SCOPE OF ANNUAL RATE CONTRACT

1.1 **PROJECT DESCRIPTION**

M/s GAIL (India) Limited proposes to supply natural gas to various small consumers in Western Region which involve last mile connectivityôs for consumers in state of Maharashtra, Gujarat & Goa for which the work is being tendered.
In general for almost all consumers, works involve but not limited to minimum underground laying of 3-Layer PE externally coated Carbon steel pipelines for various consumers / other pipelines. Optical fiber cable is laid along the pipeline by the pipeline laying contractor and real time data for SCADA purpose has to be provided by installing necessary convertors / RTU as per the requirement.
Proposed tender is to provide telecommunication and SCADA facilities to last mile consumers and integrating with existing SCADA system provided by M/s YOKOGAWA. Intended work requires online polling of consumer data through OFC / other media based on feasibility.

1.0 **WORK TENDERED**

1.1. The work tendered in this bid package consists of supply (in Contractor's scope), installation, testing and commissioning of the telecom & SCADA system for small consumers main trunk pipeline.

2.0 **SCOPE OF WORK**

The scope of work shall generally be, but not limited to the following:-

2.1. **Procurement**

2.1.1. CONTRACTOR shall procure and supply all the materials other than OWNER supplied materials, required for permanent installation of main pipeline and terminals in sequence and at appropriate time. All equipment, materials, components etc. shall be suitable for the intended service. Approved vendor list has been indicated in the bid package for various items. For items which are not covered in the vendor list, CONTRACTOR shall obtain OWNER's prior approval for the vendor. Equipment requiring specialized maintenance or operation shall be avoided as far as possible. Equipment offered shall be field proven.

2.1.2. CONTRACTOR shall procure all materials, components, equipment, consumable etc. required for successful completion of the pipeline system. CONTRACTOR shall also procure and supply spares required for pre-commissioning and commissioning/ start up as recommended for all items supplied by him as per specifications provided in the bid package. Where no specification is available in the contract, the same shall be prepared by the CONTRACTOR based on the piping material specification and shall be subject to OWNER's approval.

2.1.3. Material take-off with complete description of size, rating, material, thickness and specifications.

2.1.4. Only single offer shall be provided by the bidder fully complying to specifications/ drawings/ requirements for OWNER's review and approval. CONTRACTOR shall provide for inspection of the items at vendor's works by the OWNER/ OWNER's REPRESENTATIVE or by a reputed inspection agency and shall submit inspection reports for OWNER's clearance.

2.1.5. Carryout proper documentation of inspection and quality assurance programs for all equipment and bulk materials duly approved by OWNER. CONTRACTOR shall maintain an accurate and traceable listing of procurement records for the location, quality and character of all permanent materials in the Project.

2.1.6. CONTRACTOR shall immediately report to the OWNER of all changes which will affect material quality, and recommend any necessary corrective actions to be taken.

2.1.7. Submit periodic manufacturing progress reports highlighting hold ups and slippages, if any, to OWNER and take remedial measures.

2.1.8. Interact with authorities such as Sales Tax, Octroi, Excise, Customs etc. as necessary and arrange for transportation of the materials under his scope of supply to site.

2.1.9. All purchase requisitions including purchase orders shall be approved by OWNER/ OWNER's REPRESENTATIVE.

2.1.10. Compliance with vendor's and supplier's instructions and recommendations for transportation, handling, installation & commissioning.

3.1 Works

Vendor has to carry the feasibility, design, engineering commissioning of Telecom and SCADA works for extension of data and voice communication. Vendor has to submit the detail engineering including design and engineering of the network, link engineering for extension of voice and data communication at consumer location. Vendor has to test the OFC before taking over of cable. After taking over test report is to be submitted. Vendor has to arrange trial of the system for **7**days for acceptance of the Telecom and SCADA system.

SPECIFICATION

1. SDH EQUIPMENT

Common STM-1 equipment

Equipment specification shall conform to general purpose optical fiber transmission open system with line signal in accordance with ITU-T Rec G-707.
The equipment should have modular design and should be configurable in number of operational modes to perform complex and different network functions without need of any additional software.
The supplied SDH equipment shall be able to work in all possible configurations like Terminal (TM), Regen and Add-Drop (ADM).

The switching subsystem (Cross Connect) should meet the following requirement as a minimum.

Non Blocking: Probability that a particular connection request cannot be met should be zero.
Correctness of cross connections: Correct cross connections between the right traffic ports.
Timing transparency or no slip: Each outgoing channel shall contain the same timing information as it did at the input before switching.

Timing sequence integrity: Concatenated payloads should be switched without breaking the time sequence integrity.

Following features shall be configurable in the cards:
ETH ports:

1.4 ETH 10/100 Base T,
Auto sensing,
Flow control (802.3 xs) configurable (on/off)

Eos Mapper:

G.7041 (GFP) or X.86 (LAPS) configurable,
G.7042 (LCAS)
IEEE 802.1 Q (VLAN)
IEEE 802.1 P (Priority)
ITU-T G.707 (Virtual concatenation)

Nodes shall be hitless i.e. removing or inserting plug units must not affect the existing traffic on other units.
Configuration of nodes should be easily expandable by adding plug in units and modifying software settings.
It is required that laser transmitter is automatically shut down when the incoming signal is missing.
It shall be possible to support all network topologies ï bus, ring, mesh and mixed to support network evolution in future.
The offered Equipment shall support SFP modules at the optical Aggregate and optical Tributary Interfaces.
Receive Optical Power measurement aggregate interface should be available, which can be read by accessing the equipment through NMS.
The system should provide Visual Power On indication as well as the card level Visual
For indications for the status of individual cards following should be indicated:

LOS Indication
Card Active Indication
Card Status Indication
Receive Optical Power measurement provision for all optical interfaces should be available for the equipment, which can be read by accessing the equipment through NMS.

Provision for suitable potential free contacts should be provided for extension of external alarms to NMS.

All the data pertaining to configuration, cross- connections, administration, security, operation and maintenance of the equipment shall reside in its non volatile memory and shall enable for FCAPS management functions of the equipment from NMS and LCT. The required software shall be preloaded and configured in all SDH/PDH equipments as per site requirement before dispatch from factory. The software download to the equipment shall be

possible online without interrupting the traffic. The system should have smooth and non disruptive in case of software Up gradation.

Reliability /Availability

System availability should be greater than 99.99% (including the SDH and optical converters) & excluding logistics, fiber and power supply by others. System BER shall not exceed 1* 10(-12) .Theoretical calculations should be submitted in support of the above for proposed section in this project with 1 hour MTTR as part of bid.

Power Requirements

Bidder to provide details of power consumption of each plug in unit, as well as typical and maximum power consumption of a node.

Mechanical

Vendor to provide 600mm * 600 mm racks as per requirement.

Cables & Connectors

All cables and connectors shall be of OEM make only.

SDH REQUIREMENTS:

Synchronization

The new SDH equipment shall be preferably synchronized to existing equipments and upcoming equipments. Bidder shall provide details of synchronization as part of bid. The Synchronization Input and Output Interfaces and Traffic interfaces for all SDH equipment to be provided as mentioned under the technical specifications. The SDH equipment should have a minimum one Input & minimum one output Synch Interfaces. The SDH equipment should provide a 2MHz clock from the system. In the SDH equipment, retiming functionality shall be available to allow the transfer of high quality SDH network timing to PDH equipment.

