Hydrant System
			9 /10 Kg	75 Kg (Mobile)	4.5 Kg	200 Ltr	9 Ltr			
1	-LNG Storage & Regassification Area	Hooter & Visual		2		2		√	4	√
2	-LNG Unloading Area		2		1		1			
3	-At each access point of LNG Dyke Area		2				1			
4	-For MCC/Electrical installation in LNG Yard area				2					
5	-For each LNG Dispenser		1				1			
6	-LNG/LCNG Dispensing forecourt area			1						
7	Odorant Unit		2							
8	Fire Pump Room		1		2					
9	Air Compressor		2							
10	Ele. JBS				2					

9.10.6 Supply of Required portable type of Fire Extinguishers (CO2, DCP, ABC, Foam etc.) mentioned above is the minimum requirement. However, if any additional Fire Extinguisher or Sand Bucket stands with its canopy are required as per system requirement then bidder shall provide the same without any additional cost.

9.10.7 Bidder shall comply with all the requirements mentioned in SMPV rules, applicable PNGRB T4S regulations, applicable factories rules, requirements of local fire authorities, etc. However, fire fighting system for each LCNG station shall be designed adequately to ensure fire-fighting through fire hydrant system from all directions with coverage of entire LCNG station. Fire hydrant of LCNG station shall be equipped but not limited to following adequate numbers of below facilities-

- Double hydrant Valve with individual isolation valve
- Hose Box.
- Hose Reel
- Water Monitor (Unmanned hose holders or monitor nozzles to minimize personnel exposure to fire)
- Foam Trolley with inline inductor
- Pressure gauges
- Butterfly Valve , Gate Valves, Ball Valves and NRV
- ERW pipes & fittings of adequate size as per IS 1239 class C
- Cathodic Protection system for underground steel piping
- Fire brigade inlet
- Tank filling connection
- Diesel engine pump (with automatic start-stop)
- Electric Motor Pump (with automatic start-stop)
- Jockey pump(with automatic start-stop)
- Strainer
- Fire water sump

It is to be noted that above facilities mentioned are minimum requirements for each LCNG station. However, Bidder shall design the fire water system considering plot layout and salutatory requirements.

9.10.8 Maintenance of fire extinguisher, fire fighting system and all equipment supplied is in scope of bidder as per GEL Annual Operation & Maintenance plan (AOMP), applicable IS standards/codes and OEM guidelines.

9.10.9 Bidder to Supply of Foam generator liquid (FFFM) during commissioning and maintain/top up throughout contract period.

9.11 EARTHING:

- 9.11.1 Earthing shall be carried out as per IS Code of Practice: 3043. Earthing drawing shall be submitted by the bidder to GEL for approval.
- 9.11.2 Supply and installation of earthing system for Equipment installed in LNG yard is in scope of bidders. However, required civil work for only earthing chambers shall be done by GEL. Supply of Earthing electrodes, Compound material, GI Strip, Cu Strips along with required accessories shall be in scope of bidder.
- 9.11.3 Minimum two M10 sizes earthing bosses, one at each end of the equipment, shall be provided.
- 9.11.4 Each equipment shall be connected at different two point of earth grid.
- 9.11.5 Junction boxes, control units etc., shall be provided with an internal and external earth terminal, complete with locknut and washers. All non-conducting enclosures shall have an integral earth continuity system.
- 9.11.6 All metallic non-current carrying parts shall be made electrically continuous, by welding or bolting, using bonding straps and/or star washers or equal to ensure good conductivity across paint layers and bolted joints.
- 9.11.7 Earthing and bonding conductors shall be adequately current rated for the duty.
- 9.11.8 Metallic part of all equipment not intended to be live shall be connected to earth as per provisions of IS: 3043/IEC recommendation. Grounding of all electronics shall be separately connected to earth. Grounding of electronic equipment shall not be connected to earthing for electrics or equi-potential bonding. Separate earth pit shall be provided for electronics / instrumentation. Bidder shall make the dual earthing point at single location and integral body earthing shall be done at their works.

9.12 PERSONAL PROTECTION:

- 9.12.1 Fire-retardant cover-all should be provided to each staff deputed at site/station.
- 9.12.2 Every person involved with emergency handling/response of LNG Leakage / spillage / fighting fire due to LNG spillage/rescue in the LNG installation shall be equipped with under mentioned personal protective equipment.
 - (a) Face shield against splash protection of LNG
 - (b) Cryogenic Hand gloves.
 - (c) Full covered Cryogenic suit
 - (d) Safety shoes
 - (e) Breathing apparatus set
- 9.12.3 All personnel directly involved in day-to day operational or maintenance activity (LNG unloading activity, any maintenance job, etc.) shall wear following Personal protective equipment:
 - (a) Suitable goggles for protection of eyes from LNG spray.
 - (b) Cryogenic Hand gloves.
 - (c) Cryogenic Protective apron.
 - (d) Safety shoes
 - (e) Hard Helmet

9.13 LNG DISPENSER

- 9.13.1 Erection and installation of equipment for setting up LNG Dispensing facility are in scope of vendor. Installation of any other allied equipment for LNG Dispensing facility for supply of LNG to end customer are in scope of vendor
- 9.13.2 Vendor to provide installation plan and to take necessary approvals prior to installation.
- 9.13.3 testing and pre-commissioning check for any mechanical and electrical instruments/ equipment, station piping and other installed assemblies/ facility for LNG Dispensing Facility.
- 9.13.4 Vendor to keep ready and make available all material and its capacity test certificates for all the

- assembly & fittings used and that to be noted in pre-commissioning check list.
- 9.13.5 Pre-commissioning testing and purging of N2 or LN2 shall be in vendor's scope
 - 9.13.6 Bidder to install all the equipment, piping, foundation bolts, grouting material etc.
 - 9.13.7 hiring of Crain/ hydra, manpower, necessary tools-tackles, scaffolding, staging, support etc. and to make any temporary arrangement for support/ lifting etc.
 - 9.13.8 Supply and laying of electrical cables, Control panels and other electrical items for LNG dispensing facility
 - 9.13.9 Bidder to keep ready and make available all material and its capacity test

10. SECTION – III: OPERATION, MAINTENANCE AND TRAINING

Vendor shall provide comprehensive maintenance service for the LNG storage, LNG dispensing and regasification system at least 5 years (1year warranty period + 4 year maintenance) along with supply of required spares, material, tools tackles, equipment and manpower etc. all complete.

Each LNG storage, LNG dispensing and regasification installation shall provide along with written operating, maintenance and training procedures. Such procedures shall be drawn based on experience, knowledge of similar facilities.

10.1 BASIC REQUIREMENTS:

Every installation shall meet the following requirements:-

- 10.1.1 Have written procedures covering operation, maintenance and training.
- 10.1.2 Keep up to date drawings of plant equipment.
- 10.1.3 Have written emergency plan as part of the operations manual.
- 10.1.4 Shall be in liaison with local authorities like Police, Fire Department, Health Authorities and keep them informed about emergency plans and their role in emergency situations.
- 10.1.5 Have documents wherein safety related malfunctions are identified and analyzed for the purpose of determining their causes and preventing the possibility of reoccurrence.

10.2 OPERATING PROCEDURES MANUAL:

Every installation shall have a written manual of emergency procedures that shall include types of emergencies that are anticipated and shall include the following procedures:-

- 10.2.1 Start up and shut down procedure including initial startup of the LNG facility.
- 10.2.2 Purging and inserting components.
- 10.2.3 Cooling down components.
- 10.2.4 Identify the possibility of abnormal conditions.
- 10.2.5 Safety precautions requirement to be taken while repairs / maintenance in the installation is being carried out.
- 10.2.6 On-site Emergency Plan
- 10.2.7 Procedures for responding to controllable emergencies including notifying personnel and use of equipment i.e. appropriate to handling of emergency.
- 10.2.8 Procedure for recognizing an uncontrollable emergency and for taking action to ensure that harm to the personnel in the premises and to the public outside is limited.
- 10.2.9 Procedure for immediate notification of the emergency to the local authorities.
- 10.2.10 Procedure for co-ordinating with local authorities in the preparation of any evacuation plan which may be required to protect the public in the event of emergency.

10.3 MAINTENANCE:

Every installation shall have a written procedure based on experience and knowledge of similar facilities and conditions under which the installation shall be maintained. The procedure shall incorporate the need to carry out periodic inspection, tests on every equipment and system in service to verify that the equipment is maintained in accordance with the equipment manufacturer's recommendations.

The written manual shall set out inspection and maintenance program for each component forming part of the installation. In addition to fixing a schedule for inspection and tests, the procedure to be followed during repairs so as to ensure safety of persons and property shall also be laid down.

10.4 TRAINING:

Every installation shall be provided with a training plan and the manner in which it will be implemented and maintained. The training manual shall comprise of under mentioned components:

- 10.4.1 Detailing of raw materials, product and equipment related to LCNG Station
- 10.4.2 Procedure of basic operation to be carried out in the installation in the normal course.
- 10.4.3 Carrying out of emergency procedures that relate to duties at the installation for each concerned personnel.
- 10.4.4 On-site Emergency Plan including emergency detection, activation, communication, evacuation, response, escalation, control etc.
- 10.4.5 The characteristics and potential hazards of LNG during operation and maintenance of the facility, including dangers from frostbite that can result from contact with LNG.
- 10.4.6 The methods of carrying out duties of maintaining and operating the facility as set out in the manual of operating and maintenance procedures.
- 10.4.7 The LNG transfer procedure.
- 10.4.8 Fire prevention, including familiarization with the fire control plan of the installation, firefighting, and the potential causes of fire in a facility, and the types, sizes and likely consequences of a fire in the installation.
- 10.4.9 Recognizing situations in which it is necessary to obtain assistance in order to maintain the security of the facility.

11. SECTION – IV: RECOGNIZED INSTALLER / OPERATOR

The installer (bidder manpower) shall be trained as per SMPV/ PESO requirement. Installers shall be technically qualified and adequately experienced to undertake installation and maintenance of LNG regasification Stations. Installation, repair and maintenance work within stations shall be carried out only by such recognized installers. For this purpose suggested procedure and qualification requirements for installers are given below.

11.1 LNG REGASIFICATION STATION INSTALLER QUALIFICATION

11.1.1 Qualification Procedure for Recognition as Approved Station Installer.

- (a) The applicant fills an application form and declaration as per PESO requirement.
- (b) CCOE (Approving Authority) reviews whether the information furnished by the applicant meets with the requirements for qualification.
- (c) The Approving authority investigates the validity of the information provided by the applicant.
- (d) The appointing authority takes the decision on the application and informs the applicants by letter. If the applicant is granted, a certification for recognizing him as approved installer is issued.
- (e) The refusal for grant of recognition is also issued in writing.
- (f) The approved installer is placed under the jurisdiction of the approving authority as per the procedure.

11.1.2 Qualification requirements:

The installer of LNG stations is eligible for recognition if it is active in some or all of the following areas: Construction, Repair, maintenance, inspection, testing of LNG installation to the satisfaction of the approving authority. It shall meet the following requirements:

- I. Is a registered company.
- II. Have sufficient in-house specialists who are familiar with (a) LNG regulations for the activities concerned (b) The properties of LNG, codes of practice relating to LNG installations and regulations concerning LNG.
- III. Takes responsibilities for professional skills of its personnel.
- IV. Possesses tools and machinery in sufficient quantities to execute the work.
- V. Employs sufficient trained and experienced persons as regard to
 - (a) Materials used.
 - (b) Fittings and their installation and maintenance.
 - (c) Interpretation of drawing and schemes as far as relevant for the execution of the work.
 - (d) Operation and safety of the installation.
 - (e) Has the means of performing quality control on materials and fittings.
 - (f) Has professional administration and organization with clear levels of responsibility.

11.1.3 Validity :

The approval shall be valid to the period of 2 years and can be extended on the installer's request if it is able to prove to the approving authority that it has built at least one LNG installation in the last 2 year and to have performed repair and maintenance work in an station more than once a year. The validity of recognition expires:

- (a) At liquidation of the company.
- (b) On the date when the installer declares his intention to stop all activities or if the appointing authority terminates the validity of the approval.
- (c) The approving authority is entitled to terminate the approval if the installer does not meet his obligation under the terms on which approval has been issued.

11.1.4 Obligation of the Installer

The approved Installer at all times shall execute the work, for which he is approved, in a professional manner and with due observance of the codes of practice for such work and the Rules.

11.1.5 Supervision by the appointing authority

The approving authority shall monitor whether the installer still meets the requirement for qualification and whether it fulfils the obligation with regard to the approval.

The installer shall maintain the record of all work relating to installation, maintenance of ALD stations carried out by it and show it to the Approving authority on demand.

11.1.6 Information to be furnished with application for qualification as approved Installer

- I. Status of the company
 - (a) Name of the firm.
 - (b) Constitution of the company, whether Single/Partnership or Limited company.
 - (c) Registration details
 - (d) Address of registered office.
 - (e) Locations and address of existing business.
 - (f) Names of Promoters/Directors/Partners.
 - Background and antecedents of the promoters/Directors/Partners
 - Net worth of Promoters/Directors/Partners.
- II. Manpower available:
 - (a) Organizational setup of the company with responsibility delegated at each level
 - (b) Level of managerial involvement of the promoter.
 - (c) Names of the technical personnel engaged by the company with their technical qualifications, experience and designations.
- III. Technical infrastructure:
 - (a) Background of the engineering works undertaken by the company with details of the period in which such activity was carried out.
 - (b) Detail- of the experience in under mentioned areas.
 - Fabrication of pressure vessels and piping systems.
 - Erection of installation for LNG and other flammable gases.
 - Repairs in pressure vessels, piping and equipment connected with storage and transportation of flammable gases.
 - Maintenance of mechanical/electronic/electrical equipment used in installation used for storage and handling of flammable gases.
 - Testing of vessels/piping and equipment.
 - Corrosion protection design and installation.
 - (c) Details of technical personnel available for undertaking construction of LNG stations.
 - (d) Details of expertise in imparting training to personnel in maintenance and operation of Auto LNG stations.
 - (e) Experience in undertaking maintenance of LNG stations or other installations handling compressed flammable gases.
 - (f) Details of equipment and tools available for undertaking project work relating to installation/repairs/maintenance in LNG Stations

11.2 LNG REGASIFICATION STATION OPERATOR QUALIFICATION

Experience and Qualifications for Management and operation of LNG / L-CNG dispensing stations

11.2.1 Qualification Procedure for Recognition as Approved Station Operator

The company intends to operate Auto LNG / L-CNG dispensing station shall meet the following criteria for considering recognition by the Chief Controller, it shall -

- (a) Be a registered company.
- (b) Possess requisite rating under Auto LNG Control Order.
- (c) Possess a background of operating and managing a business activity.
- (d) Have sufficient in-house specialists well conversant with-
 - I. Knowledge and experience in installation of auto LNG equipment, their operations, maintenance & in training of personnel.
 - II. Auto LNG regulations and the hazards associated.
 - III. Codes of practice relating to setting up auto LNG stations.
 - IV. Number of such personnel engaged by the company shall be related to the stations
 - V. Proposed to be put up by the company.
- (e) Have professional administration and organization with clear levels of responsibility.
- (f) Take responsibility for the professional skills of its personnel.
- (g) Have a firm arrangement with auto LNG supplier for un-interrupted supply of LNG of Auto LNG specification to the company stations.
- (h) Have a firm arrangement with installer for installation and maintenance of its stations. The period of such arrangement shall be specified.
- (i) Have a well laid out policy with regard to selection and management of its dealers or franchisees.
- (j) Take responsibility of operations, periodic maintenance and breakdown maintenance in the stations and enters into a legal agreement with its dealers in this respect.
- (k) Take responsibility in selection and training of Managers and operators of LNG dispensing station of its franchisees/dealers and enter into a legal agreement with its dealers in this respect.

11.2.2 Emergency plan:

Every LNG dispensing station shall have a written on-site & off-site emergency plans in place to control the hazards from serious LNG leakage/spillage or fire. The plan must be drawn in consultation with local authorities i.e. fire services. This plan shall contain instructions for activation, evacuation, response including emergency shutdown of the station, warning to customers and other people in the surrounding, escalation including calls for assistance, and control including usage of firefighting equipment among others. The plan shall be tested from time to time for evaluation of its adequacy and shall be updated and modified as required.

11.2.3 Information to be furnished with application for qualification as LNG Operator

- (a) Status of the company :
 - I. Name of the company.
 - II. Constitution of the company, whether Proprietary/Partnership or Limited company.
 - III. Registration details.
 - IV. Address of registered office.
 - V. Names of Promoters/Directors/Partners.
 - Background and antecedents of the Promoters/Directors/Partners.
 - Net worth of Promoters/Directors/Partners.
 - VI. Locations and addresses of existing business.
 - VII. Details of existing business as parallel marketer, if any.
 - VIII. Capital expenditure envisaged for undertaking Auto LNG business.
 - IX. Credit rating of the company. Credit rating certificate details with date upto which valid (copy to be enclosed).
 - X. Business plans and projected cash flows.
 - XI. Sources of funds for proposed business.

(b) Marketing setup:

- I. Infrastructure for LNG sourcing/handling.
 - Import locations identified.
 - Size of imported parcels.
 - Details of Technological tie-ups, if any.
 - Business proposals.
 - Project feasibility report.
- II. Commercial arrangements (if own facilities are not planned up)
 - Tie-up arrangement with importers.
 - Supporting agreement documents for such tie-ups.
 - Quantum of product to be imported.
 - Details of storage and handling of product at different locations.
 - Fall back arrangements in case of shortfall because of failure of tie-up arrangement.
- III. Storage and distribution arrangement for LNG planned:
 - Details of storage facilities for LNG stations with their capacities
 - Plant and Equipment/Technology details
 - Details of manpower.
- IV. Arrangement planned to reach the product to Dispensing stations :
 - Details of distributor network planned. Whether the stations will be company operated or dealer operated Whether to be installed in existing petroleum outlets or to be of standalone type.
 - Details of the basis for dealer appointment in case of dealer operated stations.
- V. Training and provision for safety :
 - Operational knowledge of products and its handling
 - Capability and preparedness to meet the safety requirement in LNG towards transportation and accident relief during transportation.
 - Plans for training of staff for safe handling of equipment/product.
 - The recruitment policy and the standards for the staff.
 - Details of arrangement for handling emergencies.
 - System for handling/ redressal of customer complaint(s)

(c) Organizational Setup :

- I. Details of Organizational structure
- II. Level of managerial involvement of the promoter
- III. Names of key personnel heading various activities (Details of their qualification and experience to be included)

(d) Operation & Maintenance :

- I. Methodology to be employed to undertake maintenance of Dispensing Stations. If any outside agency to be employed, details of AMC be furnished.
- II. Details of tie-ups with installers for setting up of LNG Stations. Copy of the agreements in this respect be furnished.
- III. Arrangements for taking up responsibility of safe operation and maintenance of LNG Station. Details of agreement with dealer in this respect. Copy of draft agreement with dealer to be furnished.

12. GENERAL SPECIFICATION

12.1 Connectivity & Data Logging

The Owner intends to monitor and partly control all the stations through a central monitoring system. It is intended that monitoring, control and necessary communications shall take place between the PLC/SCADA system of LNG Facilities and having provision for connectivity with centralized SCADA system through internet connectivity. The provision of centralized monitoring, control system including SCADA is out of scope of this tender. However, local SCADA shall be in the scope of the Bidder. Bidder's scope shall be as follows but not limited to,

1. All the field instrument signals (except local pressure gauge, temperature gauge) shall be connected to RTU/SCADA. Hence necessary provisions (like supply & mountings of barriers, repeaters, etc.) shall be made available in the panel by the Bidder.
2. PLC shall have interface facility with mass flow meters, electrical multi-function meter with local monitoring system and Grid SCADA system. Local gauges shall be connected neither to local monitoring system nor SCADA system.
3. Provision shall be available to take local SCADA system in LAN along with local monitoring system / SCADA
4. All data which are required for monitoring and control the performance of the LNG Facility including the performance parameter shall be available in the memory of PLC for minimum 30 days.
5. Bidder shall demonstrate this local SCADA with all points during SAT
6. All software shall be of valid license and with life time validity.

12.2 General Specifications for Electrical Work

12.2.1 **Scope/ Introduction**

1. This Specification gives the minimum requirements for electrical equipment and work to be carried out as part of scope of work. The Bidder shall be responsible for the provision of complete electrical work in accordance with the specifications and in compliance with applicable codes and standards.
2. All the materials shall comply with the local statutory regulation.

12.2.2 **Applicable Codes, Standards and Statutory Requirements**

All equipment and services supplied shall comply with the latest revision of relevant Indian and international codes, standards and regulations. Particular reference shall be made as a minimum but not limited to the following:

IS309	Plugs, socket-outlets and couplers for industrial purposes
IS325	Three phase induction Motors
IS694	PVC insulated cables for working voltages up to and including 1100V
IS732	Code of practice for electrical wiring installations
IS1231	Dimensions of three-phase foot mounted induction motors
IS1271	Thermal evaluation and classification of electrical insulation.
IS1293	Plugs and socket outlets of 250 watts and rated current up to 16 amps
IS1554	PVC insulated (Heavy duty) electric cables
IS2148	Flame proof enclosures for electrical apparatus
IS2206	Flame proof electric lighting fittings
IS2223	Dimensions of flange mounted AC induction motors
IS2253	Designation for types of construction and mounting arrangement of rotating electrical machines
IS2968	Dimensions of slide rails for electric motors
IS3043	Code of practice for Earthing
IS3961	Recommended current ratings for cables

IS4029	Guide for testing three phase induction motors
IS4691	Degree of protection provided by enclosures for rotating electrical machinery
IS4722	Rotating electrical machines
IS4728	Terminal marking and direction of rotation for rotating electrical machinery
IS4889	Method of determination of efficiency of rotating electrical machines
IS5422	Turbine type generators
IS5571	Guide for selection of Electrical equipment for Hazardous areas
IS5572	Classification of Hazardous areas (other than mines) having inflammable gases and vapours for electrical installation
IS5780	Specification for intrinsically safe electrical apparatus circuits
IS6362	Methods of cooling for rotating electrical machines
IS6381	Construction and testing of electrical apparatus with type of protection 'e'
IS6665	Code of practice for industrial lighting
IS7098	Crosslinked polyethylene insulated PVC sheathed cables
IS7132	Guide for testing synchronous machines
IS7389	Specification for pressurized enclosures of electrical equipment for use in Hazardous areas
IS7689	Guide for the control of undesirable static electricity
IS7816	Guide for testing insulation resistance of rotating machines
IS8144	Multiple purpose dry batteries
IS8223	Dimensions and output series for rotating electrical machines
IS8270	Guide for preparation of diagrams, charts and tables for electrotechnology
IS8623	Specification for low voltage switchgear and control gear assemblies
IS8789	Values of performance characteristics for three phase induction motors
IS9537	Conduits for electrical installations
IS9628	Three phase induction Motors with type of protection "n"
IS9676	Reference ambient temperature for electrical equipment
IS9814	Lead acid storage batteries for marine use
IS9968	Elastomer insulated cables
IS10118	Code of practice for selection, installation and maintenance of switchgear and control gear
IS10810	Methods of test for cables
IS10918	Vented type Nickel Cadmium batteries
IS11955	Preferred current ratings
IS12032	Graphical symbols for diagrams in the field of electrotechnology
IS12065	Permissible limits of noise level for rotating electrical machines
IS12075	Mechanical limits of vibration of rotating electrical machines
IS12309	Code of practice for installation and maintenance of aerodrome lighting fittings
IS12615	Induction motors – energy efficient, three phase, squirrel cage – specification
IS12762	Photovoltaic devices
IS12824	Type of duty and classes of rating assigned to rotating electrical machines
IS12943	Brass glands for PVC cables
IS13234	Guide for short circuit current calculation in three phase AC systems
IS13346	General requirements for electrical apparatus explosive gas atmospheres

IS13408	Code of practice for selection, installation and maintenance of electrical apparatus in potentially explosive atmosphere.
IS13947	LV switchgear and control gear
IS14153	Guide for general description of Photovoltaic (PV) power generating systems
IS14218	Sealed cylindrical type rechargeable Nickel Cadmium cells
IS14244	Characteristic parameters of stand alone Photovoltaic (PV) systems

Where there is no applicable Indian code or standard, codes or standards published by the following international organization shall be used:

International Electrical Commission (IEC)

IEC 34	Rotating electrical machines
IEC 72	Dimensions and output series for rotating electrical machines
IEC 79	Electrical apparatus for explosive gas atmospheres
IEC 92	Electrical installations in ships
IEC 364	Electrical installations in buildings
API RP 540	Electrical installations in petroleum processing plants, 3rd ed., 1991.

12.2.3 Service Conditions

(a) Environmental

Equipment and materials shall be suitable for service under the environmental conditions given in the applicable data sheets and specification for site and utilities data of specific equipment specifications.

(b) Hazardous Areas

1. Equipment installed in a hazardous area shall be for Class 1 Zone 1, Gas Group IIA, IIB. Temperature T6, unless otherwise detailed on specific data sheets or specifications.
2. Motor shall have hazardous area classification of Class 1 Zone 1, Gas Group IIA, IIB Temperature class T3/ T4.
3. Equipment intended for hazardous areas shall conform to the requirements and be selected and installed in accordance with the Codes and Standards referenced herein the specification.
4. Isolating devices for equipment located in hazardous areas shall switch all poles of the supply including the neutral.

12.2.4 General Design Requirements

1. Equipment shall be capable of meeting its rated output continuously at system voltage variation of +10% and frequency variation of +3%. .
2. Voltage depressions to 85% of system voltage at consumer terminals during motor starting shall have no detrimental effect on equipment operation.
3. All equipment shall be designed to facilitate inspection, cleaning and maintenance with due care to safety in operation and personnel protection.
4. The rating and size of all electrical equipment and motor shall be designed based on minimum 10 % margin after considering all its (motor) design de-rating factors. The Bidder shall produce all the design calculations to owner and shall go ahead on execution of the work and procurement only after getting approval from owner.
5. All equipment shall run without undue vibration and within the noise level specification.
6. All equipment shall be designed to prevent the risk of accidental short-circuit or open circuit.
7. All materials shall be new and of good quality.
8. Electrical windings and apparatus subject to dust and moisture shall be suitable for the working conditions without distorting or deterioration, or the setting up of undue strain in any part that would affect the efficiency and reliability of the package unit.