Following shall be usable as synchronization source:

External clock
Any STM-N
Any 2 Mbps
Internal clock

The equipments at various locations shall be equipped & configured as per the following

STM-1 Equipment

Requirement of equipped interfaces from day one:

STM 1(O) Aggregate L1.1	: Four Interfaces on two cards
E1 (tributary)	: 21 Numbers with 120 ohms termination (to be terminated at Krone DDF)
Fast Ethernet 10/100Base-T	: Total 8* 10/100 auto sensing interfaces. (Electrical) in two cards

The performance of the line tributary interfaces shall be in compliance with ITU-T G-957.Bidder to provide detail specification of equipment offered.

The new SDH equipment shall be fully compatible with existing SDH equipment of GAIL including full DCC transparency.

Cross connect:

STM1 equipment shall be equipped with

- Fully non blocking with Granularity of VC-4,VC-3 and VC-12

- Aggregate to Aggregate, Aggregate to tributary, tributary to aggregate, tributary to tributary.
- Capability of following
  - Unidirectional point to point
  - Bidirectional point to point
  - Unidirectional point to Multipoint
  - Drop and continue
  - It shall allow direct mapping of any 2 Mbps into any STM1 interface without blockage at any level of the equipment.

All optical & electrical Interface Modules supplied at all locations of the pipeline shall be provided with all OEM make Cable, Connectors & associated items in complete for the integration with external usersô equipment. Any other interface required in SDH at any other locations of the pipeline to meet the overall requirement shall be supplied, installed & commissioned by the Contractor.ò

Offered SDH equipment shall be of FIBCOM/ TEJAS/ ECI/ WRI/ NSN make only so that the system can be managed from the Gail's existing SDH NMS of FIBCOM/ TEJAS/ ECI/ WRI/ NSN in Noida in Gail's Network. Vendor has to offer any of the above make of SDH equipment as per the requirement of network for seamless integration.

2. SOLAR PANEL-Type-1

SCOPE

Solar panel 200 Watt

- For powering of telecom system at remote consumer location, solar power with maintenance free battery for backup of 48 hrs in case of no light with necessary charger for load, interconnecting cable, glands, and erection accessories as required. The load capacity shall of min 200 watt. Solar panel shall have redundant charge controller and it shall switched to standby charge controller automatically in case of failure of one charge controller without failure in operation. There shall be provision of charging the batteries through grid power shall also be provided. Solar panel shall able to charge the battery with in time frame and same shall be demonstrated during FAT & SAT. Solar panel system shall equip with feature of charging the battery by grid supply with automatic switching over facility from solar to grid supply and vice versa. Tendererôs scope of work includes design, manufacture, testing, packing, storage, delivery to site, installation, earthing, testing & commissioning of the complete Solar system with solar array, charge controllers, battery banks, chargers, DC-DC converters, Distribution boxes, interconnecting cables etc as per this specification, data sheets that meet the critical load requirement.
- SPV modules manufactured using Mono Crystalline Silicon solar cells shall be used for power generation. SPV modules should have excellent durability to withstand extreme temperature and weather conditions. The photovoltaic solar array, charge controller shall be sized to meet through battery back-up, load cycle requirement of connected load with availability of solar energy. SPV array shall be connected in series-parallel combination to obtain required voltage and current rating of a solar module. However the rating of solar system shall not be less than as specified in SOR/MR. Equipments earthing- Cu plate type.

A charge controller is an important system component that regulates the power generated from renewable energy system and charges the battery and simultaneously feed the load at specified

voltage level. It should protect specified type of batteries from being over/under charged and ensures maximum battery life.

- Charger size shall be based on the maximum Array capacity.
- Automatic boosts and floats charging control

PROTECTIVE FEATURES (As per manufacturerôs standard however minimum are below)

- Maximum current limiting
- Over Temperature Trip
- Over charging Trip
- Boost charging and float charging current limiting with back up protection against overcharging & deep discharge protection against transient/surge.
- Battery open circuit protection.
- Provision for charging of battery from grid supply through grid charger automatically when no sun power is available or battery is deep discharged.

INDICATIONS (As per manufacturerôs standard)

- Indication for charging by solar panels or by Grid power.

METERS

- Load voltage and current
- Battery current and voltage with indication of status - "in charge" or "discharge".
- Solar array Voltage and Current.

CHARGER

Grid charger charges the battery bank from grid supply when solar power is not available or battery is deep discharged upto 70%. During the charging the charger will supply the load simultaneously and should protect specified type of batteries from being over/under charged and ensures maximum battery life. Grid charger turn on automatically when no sun power is available or battery is deep discharged by interlocking between the solar charge controller and grid charger. Grid charger shall be FCBC type. The charger rating shall be selected such that it can charge fully discharge battery (Bidder shall submit the calculation)

The rating of rectifier / charger shall be not less than the value calculated as follows:

For batteries = Load current + 0.2 Ah (5 hr. rating of battery)With transient and surge protection circuit in input circuit for protection from surges and voltage Spikes, necessary smoothing reactor and filters and Automatic boost and float charging control.

INDICATIONS-(As per manufactureôs standard)

- Battery charging by Grid charger or solar charger controller.

METERS

- Input Voltage and current, Output voltage and current, Load voltage and current
- Battery current and voltage with indication of status - "in charge" or "discharge".

Overall dimensions of complete battery set shall be such that it can be accommodated in minimum space available at customer site.

3. SOLAR PANEL-Type-2

SCOPE

Solar panel 100 Watt

- For powering of telecom system at remote consumer location, solar power with maintenance free battery for backup of 48 hrs in case of no light with necessary charger for load, interconnecting cable, glands, and erection accessories as required. The load capacity shall of min 200 watt. Solar panel shall have redundant charge controller and it shall switched to standby charge controller automatically in case of failure of one charge controller without failure in operation. There shall be provision of charging the batteries through grid power shall also be provided. Solar panel shall able to charge the battery with in time frame and same shall be demonstrated during FAT & SAT. Solar panel system shall equip with feature of charging the battery by grid supply with automatic switching over facility from solar to grid supply and vice versa. Tendererôs scope of work includes design, manufacture, testing, packing, storage, delivery to site, installation, earthing, testing & commissioning of the complete Solar system with solar array, charge controllers, battery banks, chargers, DC-DC converters, Distribution boxes, interconnecting cables etc as per this specification, data sheets that meet the critical load requirement.
- SPV modules manufactured using Mono Crystalline Silicon solar cells shall be used for power generation. SPV modules should have excellent durability to withstand extreme temperature and weather conditions. The photovoltaic solar array, charge controller shall be sized to meet through battery back-up, load cycle requirement of connected load with availability of solar energy. SPV array shall be connected in series-parallel combination to obtain required voltage and current rating of a solar module. However the rating of solar system shall not be less than as specified in SOR/MR. Equipments earthing- Cu plate type.

A charge controller is an important system component that regulates the power generated from renewable energy system and charges the battery and simultaneously feed the load at specified voltage level. It should protect specified type of batteries from being over/under charged and ensures maximum battery life.

- Charger size shall be based on the maximum Array capacity.
- Automatic boosts and floats charging control

PROTECTIVE FEATURES (As per manufacturerôs standard however minimum are below)

- Maximum current limiting
- Over Temperature Trip
- Over charging Trip
- Boost charging and float charging current limiting with back up protection against overcharging & deep discharge protection against transient/surge.
- Battery open circuit protection.
- Provision for charging of battery from grid supply through grid charger automatically when no sun power is available or battery is deep discharged.

INDICATIONS (As per manufacturerôs standard)

- Indication for charging by solar panels or by Grid power.

METERS

- Load voltage and current
- Battery current and voltage with indication of status - "in charge" or "discharge".
- Solar array Voltage and Current.

CHARGER

Grid charger charges the battery bank from grid supply when solar power is not available or battery is deep discharged upto 70%. During the charging the charger will supply the load simultaneously and should protect specified type of batteries from being over/under charged

and ensures maximum battery life. Grid charger turn on automatically when no sun power is available or battery is deep discharged by interlocking between the solar charge controller and grid charger. Grid charger shall be FCBC type. The charger rating shall be selected such that it can charge fully discharge battery (Bidder shall submit the calculation)
The rating of rectifier / charger shall be not less than the value calculated as follows:
For batteries = Load current + 0.2 Ah (5 hr. rating of battery)With transient and surge protection circuit in input circuit for protection from surges and voltage Spikes, necessary smoothing reactor and filters and Automatic boost and float charging control.

INDICATIONS-(As per manufacture's standard)

- Battery charging by Grid charger or solar charger controller.

METERS

- Input Voltage and current, Output voltage and current, Load voltage and current
- Battery current and voltage with indication of status - "in charge" or "discharge".

Overall dimensions of complete battery set shall be such that it can be accommodated in minimum space available at customer site.

4. DC-DC CONVERTER

Type : SMPS type
Redundancy : The modules of DC-DC converter, fault of which shall affect the delivery of required rated output (voltage/ current), shall be (N+1) protected.

Input:
1. Voltage : DC Voltage of 24V (nominal) Range: 20 -30 VDC.
2. Current : To be provided by the Bidder
3. Efficiency : > 85%
4. Protection : Current limiting circuit breaker; Over & under voltage protection; Automatic shutdown at lower input voltage.

Output:
1. Voltage : 50 VDC (preset) Adjustable 48 to 52V (non-break type) with Ripple <100 mV
2. Load Current : 300 W

3. Static Regulation : Load: + 0.5 % from 0 to full load
4. Dynamic regulation : +/- 5% for 10%- 90% step load change
5. Conversion frequency : > 90 KHz
6. Load sharing : Active current sharing & Democratic load sharing in Parallel operation.
7. Protection : Circuit breaker/fuse
   a) Over voltage : Only faulty unit shuts down
   b) Over Current : Can sustain short circuit at o/p indefinitely
   c) Over Temperature : Required

Other:

1. Lightening & Surge protection : As per latest national &International Standards
2. EMI protection : As per latest national & International Standards
3. Insulation Resistance:

a) Input & Earth : > 2 mega ohms
b) DC Output & Earth : > 1 mega ohms
c) DC input & DC O/p : > 5 mega ohms

4. Mechanical Noise : < 60 dBA

Monitoring:

1. Shall provide Display for display / monitoring of the following with accuracy of 1%:
   Input DC Voltage & Current
   Output DC Voltage & Current
2. Shall provide facility for visual indication / display / monitoring of following Alarms locally:
   Input Failure
   Output Failure
   Module failure
   o/p Over Voltage
   o/p Under Voltage
   Overload
   Fan failure (if any)

The above-mentioned alarms shall be categorized under Urgent & Non-urgent alarms depending upon the intensity of the abnormalities. Every Alarm condition shall be accompanied with Audio alarm with the audio cut-off facility. Potential Free contacts shall be provided for the extension of alarms to central location.

5. AC-DC CONVERTER

Type : SMPS type

Redundancy : The modules of AC-DC converter, fault of which shall affect the delivery of required rated output (voltage/ current), shall be (N+1) protected.

Input

1. Voltage : Single phase & Neutral Nominal Working Voltage: 220V VAC Range: 150-275V VAC
2. Frequency : 45 to 63 Hz
3. Current : To Be Provided By the Bidder
4. Power Factor : > 0.9
5. Efficiency : > 90%
6. Protection : Current Limiting Circuit Breaker; Fuse at the input of Rectifier module, over & under voltage protection. Automatic shutdown at lower input voltage.

Output:

1. Voltage : 50 VDC (preset) 48 to 56V (non-break type) with Ripple <100 mV
2. Load Current : 300 W
3. Static Regulation : Load: + 0.5 %
4. Dynamic regulation : +/- 5% for 10%- 90% step load change
   +/- 1% within 10 msec of step change
   +/- 1% for +/-25% step change in AC input voltage
5. Conversion frequency: > 50 KHz
6. Load sharing : Active current sharing & Democratic load sharing in parallel operation.
7. Protection : Circuit breaker/fuse
   a) Over voltage : Only faulty unit shuts down
   b) Over Current : Can sustain short circuit at o/p indefinitely
   c) Over Temperature : Required

Other:

1. Lightening & Surge protection : As per latest national & International Standards
2. EMI protection : As per latest national & International Standards
3. Insulation Resistance:
   a) AC Input & Earth : > 2 mega ohms
   b) DC Output & Earth : > 1 mega ohms
   c) AC input & DC o/p : > 5 mega ohms
4. Mechanical Noise : < 60 dBA

Monitoring:

1. Shall provide Display for display / monitoring of the following with accuracy of 1%:
   Input AC Voltage
   Output DC Voltage & Current
2. Shall provide facility for visual indication / display / monitoring of following Alarms locally:
   AC Mains Failure
   Rectifier Failure
   Over Voltage
   Under Voltage
   Overload
   Fan failure (if any)

The above-mentioned alarms shall be categorized under Urgent & Non-urgent alarms depending upon the intensity of the abnormalities. Every Alarm condition shall be accompanied with Audio alarm with the audio cut-off facility. Potential Free contacts shall be provided for the extension of alarms to central location.

6. LCT

Laptops, which will be supplied by the vendor to meet the requirement of the tender, shall meet but not limited to the following specifications:

- **Make:** HP / Dell / Lenovo
- **Processor** ï Min 3rd Generation Intel® CoreÊ i5
- **RAM-** 4 GB, 1600Mhz
- **Display**- Min 15 ñ or higher LED Backlit Display
- **Video Card** ï 1 GB
- **Keyboard**-Keyboard with Touchpad
- **Ports**-Min. 2 USB /Ext. Monitor/ LAN / MODEM, etc.
- **HDD**- 500 GB min., 5,400 rpm
- **CD RW** read & write function
- **DVD** read & write function.
- **Ethernet- LAN interface:** 10BASE- T/100BASE- TX Ethernet with RJ-45 interface
- **Operating System:** Licensed Windows 7 or Windows 8 OS with documentation & CD media/Recovery arrangements
- **Serial Port:** 01 (One) In case the model offered is not having a serial port than vendor to provide a USB to Serial convertor with corresponding software.
- **Antivirus:** Mcafee / Norton / AVG 1 year licensed in CD & loaded on LCT
- **Accessories:** Soft leather Carry case, 240 V AC adapters with Cable
- **Battery:** Preferably 9 cell Lithium Ion. The required Back up time shall be min. 6 hours..

7. TEST EQUIPMENTS

OTDR meter: -

Base Unit Requirements:

Test Equipment Configuration

The mainframe shall accept at least two modules simultaneously.

The Test Equipment shall be field upgradeable

The modules shall be field interchangeable

The Test Equipment shall be battery operated in any configurations.

Display

The size of the display shall be 10.4 inches minimum.

The Test Equipment shall have a LCD color display with high visibility for outside plant use.

The Test Equipment shall therefore be usable in direct sunlight.

Field operation

The Test Equipment shall be portable, battery operated and rugged for field operations.

The weight of the Mainframe shall not be higher than 5.5 kg with one function module.