9. Connections and all wiring shall be so arranged and/or protected to prevent them being damaged. Connections shall terminate at terminals of correct rating and size for the circuit and conductors.

12.2.5 Specification for Control Equipment (Panel Board)

1. Unless otherwise specified, motor starters will be located in motor control centres / control panels provided by the Bidder. These starters will accept inputs from field control stations and protective devices and provide supplies to anti-condensation heaters located in the packaged equipment. They will also provide signals back to the Purchasers Control System and Safety System.
2. Bidder shall consider standard control scheme which incorporates start stop and trip operations of LNG Unloading skid as well as low Pressure, High Pressure pump skid, local & remote (Panel & PLC) operation, auto and manual selection mode, indication of various mode like 'ON' 'OFF' 'TRIP' etc. and trip conditions of the starter. Proposed control method shall be submitted to Owner for approval before implementation.
3. The supply of all auxiliary control equipment located within and on the package unit together with interconnecting cable shall be the responsibility of the Bidder.
4. The enclosure shall be of flameproof type, made of cast aluminium alloy (LM6) and suitable for indoor/outdoor installation as indicated in the schedule of quantities.
5. The panel shall have external fixing lugs and shall be suitable for mounting on vertical face such as wall / column or steel pedestal.
6. All outgoing feeders shall be provided with adequately rated MCCB / ACB. In no case the SFU shall be used.
7. VFD shall be provided for the motor of LNG Unloading Pump skid and Soft Starter/Star Delta starter for Low Pressure & High Pressure pump skids. The same shall be placed in the electrical panel room. All cables between the panel and pump skid shall be provided by the Bidder. All cables shall be FRLS, armoured type as per the specification stated elsewhere in the tender.
8. The Bidder shall clearly identify by diagrams and schedules:
 - (a) Interfaces between package equipment to be supplied by the Bidder and that to be supplied by the 'owner' including any interconnecting cable.
 - (b) Circuits, equipment and utilities, which the Bidder requires to be supplied by the Owner in order to provide a fully integrated and operating unit.
9. When push button enclosures, isolators, air circuit breakers (ACB) / moulded case circuit breakers (MCCB) or electrical trace heating circuits are to be supplied by the Bidder then they shall comply with the following requirements:
 - (a) Start/stop push buttons or emergency stop push buttons shall be certified for hazardous area operation if applicable
 - (b) Emergency stop push buttons shall lock themselves in the 'stop' position when pressed and shall be protected to prevent their accidental operation. Padlocking facilities in the 'OFF' position shall be provided.
 - (c) If emergency switch is operated, all the output from the priority panel such as low, medium, high, direct and Mobile and dispenser shall be shut off.
 - (d) Minimum 04 numbers emergency switch to be provided at LNG facility area that is easily accessible for any of the user at the time of emergency. Additionally, 1 No. of ESD on the electrical control panel to be provided.
 - (e) All isolators shall be rated for load break duty. Isolators in motor circuits shall be rated to interrupt the stalled motor current. Off-load isolators shall not be used.
 - (f) ACBs / MCCBs shall be rated for the system voltage, current and fault level, they shall be trip free and have positive indication of contact position.
 - (g) Electrical trace heating circuits located in hazardous areas shall be fitted with residual current

protection devices (e.g. earth leakage circuit breakers).

10. All control wiring terminals and components shall be clearly labelled with the item number or designation and must be easily identifiable with those shown on the drawings.
11. All terminal blocks, connectors and wires shall be numbered and identified with core markers.
12. The bus bars receiving the incoming supply and outgoing feeder elements shall be housed in separate compartments. The separation between the compartments should be such that no flame propagation is possible.
13. Incomer circuit shall have mechanical ON/OFF indication and facility for padlocking the operating handle in off position. A flameproof cable gland for the incoming cable shall be provided suitable for the incoming cable size. Crimping type lugs shall be provided for incoming cable.
14. Bus bars shall be made of high conductivity copper or aluminium and supported by non-hygroscopic insulators. Individual compartments shall have separate inspection covers secured by screws/ bolts requiring special tools for opening.
15. All outgoing circuit shall also have ON / OFF indicators.
16. Terminals shall be provided in an independent/ common compartment for connection of outgoing cables. Terminals should be anti-loosening type and suitable for 2.5 / 4 /6 sq.mm. Copper conductor or of size. In addition to the required terminals for each outgoing circuit, provision shall be made for connection of an extra core of the outgoing cable to be used for earthing. Power terminals shall be suitable for ring type crimping lug. All the cables shall be FRLS type.
17. Flameproof cable glands shall be suitable for cable size as indicated in schedule of quantities. Flameproof threaded plug to block unused cable entry shall also be provided as specified in schedule of quantities. All cable entries (Incoming and outgoing) shall be so designed, that no water enters the enclosure when panels are installed outdoors, and if this can-not be met all the entries should be necessarily from the bottom.
18. Caution plates shall be provided on the inspection covers warning against opening without isolation. Nameplates shall be provided for each outgoing circuit and for the complete panel indicating circuit number and panel number. All nameplates shall be fixed by screws and shall be made from laminated plastic with white letters on black background.
19. The panel shall be painted with epoxy type, acid / alkali resistant paint, while hardware shall be zinc passivated / electro galvanised.
20. The supply of the panel shall be complete with all components and devices required for full and proper operation of the equipment even though such component or devices may not be stated in detail in this specification. Two sets of complete set of special tools for opening / closing of enclosure bolts, screws, shall also be supplied with the panel.
21. Approval Certificate from CMRS or equivalent independent testing agency and general arrangement drawings shall be furnished with the bids.
22. Copies of certificates from the certifying agencies shall be furnished for all the equipment used in hazardous areas. Necessary approvals from CCOE, DGMS as applicable shall be obtained by the Bidder for all equipment installed in hazardous areas.
23. All non-current-carrying metallic parts of the panel shall be inherently bonded together. Two 10mm dia. studs should be provided on the main housing for external earthing connection. Earthing terminals for outgoing circuits should also be bonded to main housing.
24. All PLC, elec. Instruments shall be isolated from the panel body with proper isolator material, isolation of body earthing between instrument earthing, same to be demonstrated and ensured during FAT and one of the check point of QAP.

12.2.6 Specification for Electrical Control Panel:

1. The VFD/ Soft Starter/ Star Delta should have up sized one size of the pump skids (Unloading pumps

skids, Cryo pump skids) power ratings. Selection of VFD/ Starter to be done by ensuring current rating with twice the full load current of pump/motor.

2. The electrical control panel should have various safety trips like :

Undervoltage	Trips when line voltage drops below the preset level for the preset time.
Overvoltage	Trips when line voltage increases above a preset level for a preset time
Phase loss	Trips if 1 or 2 phases are lost
Frequency loss	Trips if frequency is not in the range of 40-66.6Hz
Phase sequence	Trips if line phase sequence is wrong
Slow speed time	Trips when operating at slow speed for extended periods
Wrong connection	Trips the control panel when one or more motor phases is not properly connected to soft starter's load terminals or if there is an internal disconnection in the motor winding
Shorted SCR	Trips and prevents starting if any SCR is short-circuited or when motor windings are shorted
Over temperature	Heat-sink over-temperature. Trips the Soft starter when the heat-sink temperature rises above 85°C
External fault	Trips the Soft starter when a N.O. contact between terminals 19-21 closes for over two seconds
Earth Fault / Earth Leak	Alarm/ Trip for earth fault protection / earth leak detection in motor

12.2.7 Equipment Enclosures

1. Equipment Enclosures shall be of heavy-duty construction and shall provide the following minimum degrees of ingress protection.

enclosed indoor locations -	IP 42
open outdoor locations	IP 56/ IP 55
electric motor frame -	IP 65/ IP 56/ IP 55
Electric motor terminal box -	IP 65/IP 55

2. With enclosures open, all live parts shall be shrouded as a minimum to IP21.
3. As the fire water system uses hydrants and monitors, all equipment, other than inside dry enclosed buildings, shall be designed to tolerate this without detrimental effect
4. If applicable, cable entry to enclosures shall be via removable gland plates, where enclosures are certified Ex-d then entries shall be drilled and tapped with a suitable ISO metric threaded entry.

12.2.8 Cabling and Wiring

1. The Bidder shall provide all inter-connecting wiring and cabling within the packaged unit or equipment skid.
2. When a package contains a number of small power consumers, the Bidder shall provide a distribution board / control panel complete with circuit breakers, starters, earth and neutral bars. etc., of a type approved by the Owner and provide all the distribution feeders required so that only a single power supply cable need be connected to the package panel.
3. Interface cables connecting the packaged equipment to other plant equipment supplied by owner shall be supplied and installed by others.
4. The Bidder shall supply all cable size details for the approval of the Owner.
5. Top entry of cables or conduits into enclosures or equipment will not be accepted without prior approval.

6. Low voltage electrical wiring shall have multi-stranded copper conductors, 1.1 kV grade PVC insulation with round wire armouring and extruded PVC inner and FRLS outer sheaths with the marking of batch number.
7. All cables provided by the Bidder shall employ constructions utilizing galvanized steel wire armour and shall be routed and installed with due regard to minimizing the hazards associated with mechanical, heat, oil, and chemical and fire damage.
8. Control, instrumentation and power circuits shall be terminated in separate junction boxes for connection to the external cables. Motor circuits shall generally be wired direct to the motors. The position of junction boxes shall be agreed with the Owner before construction.
9. Minimum cable bending radius as recommended by the cable manufacturer shall be strictly adhered to.
10. All cables shall be identified by means of a unique cable number. The Bidder may use his standard numbering system within the package. Cable numbers shall be fixed to all cables, immediately adjacent to glands, using a corrosion and ultra violet resistant proprietary system (Grafoplast or Owner approved equivalent).
11. All internal junction box, enclosure or panel wiring shall be clearly identified by means of permanent core identification markers Grafoplast or Owner approved equivalent
12. Circuits and terminals, which operate at different voltages and those that perform different functions, shall be physically segregated.
13. Terminals associated with external sources of supply shall be fully shrouded and shall carry a label warning personnel to isolate the supply at source before commencing work.
14. Cables will be terminated into enclosures using mechanical type compression glands.
15. The Bidder shall provide cable glands of a type specified by the Owner and terminate all cables within the scope of the Package Equipment
16. All glands shall be made of brass and soft sealing washers or approved sealant (as applicable) to maintain the integrity of the enclosure and to provide a degree of protection depending on type of enclosure.
17. Gland entries into enclosures made through clearance holes must be retained with two back nuts and shall include a neoprene or equivalent sealing washer on the gland body side of the entry into the enclosure. Where sealing washers are used in conjunction with external earth tags, the washer shall be placed between the earth tag and the enclosure.
18. Where required all bonding between glands shall be carried out internally (i.e. inside the enclosure) by means of earth-tag washers or bonding plates. Gland plates shall be separately earthed to the enclosure earth stud.
19. Where the Owner or "others" are to supply cables and glands, the Bidder shall provide tapped ISO metric entries in the cable box or a removable un-drilled gland plate for drilling by others. Undrilled gland plates shall be suitably marked to facilitate correct line up with cables and terminal lug bolt or stud centers. Gland plates for single core power cables shall be non-magnetic.

12.2.9 Earthing

1. Earthing shall be carried out as per IS Code of Practice: 3043 and as shown in the relevant drawings
2. Minimum 06 Nos of GI (dirty) Earthing (80 MM Dia, 3 meter Long) electrode for body earthing of equipment and 02 nos Copper (Clean) earthing (63mm Dia, 3 Meter Long) electrode for instrument earthing shall be provided. However, Nos of earthing electrode may vary based on site situation, soil resistivity and earthing resistance.
3. For GI earthing connectivity 40 mm x 6 mm GI Strip shall be used and Cu earthing connectivity 25 mm x 3 mm Cu strip OR 25 Sq mm Flexible Cable shall be used.
4. Earthing connectivity to be ensure to each equipment with minimum 02 points of equipment

base/frame.

5. All electrical equipment on the package unit shall be electrically bonded to the package unit skid. pump motor frame also shall be connected at different two point of earth grid.
6. Junction boxes, control units etc., shall be provided with an internal and external earth terminal, complete with locknut and washers. All non-conducting enclosures shall have an integral earth continuity system.
7. All metallic non-current carrying parts shall be made electrically continuous with the package unit skid, by welding or bolting, using bonding straps and/or star washers or equal to ensure good conductivity across paint layers and bolted joints.
8. Earthing and bonding conductors shall be adequately current rated for the duty and shall be a minimum size of 4 sq.mm for connections inside equipment and 16 sq.mm for external connections. Insulated Earthing cables shall be coloured green with yellow stripe.
9. Metallic part of all equipment not intended to be live shall be connected to earth as per provisions of IS: 3043/IEC recommendation. Grounding of all electronics shall be separately connected to earth using insulated copper wire. Grounding of electronic equipment shall not be connected to earthing for electrics or equi-potential bonding. Separate earth pit shall be provided for electronics / instrumentation
10. Bidder shall make the dual earthing point at single location and integral body earthing shall be done at their works.