OTDR Measurement Capabilities

Wavelengths: 1310 +/-20nm, 1550 +/-20nm

Laser Safety: Class 1

Distance accuracy: +/- 1m +/-10-5x distance +/- sampling resolution (excluding group index uncertainties).

Vertical linearity: +/- 0.05dB/dB

Distance sampling: minimum 4cm

Number of data points: minimum 128000 acquisition points

Real time sweep: 0.1 s

Test Functions and Features:

The OTDR must have a one button operation mode.

The OTDR must give an indication of the quality of the front connection

The OTDR shall display:

The Type of event

The Distance, the Loss and the Reflectance of each event

The Slope of the fiber

The fiber Total Loss and Optical Return Loss

The OTDR shall indicate ghost detections on the trace and in the table of events. This shall be user-selectable.

Comments shall be available and linked to each event of the table

Part of the screen must be reserve to display the trace to locate the events.

The Event table must be linked to the trace.

The OTDR must have a function which positions automatically the cursor on the successive events.

The OTDR must have a function to freeze the markers for repetitive acquisitions.

The OTDR shall overlay minimum 8 traces:

Overlay current trace versus saved traces.

Overlay multiple wavelengths.

It shall be possible to toggle from one trace to the other.

The OTDR must have the capability to process automatic bi-directional measurements.
The OTDR must check automatically fiber continuity
The measurement parameters from the main instrument must be transferred automatically to the other instrument to avoid any operation error.
It must be possible to visualize the trace from one instrument, from the other instrument, or both superposed and the results at the same time

OTDR Module for long haul testing

Event Dead Zone: (Measured at +/-1.5dB down from the peak of an unsaturated reflective event)

at 1310nm: 4m
at 1550nm: 4m

Attenuation Dead Zone: (Measured at +/- 0.5dB from the linear regression using an FC/APC type reflectance)

at 1310nm: 15m
at 1550nm: 15m

Dynamic Range: (The one way difference between the extrapolated backscattering level at the start of the fiber and the RMS noise level)

at 1310nm: 42dB
at 1550nm: 40dB

The optical time domain reflectometers (at 1310nm/1550nm) should have a dynamic range >/= 25 Db, accuracy better than +/- 0.05% of length measured. Suitable printer shall be supplied with OTDR.

8. LASER SOURCE & POWER METER (HAND HELD)

(i) Optical Laser Source:

Basic requirement of optical laser source:
The optical source will be applied for loss/attenuation measurements during installation, operation and maintenance of fiber optic networks. It will be operating in conjunction with an appropriate power meter.

The source has to simulate the system parameters, so laser sources are preferred operating at 1310 and 1550 nm, coupling the output power into a SM-fiber 9/125 µm.

The instrument has to withstand all practical environmental conditions like temperature, shock, bumps etc. The instruments shall use standard AA batteries ï dry cells and it should be easy to replace the batteries in the field.

The optical ports shall have a universal optical adapter system which allows to change between different connector types. For the optical ports a robust protection cap against dust and shock should be included.

The output power of the lasers shall be adjustable between -7 and 0dBm.
Instrument specification

Parameter	Type	FP-laser
	Wavelength	Switch-able, one output port
	Center wavelength	1310 ± 20 nm and 1550 ± 20 nm
	FWHM spectral width	< 5 nm / < 5 nm
	Laser classification	laser class 1 according to IEC 825
Operating Mode	CW	output level: 0 to -7 dBm
	270 Hz, 1 kHz and 2 kHz (for line identification (Laser ON/OFF Duty cycle: 50%)	calibrated output level:-3 to 10 dBm)
	Wavelength identifier	AUTO-λ= automatic λ setting with appropriate power meter
	Automatic dual wavelength transmission	TWIN test = automatic dual λ testing with appropriate power meter
Optical interface	universal interface, physical contact	FC/PC, SC/PC, LC, DIN, ST... easy to clean, exchangeable
Power supply	4-way powering	Dry cells, NiCd, USB and AC-line
	Recharge capability	Internal fast charging function (2 hours), via AC-line adapter
	Operating time (typ.)	>45h
	Battery save function	Automatic shut off
Environmental conditions	Operating temperature	-10...+55 C
	Storage temperature	-40...+70 C
	Rel. humidity	up to 90 %
	Electromagnetic Compatibility	CE-conformance according to EN 50081-1 / EN 50082-1

(ii) Optical power meter

The power meter shall be an easy operable, lightweight, rugged and water resistant handheld instrument withstanding all practical environmental conditions like temperature, shock, bumps etc. The instruments shall use standard AA batteries ï dry cells.

The instrument must cover the whole wavelength range between 800 and 1700 nm. The operation wavelength could be set to every value between 800 and 1700 nm in 1 nm increments. Automatic wavelength detection must be there.

The instrument must have no warm up time and it must use auto zeroing with no need for manual zeroing.

The optical port must have a universal optical adapter system which would allow changing between different connector types. For the optical ports a robust protection cap should be provided.

1	Temperature	
	Operate	For all supplies 00 to + 480 C guaranteed and up to +550 C degraded.
	Storage	-100 C to +700 C
2	Humidity	At any relative humidity up to 95% within the temperature range of 0.0C to 400 C
3	Altitude	At any altitude up to 600m above sea level
4	Sand and Dust	The housing to be supplied along with the equipment should be in such a way that entry for dust, insect / rodent is totally prohibited.
5	Tropicalisation	Shall be fully tropicalised with all cards &confirmally coated with lacquer.
6	Shock and vibration	Shall withstand transportation and handling by air, sea and road under packed conditions.
7	Salt, fog and mould	Shall withstand continuous usages in marine growth environment.
8	Electromagnetic	Shall meet the requirements as per IEC Compatibility-801.

9. PORTA CABIN

1. Structural design National Building Code: 2005
IS: 875 (Part 1 to 5) Actions on structure (Loads)
IS: 800-2007 Design of steel structures
Galvanized coating
IS: 2771992 Hot dip galvanized coatings on fabricated iron and steel articles

Electrical installation
IS: 120631987 ï Degree of protection provided by enclosures of electrical equipment
IS: 21471962 ï Low voltage switchgear and control gear assemblies
IS: 46911968 ï Rotating electrical machinery

Welding
IS:8161969 ï Welding procedure tests for the arc welding

2 MECHANICAL CHARACTERISTICS
2.1 Dimensions

SHELTER	Length (mm)	Width (mm)	Height (mm)
	2500	2500	2700

2.2 Supporting mainframe
The shelter shall consist of a supporting frame. All these parts shall be bolted together and assembled with the sandwich panels to form a monolithic body.
2.3 Side walls
Sidewalls shall consist of sandwich panels to be assembled and fixed to the mainframe to form the four sidewalls. The complete assembling of the walls shall be made to avoid any thermal bridges between internal and external surfaces of the same.
Each panel shall be made as follows

- External covering with galvanized pre-painted RAL 9002 steel sheet

- Insulation with polyurethane foam, thickness 60 mm, density 40 kg/m3
- Internal covering with galvanized pre-painted RAL 9002 steel sheet

2.4 Floor (Floor load shall be min 1500 kg/m3)

The frame shall consist of two main beams, two short and additional intermediate galvanized steel cross beams all made of galvanized steel profile sections. The bottom external surface is made with galvanized pre-painted steel sheet and the top internal surface is made with a cover of replaceable type marine plywood (thickness min 19 mm) covered with antistatic PVC. Between the two surfaces, insulating material and additional intermediate cross beams for additional rigidity are inserted but not embedded.