12.2.10 Lighting

1. All exterior lighting and general area lighting shall be supplied and installed by the Owner.
2. Lighting for LNG equipment within dike area, required for operation and maintenance of equipment shall be designed and installed in accordance with the requirements by the Bidder.

12.2.11 Nameplates

All items of electrical equipment within the package shall have non-corrosive nameplates. Nameplate details shall be subject to approval by the Owner. Equipment nameplates shall be inscribed with the equipment number where appropriate.

12.2.12 Inspection and Testing

1. The Bidder shall carry out a string test to fully test the electrical operation of the package as a composite unit. If certain items, not forming part of the package, are necessary to carry out the string test then the Bidder shall provide simulated voltage references, signals, inter tripping and activating supplies as necessary.
2. All electrical equipment on packages shall have either documentation to show that type tests to the relevant Standards have been successfully completed or the Bidder shall perform these tests.
3. The specific test procedures of key items shall be as follows.

I. Medium Voltage Switchgear / Control Panel

1. Following routine tests shall be carried out and test certificates shall be furnished.
 - (a) Visual inspection and dimensional check-up.
 - (b) High voltage test.
 - (c) Hydraulic test and clearance checking.
2. Before switchgear is energized, the insulation resistance of each bus shall be measured from phase to phase and from phase to earth. Measurements shall be repeated with circuit breakers in operating position and contacts open. Each test shall be held until constant reading is obtained. Minimum time shall be ten seconds. Minimum megger reading shall be 10 Mega ohms.
3. Before switchgear is energized, the insulation resistance of all D.C. control circuits shall be measured from phase to earth. Minimum acceptable value shall be 1 Mega ohm.

4. Each adjustable protective relay shall be set, calibrated and tested by using a cycle counter, load box, ammeter and voltmeter as required or by using a suitable relay test set having good wave form. Settings, calibration points and test points shall be in accordance with values given for the approved relay settings for the job.
5. Test all current transformer secondary circuit by applying current (thru secondary injection test) to transformer secondary windings and verifying that relay(s) and/or meter(s) operate properly.
6. Test all the relevant circuit breakers for proper interlocking operation. The sequence of interlocking is as indicated on single line diagram.
7. Test the operation of tie breakers / bus couplers.
8. The following tests shall be performed on all circuit breakers before they are operated:-
 - (a) Contact alignment shall be checked and adjusted where necessary in accordance with manufacturer's instructions.
 - (b) Each circuit breaker shall be drawn out of its cubicle and shall be closed manually, and then its insulation resistance shall be measured from phase to phase and from phase to earth.
 - (c) All adjustable direct acting trip devices shall be set using values given in the approved relay settings for the job.
9. Before switchgear is energised, the following tests shall be performed on each circuit breaker in its 'test' position:-
 - (a) Close and trip circuit breaker from its control switch, push button or operating handle.
 - (b) Test operation of circuit breaker latch and check switch, where provided.
 - (c) Test proper operation of lockout device in the closing circuit, where provided, by simulating conditions, which would cause a lockout to occur.
 - (d) Trip breaker by manual operation or by applying current or voltage to each of its associated protective relays.
 - (e) All automatic control operations and interlocks shall be tested for correct operation.
10. After completion of tests, all test results shall be recorded in standard format approved by Engineer-in-charge, witnessing site engineer and Bidder's representative.
11. All test reports shall indicate the details of the instruments used for test with date and time of test.
12. After commissioning of the equipment, all measuring and indicating instruments to be checked properly for operation. Any improper operation of these indicating lamps / instruments shall be corrected by checking fuse / connections, polarity, etc. If still these are found to be not in working condition, the Bidder should report the same to the Engineer-in-charge for suitable action for replacement.

II. L.T. Cable

1. A megger test shall be made for continuity and proper end-to-end connection and correct termination after installation, on all feeder cables including motor feeder cables.
2. Record test data between phase to phase and phase to earth.
3. The test voltage, duration of test and test procedure shall be in accordance with IS : 4288.

III. Earthing

1. Check that earthing system is installed as per drawings.
2. Check that all connections are tight and connections are protected from mechanical injury.
3. The resistance to ground shall be measured at the following locations:
 - (a) The resistance of the system/neutral earthing should be maintained preferably at less than 5 Ohm.
 - (b) At each earthing point provided for lightning protection, the earth resistance shall preferably not exceed 5 Ohm.
 - (c) At any one point of each system used to provide earthing to electrical equipment enclosures,

resistance shall not preferably exceed 5 Ohm.

- (d) Measurements shall be done before connection is made between the earth and the object to be earthed.

12.3 Specification of Instrumentation

12.3.1 General Requirements

1. Bidder shall be fully responsible for design, material selection, sizing and selection of the proper instruments for their system. The compliance to this specification does not absolve the Bidder of the responsibility towards contractual obligations with regards to completeness, proper selection, satisfactory operation and easy maintenance of unit.
2. All instrument supplied shall be of field proven quality both with respect to design and materials. Prototype instruments of an experimental nature shall not be offered or supplied.
3. No instrument requiring special maintenance or operating facilities shall be offered or supplied as far as possible.
4. In the event of any contradiction between this specification, data sheets, related standards, codes etc. the Bidder shall refer the matter to the owner for clarification and only after obtaining the same, Bidder shall proceed with the manufacture/engineering of the item in a question.

12.3.2 Drawing and Document after Award of Work

1. Instrument index
2. Sub vendor list (for Instruments and Accessories) : This Document shall list out all instrument items and accessories including control system along with the name of the sub-vendors from whom the Bidder is likely to procure these items.
3. Specification of Control Panel and Control System.
4. Configuration diagram for all programmable / configurable control system like Programmable Logic Controller (PLC).
5. Utility requirement like Power consumption
6. Estimated heat load for the equipment located in control room.
7. Catalogues giving detailed technical specifications and other information for Control System and other special instruments.
8. Instrument sizing calculation:
 - (a) Instrument sizing calculation shall furnish information regarding sizing (as per standard elsewhere in this document), type, selection and other related information. Following sizing calculation shall be applicable, in general.
 - (b) Control valve sizing including noise calculations.
 - (c) Safety valves/ pilot operated pressure relief valve sizing.
 - (d) Flow element sizing including orifice plates, flow nozzle sizing and selection.
 - (e) Utility consumption calculation including power supply (UPS/Non UPS) etc.
 - (f) Cable calculations for Power cables.
9. Utility requirements
 - (a) This document shall list out the following information regarding utilities required by the Bidder
 - (b) List of utilities required i.e. Power (UPS, Non UPS), Nitrogen, etc.
 - (c) Location and estimated / actual requirement at each location.
10. Level sketches: Level sketches shall represent the nozzle elevation, nozzle sizes and rating, requirement of stand-pipe, type of level instrument etc. for all the vessels, columns, exchangers and tanks.
11. Material specification

- (a) Material Specification shall contain all those information's which are necessary for a sub-vendor / vendors to submit their most competent offer. Separate MR shall be prepared for each item. Material requisition shall contain the following information, as a minimum.
 - (b) Instruments specifications including detailed instrument data sheet and special requirements, if any.
 - (c) Testing and Inspection requirements.
 - (d) Vendor data requirements.
 - (e) Other related documents like Standard Specifications, Quality Assurance requirement, etc.
12. Purchase order specification: Purchase order specification contains all information which form part of material requisition but updated in line with the finally accepted offer of the successful bidder.
 13. Logic diagrams: Logic diagram is a logic representation of process interlock and shutdown system and details out the functionality in a schematic form, as either process cause and effect table shown on the P&ID or in a separate write-up. The schematic shall also be supplemented with operational requirements like start-up and process bypasses, reset and shut down push buttons, selector switches, status lamp etc.
 14. Instrument Loop Drawings : Each loop shall have a separate Instrument Loop drawing which shall show each component from field device to final receiver including physical location; initiating device, its terminal number, junction box with its terminal number; cable number with pair number/polarity; receiver instrument terminals/cabinet terminals; system functional blocks of loop in simplified manner (without configuration details).
 15. Panel Front Arrangement: This drawing shall show the arrangement of Panel mounted instruments like indicating instruments, alarm enunciator, indicating lamps, push buttons/switches etc. including their approximate sizes and their mounting locations.
 16. Configuration Diagram: This drawing is a graphical representation of all major hardwares required in a configurable control system which are necessary to meet all the expected functional requirements.
 17. Input/ Output Assignment: This document shall indicate the physical assignment of various I/O modules and their respective channels to various physical inputs and outputs.
 18. Instrument Tray/Trench Layout: Instrument tray layout drawing shall show the routing of main instrument tray layout for LNG Facility The drawing shall be prepared on plot-plan and shall show the size, cross-section at various locations, general notes, symbols, reference drawings and the control room entry.
 19. Instrument Cable Schedule: The instrument cable schedule shall show all instrument and power cables required for complete instrumentation. The document shall show tag number, cable number, type, length and size of cables, type of junction box, identity of local panel, etc.

12.3.3 Electrical Power for Instrumentation

The Owner shall provide raw electrical supply 230 VAC, 50 Hz +10% electrical power to bidder. Further distribution through UPS or regulation of power (110V AC/24V DC/24V AC) shall be carried out by the Bidder. The general features of electrical for instrumentation shall be as under. UPS for PLC panel with minimum 30 minutes backup time is in bidder scope.

1. All instruments, control systems (PLC) and analyzer system shall be able to operate at the following UPS specification:

Voltage level	:	220 V AC + 10%
Frequency	:	50 Hz + 3 Hz
Switch over time	:	5 milli seconds
2. 24V DC - the necessary arrangement will be in Bidder's scope
3. Solenoid Valves, Relays, Lamps : 220V AC + 10% Or 24 VDC
4. If 110 V AC required for Solenoid, the necessary arrangement will be in Bidder's scope

5. Panel/Cabinets lighting : 240V AC + 10%
6. In case 24 V DC is required for Input interrogations, solenoid valves, relays and lamps etc., the same shall be arranged by the Bidder using dual redundant power packs (230V AC to 24V DC converter).
7. Instrument power circuits shall be individually protected from fault with the help of fuses. Power supply to the individual instrument shall be disconnected with the help of DPST switch and protected with the help of fuses. Miniature circuit breakers (MCBs) may be selected in place of switch fuse unit in case protection is provided for overload protection.

12.3.4 Alarm Philosophy

1. Adequate alarms shall be provided to give audible and visual warning of any process and machine malfunction in the package.
2. All trips shall have a pre-trip warning alarm in addition to alarm at the trip condition.
3. All package alarms including pre-trip warning alarms and trip alarms (shutdown alarms) shall be annunciated on the local panel.
4. All rotating equipment shall have the status indication provided on the local panel.
5. Common pre-warning alarm and common trip alarm contacts for the package shall be provided for remote annunciation. Additional alarm contacts shall be provided when specified.
6. "Fail-safe" type with normally closed alarm contacts shall be used.
7. Location of process connections shall be from the side or from the top of the process equipment but not from the bottom. This requirement is applicable to both pipes and vessels. The location of lower side connection when necessary shall be high enough to prevent plugging due to dirt or other suspended solids. In addition, the connections shall be short, vertical or horizontal and without any pockets.
8. Material of construction of instruments shall be as per the material selection chart, attached as part of this specification. In any case Bidder to ensure that the selected material is consistent with temperature, pressure, corrosion conditions and other process equipment.
9. In case where suitable material of construction is not feasible/ possible, diaphragm seal shall be considered.
10. All process switches shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be SPDT type unless otherwise specified. Contacts used in intrinsically safe applications shall be gold plated.

12.3.5 Instrument Connections

1. Instrument connections for signal and gas supply shall be 1/4" NPT(F).
2. Electrical cable entry connection shall be 1/2" NPT(F). Suitable cable gland shall be used.
3. End connections shall meet the following, unless otherwise specified:
4. Threaded end connection shall be NPT as per ANSI/ASME B1.20.2
5. Flanged end connection shall be as per ANSI/ASME B16.5
6. Flange face finish shall be as per ANSI/ASME B16.5 The face finish wherever specified in data sheets shall have serrations as follows:

Serrated	:	250 to 500 AARH
125 AARH	:	125 to 200 AARH
63 AARH	:	32 to 63 AARH
7. Grooves or ring type joint flanges shall be octagonal as per ANSI/ASME B 16.20

12.3.6 General Specification of Instruments

(a) Common Applicable Requirements

Major instrumentation shall be electronic type but all local loops and final control elements shall be pneumatic.

1. Instrumentation shall be complete in every respect and liberal to the extent of providing data on all

operations and variables sufficient for the safe, efficient and easy operation, start up and shut down of the LNG Facility.