2.5 Roof frame

The frame shall consist of and two short cross beams made of galvanized steel profile sections. The load capacity of the roof shall be ensured by corrugated sandwich panels anchored to the frame. The individual panels are made with the same characteristics as the wall panels. Support up to wind speed of 180 km/hr.

2.6 Additional secondary roof

The additional roof shall be composed by corrugated galvanized pre painted steel sheets Installed with a minimum slope of 5% approx in a short side and with the edges extended over the edges of roof frame on each side.

2.7 Internal linings

The internal lining of the walls shall be made with RAL9002 pre painted metal sheets and floor covering made of antistatic PVC mat.

3 Other Characteristics

3.1 Access door

The access doors shall be built with a frame made of aluminum profiles and sheets. The dimensions of the door opening are:

ÅHeight 1800 mm

ÅWidth 900 mm

In order to guarantee necessary water tightness and thermal insulation, two gaskets are fixed one on door frame and another on door. The door internal and external claddings and insulation shall have the same materials and characteristics specified for the wall panels. The door shall have non detachable (not slip) hinges; lock fitted (with an antipanic lock) and shall be equipped with a locking device preventing accidental closing due to wind gusts.

3.2 Fastening of the equipment

The shelter shall be internally designed for a rapid fastening of radio equipment by means of rails anchored to the walls.

3.3 Openings

ROXTEC type cable entries in the floor/walls (Position to be defined later.)

4 Power Distribution System

4.1 Power distribution board

The distribution board is dimensioned and configured for the supply and the control of the various users installed.

POWER SUPPLY CHARACTERISTICS:

Voltage: 220 VAC 1Ph+N Frequency: 50 Hz

The power supply circuits are protected against overloads and short-circuit by automatic Thermo-magnetic circuit breakers MCBs (Miniature Circuit Breaker) with nominal current depending on

cable section and load, tripping characteristic C curve, minimum breaking Capacity. Where RCBOs (Residual Current Circuit Breaker with over current Protection)are installed, they combine in a single device protection against both earth-fault currents and overloads or short-circuit.

4.2 Lighting system & Sockets

The lighting system shall consist of internal light fixtures, each equipped with 36 W fluorescent lamps. The external lamp with crepuscular switch positioned closed to access door. The power distribution system employs unipolar cables slipped through rigid PVC tubes and conduits. On shelter walls AC sockets is installed

4.3 Earthing System

The shelter is equipped with ground copper collectors and copper strip along the walls.

The shelters are equipotential and all panels shall results as to be electrically connected one to the other and to the mainframe. In addition, a copper strap ensures the electric connection of the door to the main structure. The connection of the mainframe to the earth system is allowed by two external grounding points

5 Alarm System

The following alarm systems are provided:

ÅOpen door (micro switch)

ÅMax. indoor temperature (adjustable thermostat)

ÅSmoke/fire (detector)

ÅAir conditioners failure

The relevant dry contacts to be available on a terminal strip in the power distribution board.

6Accessories

Following accessories are provided if required:

ÅCable tray

ÅDocument pocket

ÅTilting table

ÅFixing kit

ÅGeneral maintenance kit

7 Free cooling unit & free cooling system

Free cooling system to be installed which can run on r DC and shall remove hot air from the cabin and provide proper circulation of air with auto cut feature.

8. Documentation

The standard documentation consists of an USER MANUAL containing information about Installation and Maintenance operation.

10. EXPLOSION PROOF TELEPHONE& WEATHER PROOF TELEPHONE

Explosion proof telephone and weatherproof telephone shall be of FRNSIG/SEIMENS make.

Explosion proof telephone shall be intrinsically safe and shall be suitable for installation in hazardous area of Zone I, Group IIA, IIB standards.

11. BATTERY CHARGER WITH BATTERY BACKUP

Battery charger shall be 230 V AC input and output 48 V DC. Total load for battery charger shall be 250 watt and battery backup of 8 hours. Battery charger charging modules shall be in (N+1)

configuration in hot standby configuration. Battery charger unit shall be kept in proper rack with minimum floor space. Vendor has to submit the detail engineering and design for approval.

12. ACCOUSTIC BOOTH

The explosion proof shall be housed in a suitable half hood acoustic booth. The acoustic booth shall house the explosion proof telephone set including all accessories for fixing to the telephone set. Acoustic booth shall be made of glass fiber reinforced polyester. These should be maintenance free, UV, fire and corrosion resistant .Vendorôs scope includes supply of all materials, interfaces, cabling, power supply, trenching, and backfilling.
Acoustic booth shall provide noise reductions of minimum 8 db.
Wiring, cable glands shall be included with telephone. All equipments shall be coated to ensure proper corrosion protection. Galvanization thickness for steel pillar shall be 80 mircon. All metallic parts which are not permanently protected against corrosion shall be protected with anti corrosion painting.

13. EARTHING SYSTEM

a) Standard: IS 3043-1966 or equivalent BIS & IEC standard
b) The earthing material to be used shall be Electrolytic Copper having the material specifications confirming to the IS standards
c) The dimension of the Earthing strip, which shall be connected between Earth pit & the equipment or the earthing distributor, shall not be less than 25 mm x 5 mm
d) The earthing pit should have water pouring facility
e) Earthing resistance should be less than 1 ohm or should be suitable for the equipment to which the earthing is extended.
f) The extension of earthing to the respective panels is in the vendorôs scope.

14. OPTICAL FIBER CABLE RESTORATION WORK

Restoration of Optical Fiber Cable faults after taking over of fiber by the vendor till completion of Trail run:

Restoration of Optical Fiber Cable faults after taking over of Fiber from the pipeline contractor till the completion of trial run shall be responsibility of equipment vendor. All materials required for rectification of OFC fault during trial run is in the scope of equipment vendor. All related activities such as locating fault, excavation, jointing/Splicing, Protections of joints; backfilling, jointing chamber etc shall be completed by Vendor. It shall include jointing pit with sand. Payment of joint closure shall be as per SOR. Vendor has to include all the materials e.g. sand, jointing pit, 10 meter OFC cable for rectification of joint.

15. NETWORK MANAGEMENT SYSTEM (NMS)

For managing the SDH network, the vendor has to supply NMS of FIBCOM/TEJAS/WRI/ECI/NSN. NMS shall be provided with two years warranty support. NMS system shall monitor, control and manage the following SDH equipment, which will be supplied under this project and option of integrating SDH/DWDM elements already installed in GAILôs network by the same OEM/vendor under earlier projects.

Accordingly, bidder is required to provide total solution being offered for this tender along with the DCN plan and NMS/EMS/SDH implementation scheme along with the bid.
NMS systems shall have the capability to function in both active or master and stand-by or slave modes.

Considering the above, Vendor shall plan and supply all necessary DCN hardware and software and implement DCN connectivity so as to have the manageability of all SDH elements independently from active or master NMS at Noida and Mumbai.

Under multiple OFC cut conditions in a section, some of the SDH network elements (NE) may get isolated from NMS systems. However, after restoration of link, all the active alarms of the isolated NEs shall be unloaded automatically in the active NMS.