2. The design and installation of instruments shall generally be in accordance with ISA/API recommended practices and other applicable standards like BIS, IBR etc. Material specifications and practices shall, in general, conform to appropriate ASTM or equivalent standards. All standards and code of practices referred to herein shall be of the latest edition prior to the date of owner's enquiry.
3. All instruments and equipment shall be suitable for use in a hot, humid and tropical sea-weather climate. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-65 as per IEC-529/IS-2147 and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive Sea shore atmosphere.
4. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 801 "Electromagnetic compatibility for Industrial Process measurement and Control Equipment.
5. Instrumentation electronics shall be certified by a recognized authority such as BASEEFA, CENELEC, FM, PTB, CMRI, LCIE, CESI, INIEX, ATEX and SMRS.
6. Unless specified otherwise, all Instruments shall be suitable for an area classification of "Class 1, Division 1, Group D as per NEC" OR "Zone 1, Group IIA/IIB as per IS/IEC".
7. All package mounted transmitters/transducers and temperature element shall be intrinsically safe "IA" as per IEC 79-11 and solenoid valves, switches and related junction boxes shall be certified flame proof (Exd) as per IEC 79-1 by a statutory body viz. FM, BASEEFA etc. for the specified hazardous area classification. Other special equipment's/instruments, where intrinsic safety is not feasible or available the same shall be flame proof (Exd) certified suitable for the specified hazardous area by a statutory body as per IEC 70-1. All analog as well as digital input to PLC shall be connected through barriers. All analog barrier shall be isolator type.
8. The instrumentation and control for complete LNG Facilities are to be configured for manual as well fully automatic control system including starting, shutdown as applicable for unattended operation. Control system shall be PLC based with make and model number duly approved by the Owner.
9. All controllers shall have facility for bump-less auto-manual and manual-auto transfer and set point adjustment. Flow, pressure and level controller shall be provided with proportional plus integral action, while temperature controller with proportional plus integral plus derivative action.
10. All the instrumentation shall be capable of operating for full range of operation. Range for instruments shall be selected in general, such that in normal process operation the indication is between 40% to 60% of span for linear and 60% to 80% of span for square root inputs.
11. Ranges for process switches shall be selected, in general, such that the set point falls preferably in the middle 30% of full adjustable range i.e. the set point shall fall between 35% and 65% of adjustable range.
12. All instruments shall be provided with proper tagging w.r.t. tag of instrument cables
13. Junction boxes and accessories required for flameproof instruments shall also be certified flameproof.
14. Common/ Separate junction boxes shall be provided for each type of signal i.e. intrinsically safe signals, alarm, shutdowns, thermocouples, RTDs etc. for interfacing to local panel, analog, digital, solenoids, RTD, thermocouple and power supply. Instrument junction boxes shall not have any high voltage connection. Bidder need to ensure there should not be high power interference in instrument/ Control JB.
15. All pressure gauges (Glycerine filled) and pressure transmitters shall be provided with block & bleed valves and have accuracy of + or - 1% of Full Scale Deflection (FSD).

16. The temperature gauge shall be generally mercury in steel filled type, weatherproof & with capillary extension. Capillary tubing shall be minimum Carbon Steel with CS flexible armouring. The gauge shall have accuracy of + or - 1% Full Scale Deflection (FSD). The range shall be 1.5 times of operating temperature.
17. All field instruments power shall be limited to 24 VDC. Power conversion unit if required shall be in the scope of the Bidder.
18. Units of measurement shall be:

Liquid flow	LPH or Kg/hr for LNG Flow and LNG Dispensers
Gas flow	SM ³ /Hr or kg/hr for CNG & PNG Application
Pressure	Kg/cm ² (g)
Temperature	°C
Level	% or as per system requirement

(b) Electronic Instruments

1. All electronic instruments requiring separate power supply shall generally operate on 230V, 50 Hz. Instruments operating at 24 V DC shall also be acceptable.
2. Electronic transmitters shall generally be two wire type. These shall have transmission/ output signal of 4-20 m.A DC and shall be capable of delivering rated current into external load of at least 600ohms when powered with 24 V DC nominal voltage.
3. Smart transmitter when selected, shall be used in analogue output mode. Digital integration shall be avoided unless specified otherwise.
4. All receiver instruments shall be microprocessor based and shall operate on voltage input of 0.25 to 1.25 V, 1 to 5 V, or 0 to 10 V dc, in general.
5. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-801.
6. Pneumatic Instruments shall operate on gas supply of suitable pressure and shall have transmission and output signal of 0.2 to 1.0 kg/cm²g.

(c) Panel Board Instruments

1. Panel board instruments shall generally be multi bin sub-miniature 6" x 3", except recorders, which shall preferably be 6" x 6". Instruments like microprocessor based recorders, temperature scanners, etc. shall be as per manufacturer standards.
2. Panel board instruments shall have the following graduations, in general:
 - Flow with DP cells : 0 to 10 square root
 - Pressure : Direct Reading
 - Level : 0 to 100 Linear
 - Temperature : Direct Reading
3. Multiplying factors for flow scales shall be specified on manufacturers name plate.
4. Recorder charts shall be dual graduated, in general, in 0 to 10 square root and in 0 to 100 linear.
5. Annunciator, in general, shall be solid state type with plug in modules, in a cabinet with back lighted engraved windows and integral power supply. Alarm logic module shall be single channel type. In case multi-input alarm module are selected, only one channel shall be used. Intrinsically safe annunciator circuit, when used, shall have power supply unit in a safe area.
6. The design of the alarm annunciator system shall be such that transient alarms of less than 330 milli seconds duration shall be automatically rejected.

(d) Field Transmitters

1. All field transmitters shall have an accuracy of 0.5% of span and shall be provided with output meter/output gauge at the signal output. The accuracy level certification form 'OEM' shall be documented by the Bidder along with the supply.

2. Smart transmitters when used shall be used in analogue mode only unless specified otherwise. At least one number of hand held configuration shall be supplied as a minimum.
3. Smart transmitters if specified shall have accuracy + 0.1% of span, as a minimum.

(e) Temperature Instruments

1. Thermo-wells: All temperature elements shall be provided with Thermo wells fabricated out of bar stock of minimum SS-304 material. The base of the thermo well shall be chosen to fit the instrument without air gap for minimising measuring lag.
2. Temperature Gauges
 - (a) Local temperature gauges shall be liquid/vapour/gas filled type in general and shall be manufactured as per relevant SAMA Class.
 - (b) Bimetallic type dial thermometers shall be avoided where excessive vibration are encountered, such as compressors. Only filled type with capillary extension shall be used in such cases. Capillary tubing shall be of SS-304 with stainless steel flexible armouring, and PVC covering over armour. The temperature bulb shall be of stainless steel construction in any case.
 - (c) All local temperature gauges shall have 100 mm dial size. The bulb size shall be selected to suit the thermo-well.
 - (d) All gauges shall be of weatherproof construction.
 - (e) Temperature gauges shall have accuracy of + 1% URV (upper range value).
 - (f) Thermometer stem adjustable gland with union connection and bushing shall be suitable for 1/2" NPTF) connection.
3. Temperature Elements
 - (a) For remote temperature indication/recording/control/switch etc. the thermocouples or resistance temperature detector (RTD) shall be used depending on the process requirements. Elements shall be spring loaded, mineral insulated and shall have stainless steel sheath.
 - (b) Thermocouples shall be as per IEC-584-2/IS-7358 and shall have a wire of size 18 AWG for single and 20 AWG for duplex thermocouples. These shall be magnesium oxide (MgO) filled ungrounded type, unless necessary otherwise. The type of thermocouple shall be selected based on temperature. Following guidelines shall be followed:
 - Copper-Constantan (ISA-Type-T) : (-) 200 to 200oC
 - Chromel-Constantan (ISA-Type-E) : (-) 200 to 600oC
 - Iron-Constantan (ISA-Type-J) : 0 to 600oC
 - (c) The design of thermocouple assemblies shall be such that replacement on line is possible
 - (d) RTD (Resistance Temperature Detector) shall be platinum element 3 wire type with 100ohms resistance at 0°C calibrated as per IEC 751/DIN 43760. RTD shall be used within a temperature range of -200 to 650°C. Three wire system shall be adopted in connecting the element.
 - (e) RTD shall be used where accuracies of the order of 0.25% or better and smaller measuring spans are required.
4. Temperature Transmitter
 - (a) Temperature transmitters shall have a built-in line arising function to produce an output linear to temperature range.
 - (b) Temperature transmitters shall have an accuracy of + 0.25% of URV as a minimum.
 - (c) Burn out protection must be provided with temperature transmitters and trip amplifiers. Upscale or downscale protection shall be decided based on its application to ensure fail safe operation.
 - (d) Temperature Transmitter shall have built in Display for local monitoring field parameters.

(f) Pressure Instruments

1. Pressure Gauges

- (a) Liquid filled pressure gauge of diameter 4", (0-400 kg/cm²) with bleed and block arrangement shall be used. Thus each cascade shall have three pressure gauges. Pressure gauges shall be securely mounted. Liquid fill shall be lockable.
- (b) Pressure gauge dial shall be white, non rusting plastic with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.
- (c) Pressure gauges shall be weatherproof with dial size of 100 mm and shall have features like screwed bezels, externally adjustable zero, over range protection and blow-out discs. Pressure gauge sensing element shall be of SS-316 and movement of SS-304, as a minimum.
- (d) Pressure gauges shall have an accuracy of + 1% of URV as a minimum. Differential pressure gauges may have an accuracy of + 2% of URV.
- (e) Over range protector and pulsation dampener, whenever used, shall be of SS-304 as a minimum. Pulsation dampener shall be used for all pulsating services. It shall be floating pin type, externally mounted and externally adjustable.
- (f) All pressure gauges with maximum operating pressure exceeding 60 kg/cm²(g) shall be solid front type.
- (g) Connection shall normally be 1/2" NPT(M) bottom
- (h) Cases shall normally be cast aluminium alloy or black phenol and weatherproof to IP-55 as per IEC-529/IS-2147. Blow-out discs shall be provided.
- (i) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.

2. Pressure/Differential Pressure Transmitters

- (a) Pressure/Differential pressure transmitter shall have electronic state-of-art capacitance or any other type of sensor meeting all functional specifications. Element material for transmitters shall be SS-316, as a minimum, and shall be able to withstand over pressure of at least 30% of range or maximum working pressure whichever is higher.
- (b) All transmitters shall have an integral output meter. Remote mounted meters may be provided if required in addition.
- (c) All transmitters shall have an accuracy of + 0.25% of URV, as a minimum.

3. Pressure Switches

- (a) Pressure switches shall have either diaphragm or bellow type of process element with SS-316 material of construction as a minimum.
- (b) Pressure switches shall be blind type with 1/2 NPT (F) process connection and shall be operative in full specified range. The switch differential shall be selected as per operating conditions.
- (c) Pressure switches shall have repeatability of + 0.5% of URV, as a minimum.
- (d) Receiver pressure switches shall have SS-316 bellows as measuring element with 1/4" NPT(F) connection.

(g) Level Instruments

1. Level Gauges

- (a) All gauge glasses shall be steel armoured reflex type or tubular with body and cover material of forged carbon steel as a minimum and shall have tempered borosilicate glass with asbestos or other suitable gasket. All gauge glasses must have a rating equal to or more than the vessel design pressure and temperature.
- (b) All gauges shall have top and bottom chamber connections, unless otherwise specified. In addition each gauge shall be provided with ball check valves and pipe union.
- (c) Gauge glass cocks shall be forged off-set type with an integral ball check and back seating stem. Primary isolation valves are normally required in addition to the gauge glass cocks

2. Level Transmitter

- (a) External displacer type instruments with side-side connections and rotatable head shall normally be used for level measurement up to 1219 mm. Side-bottom connections are preferred where RTJ flanges are required. Internal displacer type of level transmitters shall be avoided unless application necessitates its use.
- (b) All displacer type of level transmitters shall be of torque tube type with torque tube material of inconel, as a minimum.
- (c) In general, displacer type instruments shall be used with displacer lengths of 356 mm, 813 mm and 1219 mm. For interface level measurement, displacer type instruments shall only be used.
- (d) Differential pressure transmitter shall be used for level measurement above 1219 mm, for services requiring purge or where liquid might boil in external portion. Transmitter should have built in LCD Display for local monitoring.

3. Level Switch

- (a) Level switches shall generally be external or internal ball float or displacer type with flanged head.
- (b) Switch shall be sealed micro type with contact rating suitable for the specific application
- (c) Level switch shall be furnished with SPDT contacts with adjustable differential, unless otherwise specified.

(h) Mass Flow Meter

- 1. LNG Facility shall be equipped with Mass Flow Meters for measuring Liquid and Natural Gas for reconciliation purpose:
 - i. Liquid (LNG) Mass Flow meter – For measurement of LNG. Mass flow meters shall be of 'Coriolis' type.
 - ii. Gas Mass Flow meter – For measurement of Gas at the outlet point of CNG Stream and PNG Stream separately. Mass flow meters shall be of 'Coriolis' type.
- 2. Shall have Provision of local display and output must be communicated with PLC display
- 3. Each Mass Flowmeter shall include a sensor with integral transmitter i.e. meter electronics certified intrinsically safe/explosion proof by statutory authority suitable for the required hazardous area as per IS-2148 /IEC-79. Also the offered sensor and the transmitter shall be weather proof to IP 65 as per IS-2147/IEC-529. Statutory authority for local installation is CCoE. The meter electronics / Transmitter shall be provided with isolated Analog output and Digital output (AO/DO) for each process parameter for the purpose of SCADA inputs. SCADA protocol shall be Modbus standard.
- 4. Allowable pressure drop for the flowmeter shall be minimum not exceeding 1.0 kg/ cm². Offered mass flowmeter shall be necessary for Custody Transfer application but not exceeding 0.5% of span.
- 5. Calibration for the offered mass flow meter from a recognized institute shall be in L/Hr, Kg/hr and SM3/hr. Pressure, Temperature compensation shall be provided by the meter.
- 6. Flying lead type electrical termination is not acceptable. All electrical connections shall be NPTF. Cable glands shall be provided for electrical power, signal and control connections. Cable glands shall be double compression type and certified weatherproof and explosion proof for the required area classification as per IS-2147 and IS-2148. Additional gland shall be provided for AO/DO.
- 7. Offered Mass flowmeter shall be completely free from corrosion of measuring tube due to alternating stresses continuously occurring in the tube. Also measuring tube shall be completely free from erosion, which may result due to fluid velocity.
- 8. The design of meter electronics shall be in compliance with the electromagnetic compatibility requirements as per IEC-801. Meter Electronics shall include all the associated preamplifiers converters lineariser signal isolators etc.
- 9. Installation details like straight run requirements, recommendation for horizontal /vertical

installation, minimum distance between upstream and downstream pipe bends from Mass flowmeter to be provided.

10. Bidder shall calibrate each Mass Flowmeter at his shop or any recognised test house with the fluid (Use design process conditions) for which it is to be used as per Clause no.9 of MPMS (Draft standard Nov. 2000). In case it is not possible to calibrate the Mass Flowmeter with actual fluid. Bidder must indicate:
 - (a) Fluid used for calibration
 - (b) Correction factor/Adjustment required for actual process fluid. In any case, inaccuracy when extended to actual process shall not exceed the specified limits (as per manufacturer's standard).
11. Bidder shall submit the following test certificates and test reports for owner's review: -
 - (a) Material test certificate with detailed chemical analysis from foundry (MIL Certificate).
 - (b) Certificate of radiography / x-ray for any welded joint.
 - (c) Hydrostatic test report with pressure of 1.5 times the design pressure.
 - (d) Calibration report including calibration factors for each Mass flow meter certificate from statutory body for offered sensor and transmitter for required area classification

(i) Pressure Relief Valves

1. For Liquid line: All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521 and Indian Boiler Regulations.
2. For LP and HP Gas Line: Safety relief valve shall be designed as per API 520 and Testing shall be performed as API 527. Testing medium shall be Air/ Gas.
3. Pressure relief valves shall be full nozzle full lift type except for thermal relief valves.
4. 3/4" x 1" threaded (NPT) modified nozzle type valves with typically 0.38 cm² orifice size shall be specified for thermal relief.
5. The body material shall as a minimum be as per piping specifications. Nozzle and disc material shall be SS-316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle design are unavoidable, body material shall be at least same as nozzle material.

12.3.7 Interlock and Shutdown System

1. Interlock and Shutdown System shall be an independent system with its own dedicated primary element except for flow. In which case common flow transmitter with separate receiver alarm card shall be used. However separate element with trip amplifier shall be used for temperature. in no case the initiating contacts shall be derived from indicators, controllers, recorders, scanners, alarm annunciator or any such instrument.
2. The system shall be designed fail safe & shall meet the following requirements, as a minimum:
 - (a) All initiating contacts shall be close under normal conditions and shall open under abnormal conditions.
 - (b) All relays and solenoid valves shall be energized under normal conditions and shall de-energize under abnormal conditions.
 - (c) Emergency shut-down switch contacts shall be wired in series with the final actuating device to ensure positive shutdown.
 - (d) If desired, because of operational or maintenance requirements, adequate trip by-pass facilities are to be provided with warning lights to indicate that the trip has been bypassed. Trip bypass alarms shall be provided in local as well as in remote location. All such by-pass switches shall be key-operated type.
3. The system shall be designed using electromagnetic relays unless specified otherwise and shall be located locally or remotely as per the operational requirements.
4. Each shutdown circuit and solenoid valve shall be provided with a switch-fuse unit separately.

12.3.8 Control Panel

1. The local control Panel installed in LNG Dike Area / Yard to operation various pumps / ESDs shall be flame proof with enclosure made from cast aluminium (LM6).
2. Enclosed cubicle panels shall have removable hinged doors, generally at the side or back for easy maintenance and accessibility of the instruments. Doors shall be double leafed type with handle and shall be provided with lock and key. Adequate illumination shall be provided inside the panel. All light fittings shall be suitable for 230 V, 50 Hz ac.
3. No fluid of any kind, except instrument gas shall enter the control panel. Also power supply greater than 230 V shall not be taken in to local panel.
4. All cable entries to the local panel shall be from panel bottom only using cable glands of adequate size. Cable gland plate thickness shall be a minimum of 3 mm cold rolled cold annealed (CRCA) as a minimum. All unused cable entries must be plugged.
5. The design of control panel shall incorporate provision for expansion by installing adequate spare capacity. Each panel shall be designed to accommodate the following additional items, as a minimum:
 - 20% of panel front/inside mounted instruments including lamps, push buttons, switches, relays etc.
 - 20% additional power feeders each provided with switch fuse assembly.
 - 20% additional spare windows in alarm annunciators.
 - 20% spare cable entry points.
6. The internal panel layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and on-line calibration. No instrument, terminals, power distribution box etc. shall be mounted on the panel side plates inside the panel.
7. All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel.
8. All control panels shall be supplied in pre-tubed/pre-wired conditioned and shall be completely tested at manufacturer's works prior to dispatch.

12.3.9 Programmable Logic Controller (PLC)

(a) General

1. The programmable logic controller (PLC) shall be micro-processor based system. The system shall in addition be of modular in construction and expandable in future by adding additional modules. Redundancy at I/O level is not required. Other redundancy shall be as per the tender specifications.
2. The PLC shall have provision of 100% redundancy to avoid downtime and loss of data in case of any problem. Bidder shall provide hot redundant PLC CPU for LNG storage, LNG dispensing and regasification system.
3. On-line replacement of any module shall be possible in such a way that the removal and additional of any module shall be easily possible.
4. Programmable logic controller shall be able to operate satisfactorily from 15°C to 30°C and 20% to 80% non-condensing humidity. The system shall be installed in environmentally controlled control room unless specifically indicated otherwise.
5. The system shall have extensive set of self-diagnostics hardware and software for easy and fast maintenance. Diagnostics shall be required at local as well as at console level.
6. Separate power supply unit shall be provided for individual I/O rack and processor unless otherwise specified. Suitable battery back-up shall be provided for volatile memory protection.
7. Operation of PLC shall be completely unaffected by a momentary power loss of the order of 20 milliseconds.
8. The system shall be programmed in general as per the logic diagram or ladder diagram.

9. The system shall have provision for an additional tag for mass flow meter for mobile cascade filling and similarly an extra window to be provided in HMI/ MMI.

(b) System Configuration

1. Bidder shall offer system configuration as per the respective job specifications. However, each sub-system offered shall meet the minimum requirements specified in the following paragraph.
2. Input/output Sub-system :
3. Each I/O shall be electrically isolated from external control circuit by suitable means. The minimum isolation level between I/O and logic circuit shall be 1000 V dc.
4. Each I/O shall be protected against the reversal of polarity of the power supply voltage to I/O.
5. Each module shall have a LED for each I/O per channel to indicate the status of each Input/ Output.
6. Each output shall be short circuit proof and protected by using fuse. Visual indication of fuse blown must be provided for each output.
7. PLC input card shall have the provision to incorporate minimum three (3) analogue inputs from Suction train package.

(c) Processor Sub-System

1. The processor shall have capability to implement all the control functions required to program instructions required by the logic schemes.
2. Memory shall be non-volatile. In case volatile memory is provided, battery back-up shall be provided for a minimum of three months to keep the storage intact. A battery drain indication shall be provided at least one week before the battery gets drained.
3. It shall be possible to generate the first out alarm output by the PLC.
4. PLC Console
5. The PLC console shall be used for programming, program storage, fault diagnostics and alarm monitoring. It shall be possible to use this for plant operation, whenever specified.
6. The keyboard shall be easy to operate with each key clearly identified. It shall be provided with a lock and key to prevent any unintentional program modification.
7. It shall be possible to modify, add or delete the application program on-line without affecting the output.
8. PC based console when offered must be of current release and state-of-the art.
9. System Power Supplies
10. Programmable Logic controller shall operate on uninterrupted power supply with following specifications:

Voltage	-	230V + 10%
Frequency	-	50 Hz + 3 Hz
Switchover time	-	5 milliseconds
11. Each I/O rack shall be provided with a separate power supply.

(d) Self-Diagnostics

1. The system shall have extensive set of self-diagnostic sub-routines, which shall be able to identify the system failure at least up to module level. At local level, failure of a module shall be identified by an individual LED.
2. Whenever auto-testing of I/O modules is specified, the testing software must be capable of detecting faults in case of normally open as well as normally close system.

12.3.10 Specification for Installation Material

The installation material for instrumentation and control work includes items such as, but not limited to, cables, cable glands, junction boxes, instrument valves, and manifolds, mounting accessories, impulse piping/tubing, pipe/tube fittings, pneumatic signal tubes, instrument gas line pipes and fittings, filter regulators, insulation materials, cable duct and trays, conduits, identification tags,

structural material required for instrument supports and trays etc. Some of the salient features and minimum requirements for some of the main installation materials have described in the following clauses. However items for which specification have not been provided, Bidder may follow his own specification and applicable international standards.

(a) Cables

1. All cables shall have PVC/FRLS insulated/Armored/Screened primary insulation of 85°C PVC as per IS-5831 Type C and inner and outer jacket shall be 90°C PVC to IS-5831 Type ST-2. Oxygen index of PVC shall be over 30% and temperature index shall be over 250°C.
2. The insulation grade shall be 600V/1100 V as a minimum and shall meet insulation resistance, voltage and spark test requirement as per BS-5308 Part-II.
3. All cables shall be twisted and armored. Armor over inner-jacket shall be of galvanized steel wire/flat as per IS-1554 Part I.
4. Maximum DC resistance of the conductor of the completed cable shall not exceed the following
 - 12.3 ohms/km at 20°C for cables with 1.5 mm² conductor.
 - 39.7 ohms/km at 20°C for cables with 0.5 mm² conductor.
5. The mutual capacitance of the pair or adjacent cores shall not exceed 250 pF/m at a frequency of 1 kHz.
6. L/R ratio of adjacent cores shall not exceed 40 microhenry/ohms for cables with 1.5 mm² conductor and 25 µH/ohms for cables with 0.5 mm² conductor.
7. The drain wire resistance including shield shall not exceed 30 ohms/km.

i. Signal Cables

1. Single pair shielded signal/alarm cables shall be used between field instruments/switches and junction boxes/local control panels.
2. Multipair individually and overall shielded signal/alarm cables shall be used between junction boxes/local control panels and control room, in general.
3. The single pair/triad cables shall be 1.5 mm² conductor size, made of electrolytic copper conductor of 7 strand each of 0.53 mm diameter, multipair cables with 0.5 mm² conductor size shall have 16 strand of annealed grade copper conductor with each strand of 0.2 mm diameter, multi triad cable or multipair cable with 1.5 mm² conductor shall have 7 strand each strand of 0.53 mm diameter.
4. Shield shall be aluminium backed mylar/polyester tape bonded together with the metallic side down helically applied with either side having 25 % overlap and 100 % coverage. The minimum shield thickness shall be 0.05 mm in case of single pair/triad and 0.075 mm in case of multi-pair/triad cable.
5. Drain wire shall be provided for individual pair and overall shield, which shall be 0.5 mm² multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.
6. All multi-pair cables shall have 6 pair/12 pairs only. White multi-triad cable shall have 6 triads/8 triads only.
7. Power, signal and control Cables, FLP glands including FLP gland for incoming cables to incoming electric panel, electric accessories for the package.

ii. Control Cables

1. Single pair control cables shall be used between field mounted solenoid valves and junction boxes/local control panels and shall meet the requirements specified in paragraph above.
2. Multi-pair control cables shall be used between junction boxes/local control panel and control room mounted device in general. These cables shall have only overall shielding.
3. These control cables shall have 1.5 mm² conductor size with 7 stranded conductors of annealed electrolyte grade copper, with each strand of 0.53 mm diameter.

iii. Thermocouple Extension Cables

1. Single pair shielded thermocouple extension cables shall be used between thermocouple head and junction boxes transmitter/local control panel mounted instruments.
2. Multi-pair individually and overall shielded thermocouple extension cables shall be used between junction boxes and control room mounted devices.
3. The cable shall have 16 AWG and 20 AWG solid conductors for single and multi-pairs respectively.
4. All thermocouple extension cable shall be matched and calibrated in accordance with IEC-584-2
5. Shield shall be aluminium backed by mylar/polyester tape bonded together helically applied with the metallic side down with either side having 25 % overlap and 100 % coverage. The minimum shield thickness shall be 0.05 mm in case of single pair/triad and 0.075 mm in case of multipair/triad cable. Drain wire shall be 0.5 mm² multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.
6. Inductance shall not exceed 4mH/km. However for J-type thermocouple inductance could be 8 mH/km.
7. All multi-pair cables shall have 6 pairs/12 pairs only.

iv. Power Supply and Other Cables

1. All power supply cables shall be as per IS-1554 part I and shall have copper/aluminium conductor depending on conductor size. Minimum conductor size shall be 2.5 mm² of copper conductor. For higher size, aluminium conductor can be considered. All these cables shall be PVC/FRLS, XLPE/PVC insulated and armored.
2. Any other special cable required for instruments shall also be supplied as per requirement.

v. All Ethernet/communications cables shall be PVC/FRLS, XLPE/PVC insulated and armored.