SYSTEM DESCRIPTION

The Network Management Systems shall be for the ultimate capacity of the offered SDH equipment.
The Network management system shall be of open architecture and the NMS shall have built-in supervisory facilities for monitoring the health of various stations automatically. Data from various stations shall be available at both the Network Management systems and shall monitor and control all stations.
Network management system should typically include automatic fault management (showing network alarm information, etc), configuration (node installation, configuration, software download, dynamic end-to-end path, trail management, etc.) performance management (collecting performance data for SDH (such as RS termination, MS termination & high low order path termination. etc.) and security management (assigning user rights, keeping log records etc).
All the databases should have disk mirroring/ standby configuration. External backup should also be provided (this should have both options of manual & scheduled backup). The hardware should be provided from proven sources. Hardware shall include work stations (HP, SUN etc.) with in ï built N MS all complete. The work stations shall include 19ò LCD screen.
STM-1, STM-4 and STM-16 shall be manageable through a single application Platform. Collection and data base storage in the Network Management System should be fully automatic. Operation for NMS should be pre-emptive (i.e. in case of any wrong operation the system software should not crash).
Should provide control and robustness for database backup and download by supporting database target verification to prevent the use of a wrong database.
This management platform will provide topology view (graphical and textural) of all the elements including SDH equipment and alarm log.
Management data (Q3 interface) shall be carried between SDH nodes by the DCC (Data Communication Channel) bytes of STM SOH.
The management platform should have graphical user interface and the graphical view of the network elements should offer a quasi-photographic picture at the highest level, going down to block diagram views of the functional blocks i.e. the network management system shall graphically depict the entire network in a single global view.

From this view the following should be accessible
The topology level- shall display in the main window and shall be the background for all other management views.

The NE shelf view ï shall show the internal physical layout of the NEôs i.e. the various cards installed in their slots.
All functional operation shall be mouse performable.
Throughout all presentation layers, continuous alarm information should propagate. For all views and tasks, a context sensitive on line help should be provided. In addition, complete product documentation should be accessible via the online help system.
The routing protocol shall be dynamic and in accordance to ISO (ES-IS) and IOS (IS-IS) protocols. Updates of routing tables should be automatic.
Any network element should be accessible from the other point of the network through remote Login in NMS.
Vendor to provide details of the NMS provided including details of hardware and software utilized and also how the network management can be expanded if the network grows (state addressing rules, action required limits of network (size, etc.)

CONFIGURATION
It should be possible to read the configuration from the network elements into a file, make the desired changes in to the file and restore the configuration into the network element, thus providing a way of saving the configuration of a network in the NMS for backup purposes.

USER ACCESS
It should be possible to connect two NMS or one NMS and one local craft terminal (hand held service terminal /lap top computer) to the network at the same time.
Each user should have a login to the NMS when starting it. The user name should define the access right for the system.
User privilege classes
The different user privileges available shall be as follow:

Allow Action	Operator	Experienced user	Network Administrator	System Administrator
Display network file	Yes	Yes	Yes	Yes
Enable profile monitoring	No	Yes	Yes	Yes
Create new profile	No	Yes	Yes	Yes
Create new network maps	No	No	Yes	Yes
Create new network files	No	No	Yes	Yes
Purge historical alarms	Yes	Yes	Yes	Yes
Install communication drivers	No	No	No	Yes
Configure drivers	No	No	No	Yes

INTERFACE TO HIGHER LEVEL MANAGEMENT SYSTEM
Vendor to provide details of such interfaces.

EATURES / FACILITIES:
Trail creation by pointing the start of the trail to the end point of the trail automatically
Multiple views of layered topology
Unified management of different transport layers

Multilayer service provisioning

Evolving TMN functionalities including fault management, performance monitoring, equipment configuration and administration, transmission and connectivity management and system and authorization control features.

Open CORBA interfaces towards the TMN upwards.

The network management system should be capable of managing both the optical platform and transport network simultaneously through the versatile network manager. The comprehensive management system should provide maximum integration and full modularity.

The network management system should have free flow of management information between the SDH and other complimentary access without regard to their source of manufacture it should support data communication channel (DCC) hardware transparency and allow the creation of DCC path for the transfer of third party management information through the network element and sub networks. The NMS shall be provided with CORBA interface for Integration with the other vendorôs NMS on a common platform.

The network management system should deliver end-to-end management.

The NMS hardware should be based on either UNIX or Windows NT platform with either Sun or HP Work stations. The software should be user friendly.

Workstation with 19ò LCD display screen one each shall be provided with each new NMS. Server Rack (similar to one installed in Noida Server room) for NMS systems shall have to be supplied by the vendor with each new NMS.

100 NES shall be manageable from this NMS at minimum.

It should be in compliance to ITU-T recommendation.

The hardware should be provided from proven sources.

Printer interface support in the NMS shall be provided for printing the following as a minimum:

Time, date and alarm

Type of alarm

Name of station

Time, date of alarm reset

Severity, Status of alarm

Alarm reporting interfaces: Real time screen display, both graphical & textual for alarm occurring at any station without need for logging into the particular station.

The management system shall also provide audible alarms (with a provision to disable the same, as and when required by Owner), whenever a new alarm enters the management log. Reminder function sound visible blinking shall be available whenever unacknowledged alarms are present in the system. Alarm export to a remote location should be possible in future (without any additional software). Suitable port for the same shall be provided.

Alarm categories:

Critical

Major

Minor

Warning

Cleared or Acknowledged

All details of the alarms shall be coming automatically and directly without any human intervention. All alarms (time, date of alarm, Type of alarm, Name of Station, Time, date of alarm reset etc.) shall come discretely at the NMSs, with all details, for each of the above categories (no summed alarms).

Fault message storage: To be stored in a database.
Maximum number of records to be stored: Vendor to provide the upper limit of storage of records.

Housekeeping of the database:
When the database gets near to the maximum number of records set at the installation, an alarm should be produced for the user. In case database gets filled up, following should be available. A tool for selectively deleting records is to be provided with the NMS. For backups, tools should be provided. In case the user does not delete/clear records, first In first out (FIFO) principle shall apply.
The user interface should have separate alarm lists for new, acknowledged and cleared alarms. A separate dialogue should be available for analyzing the historical alarms.

PERFORMANCE DATA
The performance data should be available for each network element.
Performance monitoring should be available according to ITU-T
Two separate records for last 15 minutes and 24 hour records shall be available. Performance monitoring shall be possible to set on all above functional blocks, including history records.

BACKUP
Back-up provision shall include but not limited to the following:

- Fault data
- Performance data
- Configuration data
- Cross-connection data
- NMS System data

Accordingly, vendor is required to provide total solution being offered for this tender along with the DCN plan and NMS/EMS/SDH implementation scheme along with the bid.
Accordingly, vendor is required to provide total solution being offered for this tender along with the DCN plan and NMS/EMS/SDH implementation scheme along with the bid.

16. CLOCKS

Reference clock shall be based on GPS as per ITU-T rev G-811(with SSU having holdover as per G.812). Other critical cards/key functions (redundant output) shall be duplicated of power supplies.

Minimum 4 output (2 MHz) clock shall be provided suitable for the project and shall terminate these clock outputs in the TIC cabinet.

Unit shall have NTP card. Unit should support remote (TCP/IP) as well as local management (RS-232). It shall have high frequency stability and long term accuracy.

It should provide additional backup input port (2 Mhz) to ensure continuous synchronization reference with no GPS signal is available.

17. FXO/FXS Gateway

For extension of analog telephones to the remote locations via Ethernet / IP network, FXO type VoIP gateways shall be provided at EPABX side and FXS type VoIP gateway shall be provided at remote location to which analog phone shall be connected.

FXO VoIP gateway shall be installed at EPABX location with no. of ports suitable for as per the requirement while 4 Port FXS VoIP and four additional ports gateways shall be installed at remote location.