(b) Cable Glands

1. Bidder shall supply all cable glands required for glanding the cables both at field instrument and local control panel side, junction boxes side and at control room side.
2. All cable glands shall be nickel-plated brass and they shall be double compression type suitable for armored cables.
3. Flame proof glands shall be supplied with Ex(d) certification.

(c) Junction Boxes

1. Bidder shall supply junction boxes as per the cable selected, wherever required. These shall be of Die cast aluminium alloy (LM-6) body and shall be weather proof, as a minimum.
2. These boxes shall have terminals suitable for minimum or 4 mm² or less cable termination mounted on rails. 10 % spare terminals shall be supplied in each junction box.
3. Flame proof junction boxes shall be supplied with Ex(d) certification. All such boxes are weather proof also.

(d) Instrument Valve and Manifolds

1. Bidder shall supply instrument valves (miniature type) and valve manifolds wherever required.
2. Body rating shall be as per piping class or better. However trim material shall be SS 304, as a minimum. All valves and manifolds shall be forged type only.
3. Valve body and trim material shall be SS 316, unless otherwise specified. Superior trim material shall be selected as required by process conditions. Packing material in general shall be PTFE.

(e) Pipe and Tube Fitting

1. The fitting/ferrule hardness shall be in the range of RB 85-90 so as to ensure a minimum hardness difference of 5 to 10 between tube and fittings. The ferrule shall be of stainless steel material, in general.
2. Socket-weld type forged pipe fitting of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 3000 lbs. Weld-neck flanges shall be used where socket weld type are not allowed by piping class.

3. Instrument gas fittings shall be suitable for use on SS tube confirming to ASTM 269 Hardness not exceeding RB 80.
4. All threaded fittings shall have NPT threads as per ANSI/ASME B 16.11 only.

(f) Instrument Signal Tubes

1. Bidder The instrument gas tubing material shall be Stainless Steel series –316 conforming to ASTM-A269.
2. Bidder shall avoid use of intermediate connections and shall estimate single length for each instrument location.

(g) Cable Trays

1. All cables in the cable trench shall be laid in cable trays.
2. These cable trays shall be made out of Galvanised mild steel sheets of 2.5 mm thickness. Ladder trays shall be of Mild structural steel and shall be painted with red-oxide primer. 50 mm x 50 mm angle shall be used as a minimum.
3. The width shall be so selected that 50% of tray space is available for future use.
4. Suitable cable clamps shall be supplied for binding the cables/tubes at every 500 mm.

(h) Instrument Support / Structural Steel

Bidder shall supply instrument stands, stanchions and other structural steel material required for supporting the cable trays, impulse lines and instruments.

12.3.11 Installation Work

1. Bidder shall be fully responsible for installation of all instruments within their battery limit, in line with the installation standards (typical) furnished along with this specification.
2. Whenever installation is beyond the scope of vendor / Bidder, the owner will install the instruments as per the detail/documents/drawings furnished by the Bidder/Bidder. However, in such case it must be ensured that complete installation material shall be supplied by the Bidder.
3. All direct mounted instruments like thermocouples, thermo wells, temperature gauges, pressure gauges, pressure switches etc. shall be installed in such a way that they have good readability and accessibility.
4. All pressure / differential pressure instruments shall be provided with block and bleed/bypass, drain/vent valves etc. as per the installation standards, and shall have accessibility.
5. All primary piping/tubing (impulse lines) shall have a slope of 1 In 12 on the horizontal run.
6. All welding shall be carried out as per the relevant codes with proper electrodes. Any testing (non-destructive) like D.P. Test and radiography on root weld and final weld shall be carried out as applicable. All consumables shall be part of Bidder's scope of supply. Any pre/post weld heat treatment as required by the relevant codes shall be carried out.
7. All threaded joints shall be joined with PTFE tapes only.
8. All impulse lines shall be supported at regular intervals.
9. Instrument drain/vent connection shall be piped to safe area or connected to vent header to avoid accumulation of gas in the station.
10. All tubes/cables shall be properly laid on cable trays, which shall be supported at regular intervals.
11. Separate routing or physical separation shall be maintained between signal cable, shut down & power cables.
12. The cases of instrumentations shall be earthed by earthing wire to the nearest earth bus bar for safety runs.
13. Where cables are to be buried or laid in concrete trench, requirement of trenches shall be provided with prior intimation to client.

12.3.12 Installation of PLC System

1. The system shall be installed by the system Bidder who would be responsible for installation and

termination of interconnecting cables in the system racks/cabinets. All interconnecting cables shall be identified and the individual cores/wires shall be properly identified using ferrules. Direct-cross ferruling method shall be used for identification.

2. All system communication cables shall be laid in covered GI (Galvanized Iron) trays away from power cables. Prefabricated cables shall be avoided for interconnection if these are to be routed outside the cabinets. If unavoidable these should be laid in covered GI trays.
3. All panels/cabinets shall be properly levelled and secured firmly with the base supporting structure. However, the console and printer stands need not be secured to base structure.

12.3.13 Grounding

1. Each cabinet, console and other equipment supplied as a part of a system shall have earthing lugs, which shall be secured to the 'AC mains earthing bus'.
2. All circuit grounds and drain wires shall be connected to the 'system ground' bus, which is isolated from 'AC mains earth'. This bus shall typically be 25 mm wide and 6 mm thick of copper.
3. The total resistance of system ground shall be less than 5 ohms unless otherwise recommended by system manufacturer.

12.3.14 Testing and Calibration

1. All impulse lines shall be tested hydrostatically at 1.5 times the maximum operating pressure. Ensure that instrument and vessel/piping is isolated during this test.
2. In case of special instruments/items, where hydro-testing is not permitted due to service condition, the impulse lines testing shall be carried out by using gas or nitrogen.
3. All external cage type level instruments shall be drained and dried with dry air to remove any traces of moisture, oil and dust.
4. After pressure testing, all these impulse shall be drained and dried with dry air to remove any traces of moisture, oil & dust.
5. Instrument gas lines shall be duly tested with soap solution for any leak after pressurizing and isolating the main root valve. After isolation, the rate of fall in pressure shall be less than 1kPa for every 4.4 meter (1 psi for each 100 ft) of tubing for a test period of 2 minutes.
6. Signal tubes shall be flushed and tested with instrument gas for any leak at a pressure of 1.5 kg/cm²(g). After pressurising the line, the source of pressure is cut off and rate of fall in pressure shall be less than 1kPa for every 4.4 meter (1 psi for each 100 ft) of tubing for a test period of 2 minutes.
7. All instrument cables shall be tested for continuity and insulation. While meggering the cables for insulation testing, ensure that all instruments and barriers are isolated at both ends.
8. All instruments supplied by the Bidder shall be calibrated using proper test equipment.
9. All instruments shall be calibrated for 0%, 25%, 50%, 75%, 100% and vice versa.
10. All temperature gauges shall be calibrated using temperature bath.
11. All thermocouple activated instruments shall be calibrated by generating millivolts by a potentiometer.
12. All transmitters shall be calibrated as per instrument ranges.
13. All displacer type level transmitters shall be calibrated with water or suitable fluids and corrected for specific gravity.
14. All alarm and trip switches shall be calibrated over the entire range and finally set and checked for alarm/trip points and reset points as per the alarm/trip set point schedule. After setting, these shall be sealed.
15. Bidder shall check/Calibrate flame detector with UV torch or appropriate instruments. Bidder shall calibrate the GA's detector with calibration GAS bottle or cylinder
16. All control valves, prior to stroke checking, shall be externally cleaned thoroughly. The full stroke of valve shall be checked for opening and closing. Any adjustment required for obtaining full stroke and

reducing hysteresis shall be carried out. The hysteresis shall not be more than 1% URV (upper range value) with positioners and 5 % URV without positioners.

17. Bubble tight shut off control valves & shut down valves shall be checked for leak test and gland leak test.
18. Solenoid valve shall be checked functionally for its operation.
19. Safety valves and relief valves shall be set/tested by using dry air/nitrogen. Leakage, if any shall be removed by proper lapping of seat & disc.
20. All electronic/pneumatic receiver instruments shall be calibrated as per the manufacturer's instructions. Controllers shall be aligned properly.
21. All special instruments like analyser shall be checked and calibrated as per manufacturer's instructions. Prior to testing, all analyser sample lines shall be thoroughly cleaned by carbon tetra chloride or any other cleaning liquid. After cleaning, these lines shall be thoroughly purged with dry nitrogen.
22. The accuracy of overall loop shall be within $\pm 1\%$ for electronic and $\pm 1.5\%$ for pneumatic loops.
23. After performing the calibration of all instruments, the entire loop shall be checked for proper operation.
24. The entire shut down scheme shall be simulated from the process trip switches and the scheme shall be tested for its proper operation prior to start up of the unit.
25. If no instrument gas is available, Bidder shall provide necessary dry N₂ cylinders to carry out the above activity.

12.3.15 Testing of System (PLC)

All the system function shall be checked thoroughly for proper functioning. These shall include but not limited to the following tests:

- (a) Visual & Mechanical.
- (b) Complete system configuration loading.
- (c) Demonstration of all system functions.
- (d) Checking of all system display.
- (e) Checking of correct functioning of all keyboards.
- (f) Demonstration of all system diagnostics.
- (g) Checking of proper functioning of all printers, hardcopy unit and printing of all reports.
- (h) Checking of all disc drives.
- (i) Complete checking of logic system, loading of user's program and checkout of results.
- (j) Checking of correct change-over of the back-up/redundant unit in case of failure of main units.
- (k) The input signals shall be simulated by disconnecting the field wires for all inputs. Wherever control room mounted Transmitter/Converters/Receivers switches are used, the functioning of same shall also be checked.
- (l) Checking for fail safe 100% redundancy

12.3.16 Loop Checking

1. Loop checking shall be carried out by Bidder, which shall include proper functioning and interconnection of all items in the loop.
2. All inputs signals shall be generated in the field and corresponding reading shall be checked at all corresponding displays.
3. All the outputs shall be checked in the field, by physical verification of valve stroke or operation of solenoid valve/pick-up of electric contactor.
4. After loop checking completed, Bidder shall connect back any terminals and connections removed during loop checking

12.3.17 Commissioning

1. Bidder shall submit commissioning procedure, which include list of commissioning spares, pre-commissioning checklist.
2. This activity shall be carried out in a systematic manner so as to avoid any accident to operating personnel.
3. During the start up all the instruments calibration, controller alignment, trip point setting shall be trimmed so as to meet the operation requirements.
4. Prior to guarantee run of LNG Facility, the vital instrument as required by Bidder have to be recalibrated and the results recorded.

12.3.18 Construction Philosophy

(a) LCP Arrangement

1. Higher of 10% or minimum one of each type (Range/Type/Material of construction) of complete instruments, unless otherwise indicated elsewhere in this specification. This shall include all instruments except control valves, safety valves, Displacer type of level transmitters, Displacer/Float type level switches, level gauges, analyzers, programmable logic controllers, personal computers, etc.
2. Installed spare modules of higher of 10% or minimum one of each type of Input/output modules (including termination panels, if applicable) to enhance the system functional requirement of Programmable Logic Controller.
3. A minimum of 20% spare windows with alarm modules shall be provided in alarm annunciator.
4. A minimum of 20% spare status lamps/switches/push buttons/terminals or one of each type, whichever is higher, shall be provided.

(b) Commissioning Spares

All spares required during commissioning of the package/system in the Bidders scope of instruments.

(c) Normal Operational Spares

Bidder shall supply a list of spare parts for each instruments and system required for 2 years of continuous operation.

12.4 Inspection and Testing

(a) General

1. Inspection and Test Requirements shall be as specified in respective equipment / item / work specification, unless specified hereunder.
2. Bidder shall confirm compliance to all inspection and testing requirements stipulated therein and include the inspection charges in the lump sum cost.
3. All tests which are required to be witnessed as per data sheet, this specification and mutually agreed and finally approved Quality Assurance Plan shall be witnessed by the Owner or authorised representatives of the Owner or the Third Party Inspection Agency as appointed by the Owner. The Bidder shall notify the timing of such inspection and testing to the Owner at least 30 days in advance.
4. The Bidder shall submit detailed Test Procedure for Approval of the Owner in advance of the actual date of conducting each test.
5. A test procedure shall be established to demonstrate that items will perform satisfactorily in service. The object of the test procedure is to ensure that all the required testing is identified, performed and documented.
6. The test procedure shall include a schedule listing the proposed tests.
7. Each item of the contract shall be tested and certified in the works where it is manufactured.
8. The Bidder shall arrange for the inspection and tests at their works /at their sub-vendors' works and

at the project site, in the presence of representatives of the owner / third party inspection agency as per the approved QAP. All necessary arrangements for inspection and testing including supply of all material at the shop and at the site shall be made by the Bidder.