The FXO and FXS VoIP gateways shall be compact in design with different port options and shall support transparent voice calls on all ports using a standard analog telephone.

VoIP gateways shall support industry standard SIP, H.323 and G.729, G.723 codecs.

WAN Interface	: 1 x 10/100 Base-T (RJ-45 Port)
FXO Interface	: 8 port as
FXS Interface	: 4-Port
FXO Connectivity	: 2-wire Loop start on RJ-11/12, Ring detection, tone detection, disconnect supervision, Caller ID detection
FXS Connectivity	: 2-wire Loop start on RJ-11/12, Ring & On-Hook Voltage, Caller ID
Voice Signaling	: H.323, SIP, DTMF, All tones programmable (dial, ringing, busy)
Management	: Web/HTTP, CLI with local console and remote Telnet

18. FIBER TERMINATION CLOSURE (FTC)

The FTC shall be **wall-mounted/rack mounted** type as per the case after due approval by EIC. The FTC shall have grounding arrangement for both the metallic layers of the cable. The cable shall be spliced to pigtails on trays provided in the FTC. The connector side of the pigtails shall be secured with suitable coupler/through adapter provided as integral part of the FTC itself. The FTC shall have trays suitable for splicing maximum of 6/12 fibers per tray. FTC for all stations shall be installed with trays for minimum 48 fibers (with connectors & pigtails provided & installed for all 48 fibers for intermediate & also for terminal stations).
The FTC shall be from one of the following recommended sub-vendors or equivalent:

1) Raychem, 2) Corning 3) 3M 4) Siemens 5) Tyco

Specification For Single Mode Optical Fiber Pigtails, Patch chords & Connectors To Be Used In The FTC

This specification provides requirements for single mode fiber Pigtails and connectors. They should meet the ITU-T recommendations G-652 & G.655. Both connectors and cables should be robust and should withstand wear and tear due to frequent use, connection and disconnection. Normal expected life should be 15 years or more.

Optical fiber cables, connectors & pigtails shall be fully compatible and matching to each other.

OPTICAL PIGTAILS

OPTICAL PARAMETERS: (In line with the cable specifications provided in this bid document)

CONSTRUCTION OF FIBER USED IN PIGTAILS

Primary coating Material	:	Silicone
Primary coating Diameter	:	400 um nominal
Secondary coating Material	:	Nylon
Secondary Coating Diameter	:	900 um nominal

PHYSICAL PARAMETERS OF CABLE

Pigtail Length	:	As required
Fiber Reinforcement	:	Kevlar/ Aramid
Outside dia.	:	3 mm
Type of connector	:	+/- 10 % FC

OUTER SHEATH:

A circular sheath of not less 0.5mm thick of suitable material and color free from pinholes and scratches and other defect etc. shall be provided. A low smoke, Halogen free, fire retardant material shall be used.

MECHANICAL PARAMETERS FOR PIGTAILS

Performance Parameters of the completed Patch cord and pigtails shall meet requirements of IEC 794.

19. IP CAMERA

FIXED TYPE
General
Camera shall be IP based network color camera suitable for indoor & outdoor application with following minimum features:
Motion JPEG or MPEG-4 based hardware compression with built-in web server
Direct IP based (without external converters, cards, etc)
Zoom and auto focus
Local Storage
Power over Ethernet
HDTV quality
Intelligent video capabilities
Camera shall be housed in weatherproof housing

Connections
Network: 10BaseT/100BaseTX Ethernet networks (RJ-45) for LAN/WAN

Video
Lens: Varifocal (3.0-8.0mm) DC-iris
Focus range: 0.3 m to infinity
Progressive scan CCD
Light sensitivity: 0.65 lux color
IR sensitive black/white video at night
Frame: 25fps or better

Functions
Built-in video motion detection
Scheduled and triggered event functionality with alarm notification
Pre and post alarm buffer
Digital time, date code embedded
Password protection for restricted camera access

Software
Win 2000, XP Operating condition

Environment Condition
Outdoor with temperature range of 0-50 °C

Camera shall be integrated with existing CCTV NVR server.

20. MANDATORY SPARES OF SDH

10% mandatory spares (for SDH)shall be provided for all electronic cards, etc. (with rounded off at the higher side with 02 cards minimum in case of total 03 cards or more . However, in case of only 01 OR 02 cards, only one spare card shall be provided. These spares shall be provided along with respective equipment. Mandatory spares shall be considered based on card calculation for single SDH equipment.

100 % spares shall be provided for consumables e.g. fuses, lamps, plugs, clamps etc. Spares shall be provided from the same manufacturing facilities / location from where the respective equipment, subsystems are offered. The spares shall be provided from the same manufacturing facility /locations from where the respective equipment, subsystems are offered.

21. EQUIPMENT RACKS FOR TELECOM SYSTEM

Equipment shall conform to the similar housing standard. The telecom cabinets shall have the following dimensions including Optical, EPABX, Power distribution panel, etc.:
Height: 2100 mm (2000 mm + 100 mm base plate)
Width: 600 mm
Depth: 600 mm

Color: Grey color (RAL 7035) for external and Pale cream (RAL 9001) (Semi Glossy) for inside of the cabinets. {The color shall be finalized during detailed engineering}.

All cabinets shall be with lockable glass front and perforated rear doors with preferably top cable entry and with gaskets and fittings to keep out moisture, corrosive, salts, dust & gases. As far as possible, the cabinets shall be manufactured using standard modular design and standard equipment.

All doors, trays and other weight supporting parts shall be fabricated of metal adequately reinforced to limit vibration and ensure plane surfaces and shall be well-housed and tidy in appearance. All fasteners including nuts, bolts, flat/lock washers and screws shall be of nickel plated MS. Document pocket/ wallet shall be provided on the inner side of the front and rear door of each cabinet.

Preferably all racks shall be of same size, color & make/model. Equipment racks shall be protected against entry of rodents, insects, lizards etc. Each rack shall arrangement of natural cooling & venting.

Racks for all the equipment of individual system, sub-system shall be as per international standards and shall adhere to all the quality norms.

Equipment protection for racks shall be of IP-42 and shall of Make Rittal or equivalent.

22. 24 V SUPPLY MODULE

24 VDC supply module shall have 230 V AC input ant 24 VDC output. 24 VDC output shall have (N+1) configuration. Supply module shall be designed for 150 Watt load.

23. JOINT CLOSURE

Jointing closures shall be suitable for armored optical fibers and unarmored optical fiber cables of all construction designs (slotted core, stranded tube, central tube). Jointing closures shall have 4 entry ports to allow entry/exit of one OFC from each port. The same shall have provision of blocking/sealing of the ports, if not in use.

The fibers and their storage shall be managed with proper bend radius controls and protection. There shall be no requirement of any kind of adhesive tape to keep the fibers in the tray. The fiber organizer trays shall have provision of maximum 12 fibers per tray for future. The trays should be hinged in such a manner that if moved about the hinge, the fibers are not strained, kinked or stressed. Also, it should be possible to work on the fibers on one tray without disturbing the fibers on the other trays.

For routing of fibers to the tray that are capable of moving about the hinge, proper transport tubes shall be provided. These tubes shall be transparent and non-kinking.

The jointing closure shall enable the metal parts of the cable and the internal metal parts of the closure to be maintained at earth potential. The sealing of the entry ports, shall provide

adequate sealing and shall be capable of withstanding an axial pull applied using 50kg freely suspended weight of the cable, without using any additional clamps, etc.
Jointing closures should be Dust tight (No dust ingress) and Protected against immersion in water (suitable for continuous immersion in saline water under 4 meter water-head) and should be complete with all accessories including splice cassettes splice protection sleeves and all other accessories including accessories for electrical continuity of metallic layers of optical fiber cable, etc along-with instruction sheets. 25% spare splice protection sleeves shall be provided in each kit.