9. After completion of inspection and testing, Bidder shall provide requisite certificate in accordance with referenced specifications and Owner's document requirements. Certificates of approval for equipment for use in hazardous areas and test certificates confirming ratings of equipment (where appropriate) shall be required.

(b) Packing and Forwarding

1. After the equipment's are tested, all exposed machine surfaces shall be suitably protected and painted with approved type of easily removable protective coating. Pipes shall be cleaned and suitably painted to prevent corrosion.
2. All nozzle openings shall be covered by metal closures to prevent entry of dust and dirt.
3. All delicate components/instruments shall be packed separately with proper tag marking in wooden case
4. The Tag. No. of the item shall be prominently painted on the packing case.

(c) Minimum Requirements for Quality Assurance Plan

The Bidder shall develop Quality Assurance Plan (QAP) and get it approved from the Owner. Hard copy of test reports/ data dossier – 3 sets proper (Including CDs) with O&M Manual for LNG Facilities shall be provided at the time of delivery of equipment at GEL site

The QAP shall as per the applicable codes / standards and manufacturer's standard. However, the minimum points shall be as follows.

R : REVIEW

W : WITNESS

Sr. No.	Particulars	Bidder's Scope	Scope of third party appointed by the Bidder	The scope of owner/ owner's representative
1	Chemical Analysis of Material of Construction	R	R	R
2	Intermediate stage inspections	W	R	R
3	Non-destructive testing of pressure parts & welding	W	R	R
4	Hydrostatic Test of pressure parts	W	W	R
5	Visual Inspection of all major parts	W	W	R
6	Final Inspection / Dimensional Check	W	W	W
7	Performance Test at Bidder's / Vendor's (as applicable) works	W	W	W
8	Performance Test at site	W	W	W
9	Witness Tubing	W	W	R

All instruments / control provided by the Bidder shall be inspected by the Owner / Consultant.

12.5 Other Requirements

1. Any item which is not included in the BOM/SCOPE but required for commissioning /operation/safety of the system shall be provided without any cost and time implication.
2. The Bidder shall have to furnish the conceptual Equipment layout to be given along with his offer to enable the Owner to finalize plot size for the refueling stations.
3. The foundation of the equipment shall be designed the Owner, based on the loading data and foundation

plan furnished by the Bidder

4. Foundation bolts and vibration pads if any, shall be supplied by the Bidder well in time before casting of the foundation. Price of the same shall be included in the quoted price. If not supplied in time, cost of the same as paid by owner to others shall be deducted from the amount due.
5. The foundation of the equipment shall be constructed by other agencies. However, this shall be checked by the Bidder for its correctness. At the time of erection, rectification required, if any, shall be pointed out sufficiently in advance to the owner. However, rectification of minor nature shall be carried out by the Bidder at his own cost, prior to the erection of the equipment.
6. Bidder shall provide loading data and foundation plan required for design of foundation. However, following activities are in GEL scope:
 - (a) Design of foundation
 - (b) Checking of foundation for correctness
 - (c) Major Rectification of foundation
7. Any equipment or component which fails to perform or gets damaged during transportation, installation, commissioning and performance guarantee test run, shall be replaced by the Bidder free of cost to the owner.
8. The Bidder shall give the list of tools, tackles and components required for erection and commissioning of LNG Facilities. The same shall be used during O&M contracting period. Afterward the same shall be handed over to the Owner at no extra cost.

12.5.1 Spares and Consumables

The rates and prices quoted by the bidder shall be inclusive of charges for spare parts and consumables required during the erection and commissioning, defect liability period and entire O&M period as per SOR.

(a) Testing

1. The Bidder shall follow good engineering practice and/or the testing manuals supplied by the equipment manufacturer for the testing of equipment.
2. All pumps shall be tested by running on LN2 medium.
3. No load running tests shall be carried out, where required.
4. The mechanical testing of all equipment shall be carried out to the satisfaction of Engineer-in-Charge and their signature shall be obtained on the test certificates.

(b) Miscellaneous Steel

All Studs and nuts, anchor bolts, nuts, lock washers, supports and other miscellaneous items shall be supplied by the Bidder. Before installing the equipment, the Bidder shall verify location of Studs and nuts.

(c) Grouting

Grouting of Anchor bolts and nuts, holes, pockets and under base plates or under equipment have been broadly classified into two categories e.g. non-shrinking grout and ordinary grout. Non-shrinking grout shall consist of 1 part of ordinary Portland cement, 1 part of clean dry well grades sand and 1 part of Ferro-grout of similar additive (approved by the Engineer-in-Charge). Water should be kept minimum so that the mix can be applied adequately. The grouting material shall solidly fill the spaces to be grouted and permanently retain its original volume so that the base plate will be held firmly in the set position. The amount of water used in mixing shall be kept to a minimum such that the grout shall have a consistency to stiff to flow. The top of foundation shall be clean and free of all laitance loose particles, oil, grease, etc. and shall be wetted thoroughly leaving no puddles prior to grouting. All trapped pockets in the steel structures shall be prepared using ordinary grout. Under no condition neat cement shall be used for grouting. Required quantity of grouting material shall be

in scope of bidders.

- i. Non-shrinking grout shall be used for grouting purposes in;
 1. All vessels etc. having equipment height more than 6.0 meter from anchor base
 2. All horizontal vessels having diameter 1000 mm and above
 3. All Tanks, Vaporizers, Pumps Skids and engine foundations
- ii. Ordinary grout shall be used for grouting purposes in:
 1. All vertical vessels etc. having height less than 6.0 m from anchor base
 2. All horizontal vessels having diameter less than 1000 mm
 3. All structural frames or platforms having height less than 6.0 m
 4. All pumps, horizontal or vertical
 5. All other miscellaneous foundations or piles or on paving

(d) Placement:

1. All anchor bolts holes shall be completely filled with grouting material
2. The finished surface shall be floated smooth and shall slope away from base plate approximately 1:25
3. After the initial set is over, the grout shall be kept thoroughly wet for a minimum of 5 days
4. Care is to be taken during grouting so that the base plate level and alignment is not disturbed.
5. Over and above the grouting clearance shown in foundation drawings, grouting of pockets made by base frame for machinery, equipment, steel structures etc. shall also be completely filled with grouting as per direction of Engineer-in-charge.

12.5.2 Pre-commissioning and Commissioning

1. The Bidder shall inspect equipment within its battery limit after erection as per pre commissioning check list and submit the completion certificate, and arrange for pre-commissioning checks, functional tests of instrumentation and control before trial runs of 72 hours and commissioning.
2. On completion of erection and commissioning. The Bidder shall arrange for the performance and guarantee tests run of the LNG Facility.
3. The Bidder shall make provision of system precooling with sufficient quantity of Liquid Nitrogen during the pre-commissioning and commissioning period. For this the Bidder shall arrange liquid nitrogen through cryo tankers with required assembly to connect LNG Facility at site.

12.5.3 Handing Over and Training

(a) Handing Over the LNG Facility

The Bidder shall run LNG Facility for 72 hours continuous trouble-free operation of each system equipment in all aspects in presence of the Owner or the authorised representatives of the Owner before it is handed over to the owner.

(b) Training of Owner's Personnel

The Bidder has to impart the training to the staff attached with LNG Facility at the time of induction, which covers minimum of following aspects as per PESO, PNGRB, SMPV, GCR, OISD-179:

1. Hazardous characteristics of LNG.
2. Familiarization with operational procedures and practices.
3. Hands on experience on Operation of Equipment.
4. Routine maintenance activities of the facilities.
5. Knowledge of emergency and manual shut down systems.
6. Immediate and effective isolation of any LNG leak.
7. Accounting of product.
8. Safety regulations and accident prevention.
9. Evacuation and safe escape of vehicles.

10. The Bidder has to suggest type and time period of training programme in technical bid considering the above contents. The cost of the same shall be furnished in commercial bid.

12.6 Non-material Requirements (Drawings and Documents)

1. Unless specified 4 copies each of below documents shall be submitted at the stages defined.
2. The bidder would need to specify the timeline when the documents requiring approval would be submitted in the PERT chart.
3. The Bidder to note that any routing of services and auxiliaries falling in The Bidder's scope of supply, outside the skid boundary and interfacing with the client facilities, such as cable routing, piping, etc would need to be first proposed in a general arrangement drawing for client's approval.
4. Documents mentioned below are the minimum requirement. However, bidder shall submit all the documents which are required for LCN station installation, commissioning and O&M.

Item	Description	Document Required Stage		
		For Approval	For Information	Final/As-Built
	General			
1	Catalogue details for individual bid items such Cryo Pumps, Motor, LNG Dispensers, Vaporisers, LNG Tank, Controller, Ancillaries and Auxiliaries	Yes		Yes
2	Utility and their consumption requirement at battery limit		Yes	Yes
3	Itemised electrical load data	Yes		Yes
4	Itemised bill of material for all equipment being supplied along with sub-assemblies.	Yes	Yes	Yes
5	A project schedule in form of a PERT chart outlining from the date of PO, the timeline for engineering, approvals, procurement, deliveries, inspection, erection and commissioning including milestone such as FAT and SAT	Yes		
	Design Documents			
6	Process flow diagram	Yes		Yes
7	Process and Instrument diagram for each bid items as applicable along with composite P&ID from tie-in point of main gas line up to the dispensing point with inter-locks	Yes		Yes
8	Sizing calculation of all pressure and non-pressure parts	Yes		Yes
9	Estimated heat load for equipment located in control room	Yes	Yes	
10	Design Documents for Fire Hydrant System, Pressure drop calculation, selection of system equipment, fire water calculation, Fire water P&ID, layout, datasheet of components and accessories	Yes		Yes
11	Electrical single line diagram	Yes		Yes
12	Electrical wiring diagram		Yes	Yes
13	Datasheet of Cryo Pumps, Motor, LNG Dispensers, Vaporisers, LNG Tank, Controller, Ancillaries and Auxiliaries	Yes		Yes
14	Datasheet of Instruments and system components (i.e PG, PT, TE, TT, LT, DPG, DPT, MFM, SRVs, ESDs, Valves, Flashers, Hooters, etc)	Yes		Yes
15	Starting time calculation at 100% and 80% of rated voltage		Yes	Yes
16	Itemised equipment list, listing all the sub-assemblies, capacities, rating and MOC	Yes	Yes	Yes
17	V-belt , pulley with selection chart and calculation	Yes		Yes
18	Torque speed characteristic		Yes	Yes
19	Acoustic / mechanical evaluation report		Yes	Yes
20	Structural loading details with dynamic and static load cases.		Yes	Yes
21	Control system architecture	Yes		Yes
22	Control philosophy and Alarm and shut down list with set point	Yes		Yes
23	Loop diagram		Yes	Yes

24	Piping and Tubing Material Specification	Yes		Yes
25	Cause and effect diagram	Yes		Yes
	General Arrangement Drawings			
26	LNG Storage Tank	Yes		Yes
27	Low Pressure Ambient Vaporizers	Yes		Yes
28	High Pressure Ambient Vaporizers	Yes		Yes
29	Unloading Skid	Yes		Yes
30	Fly Saturation skid	Yes		Yes
31	Cryo Pumps Skids	Yes		Yes
32	Vaporizers Change over skid	Yes		Yes
33	LNG Dispenser	Yes		Yes
34	Priority Panel	Yes		Yes
35	Electrical panels	Yes		Yes
36	Motor driven fire water pump	Yes		Yes
37	Diesel engine driven Fire Water pump	Yes		Yes
38	Jockey Pump	Yes		Yes
39	General Arrangement of LNG Facility within dike area as well as associated accessories	Yes		Yes
40	General Arrangement of electrical control room with associated accessories	Yes		Yes
41	General Arrangement of fire pump room with associated accessories	Yes		Yes
42	Foundation plan for all the items requiring civil foundation		Yes	Yes
43	Tubing and Piping GA and Isometric drawings	Yes		Yes
	List of Spares			
44	Itemized price list of mandatory spares	-	Yes	-
45	Itemized list of spares for erection / commissioning	-	Yes	-
46	Item list of spares for 2 years running	-	Yes	-
	Testing and Certificates			
47	Overall as well individual assembly quality assurance plan	Yes		Yes
48	Drawing for testing arrangement and test procedure to be adopted		Yes	Yes
	Certificate for following			
49	a) Hydraulic testing			Yes
50	b) Non destructive testing			Yes
51	c) Material composition and physical properties			Yes
52	d) Leak proofness list of frame			Yes
53	Design / Actual assembly clearance chart		Yes	Yes
	Test records of following:			
54	a) Performance test			Yes
55	b) Noise level test			Yes
56	Dispenser communication protocol		Yes	Yes
57	Statutory documents		Yes	Yes
58	Installation and O & M manual		Yes	Yes