The jointing closures shall be from one of the following recommended sub-vendors or equivalent:
1) Raychem, 2) Corning 3) 3M 4) Siemens 5) Tyco

24. ANALOG PHONE

Direct 8 One-Touch Memory
140 Incoming Calls Memory
16 Outgoing Memory
12 Two Touch Memories
Back Lit LCD
Flash, Pause & Alarm Clock
Speakerphone With Programmable Volume setting
Speaker/ Ringer In Use Indication
Ringer High/ Medium/ Low Switch
Phone Book
Display of Incoming Numbers, New Call, Total Calls & Repeat Calls.
8 Ring Melody Selectable
5 Step LCD Contrast Adjustable.
Tone (t) Pulse (p) Function through Switch

25. Extending connectivity for last mile consumers through hiring of VPN connectivity from service provider

VPN connectivity is to be hired from third party with complete end to end and to be provided at each location. Vendor has to provide the complete package of solution for extending data to the centralized scada system. This service will be required for two years from date of commissioning. Bandwidth of the link shall be minimum 64 kbps. Payment shall be made on provision of VPN connectivity for each location.

26. Installation and commissioning of converter and interfacing of the same with flow computer and integration with SCADA system

Converter is to be installed near flow computer and shall be interfaced with existing flow computer. Vendor has to coordinate with flow computer vendor, Centralized SCADA vendor and carry required configuration in the RTU and / or in CSCADA system to extend flow computer data to central scada system through available media.

27. Installation and commissioning of telecom system at each site

Telecom equipment is to be installed, erected and powered on each at site in complete respect.

28. Integration of SDH system with existing NMS

Vendor has to integrate the SDH equipment with existing NMS of ECI, Fibcom, Tejas, WRI, NSN. Vendor has to submit the detail engineering plan and get the approval before execution of works. Vendor has to carry seamless integration with existing pipeline network.

29. Testing of OFC and submission of reports for each project

Vendor has to test the fiber and submit the reports for total 24 fibers. Vendor shall test the OFC through their OTDR meter.

30. Installation and commissioning of solar panel

Solar array shall be grouted properly so that it is not affected by wind. Vendor has to submit the details about foundation with engineering drawings for approval before carrying the complete installation and commissioning works of solar panel.

31. Outdoor equipment panel type-1 for active elements

- Cabinet case H1450x W800 x D600
- Equipment chamber : providing 20U, 19 inch equipment installation space
- Ingress Protection : IP55
- Two DC Fan 120x120x38
- One Door switch
- One Roxtec feeder window with provision of 4 cable entry
- One DC power distribution box
- 30W LED lamp
- Convert switch 230V, 32 A
- 220 V Industrial socket 220 V, 32 A
- 220 V industrial plug 220 V, 32 A
- 600 Watt Air conditioner door mounted type (assembled with door)

32. Outdoor equipment panel type-2 for active elements

Dual Cabinet (Separate Equipment case & Battery case)

- Overall Cabinet case (H 1450 x W1200 x D600(mm))
- Ingress Protection : IP55

Cabinet Compartment

- Cabinet case (H 1450 x W 800 x D600 (mm))
- Two DC Fan (120 x 120 x 38)
- One Door switch
- One Roxtec feeder window with provision of 4 cable entry
- One DC power distribution box
- 30W LED lamp
- Convert switch 230V, 32 A
- 220 V Industrial socket 220 V, 32 A
- 220 V industrial plug 220 V, 32 A
- 600 Watt Air conditioner door mounted type (assembled with door)

Battery Compartment:

- Battery case (H 1450x W 400 x D600(mm))
- Two DC fan (120x120x38)
- One Roxtec feeder window with provision of 4 cable entry
- Door switch
- 30W LED lamp

33. Laying of OFC through HDD method

Vendor shall submit route survey report and provide profile for HDD.OFC is to be laid though HDD method by HDD machine. First HDPE duct shall be inserted through HDD method. After the laying of HDPE duct OFC shall be blown inside the HDPE duct. Vendor shall supply 24 fiber armored OFC cable and HDPE duct for this work. In case OFC is laid in gas pipeline ROU then vendor has to take utmost precaution in locating the pipeline first so that existing gas pipeline is not damaged.

34. Laying of OFC through direct trench method

Scope includes trenching of depth 1 meter and the laying of OFC cable in the HDPE duct at the bottom of trench. OFC cable shall be laid by providing padding of sand of 100 mm and providing and laying of warning mat. Vendor shall supply 24 fiber armored OFC cable and HDPE duct for this work. In case OFC is laid in the ROU of an existing gas pipeline then vendor has to take utmost precaution in locating the pipeline first so that existing pipeline is not damaged.

35. Installation of outdoor panel

Outdoor panel shall be installed at 1.5 ft above the ground on cement structure and shall be grouted firmly to withstand the wind. Contractor has to construct the cement structure to erect the outdoor panel. Outdoor panel shall be protected with canopy type structure from

direct sun and direct rain. The canopy type structure shall be strong enough to withstand rain and wind and shall protect the outdoor panel from direct exposure.

SCADA

GENERAL DESCRIPTION

1. Integration of additional SCADA parameters in the Server/ existing nearby RTUôs in GAILôs various pipelines in the states of Maharashtra, Gujarat & Goa to provide SCADA facilities to last mile consumers and integrating with existing SCADA system. This shall be done using the following three scenarios which shall be decided during detailed engineering.
    1. Addition of signals in nearby existing/new RTU through hardwired connections
    2. Supply and installation of necessary convertors
    3. Supply and installation of RTU
2. The make and models of the RTU presently installed in the states mentioned in the scope of contract are as below:
    1. Invensys ï SCD 5200
    2. Synergy ï Husky Series RTU- 6049-E70
    3. CSE-Semaphore ï T-Box
    4. ABB ï AC800 F

SCOPE OF SUPPLY

1. Vendorôs scope of supply and shall include ,but not limited to all the activities of project management, design, engineering, manufacture, Procurement of material and bought out components, assembly at shop, internal testing, FAT (if necessitated by GAIL), supply, installation, field testing, commissioning, SAT, warranty, post warranty, test run, packaging, delivery, forwarding, transportation (freight), insurance, port handling, custom clearance, inland transportation etc. of the material, coordination/ providing necessary support/ assistance to GAIL for integration of the installed material (supplied by vendor) with GAILôs existing system, receipt & storage at site, quality assurance and quality control of the equipment and documentation with the turnkey responsibility and meet the requirements of the project, its objectives, functional & specific requirements described in the specifications & taking care of other attachments etc.

2. System Proveness

The RTU/ Convertors/ equipment offered will be the extension of existing system and Vendor shall responsible to meet the proveness as define in the existing system.

3. Certificate For Logistics Support

Vendor shall provide backup engineering, maintenance support and spare part supports for a period of ten (10 years) for the system being supplied .Logistic support certificates as per format attached with the bid document. Certificates from sub vendors for items such as RTUs/ Convertors/ Switches etc, and vendor shall also furnish performance guarantee certificate as per the format attached with the bid document.

4. Spares

Supply of Mandatory spares and Commissioning Spares of all supplied RTUs and other important Equipment shall be provided as per the following:

a) Mandatory Spares for RTU

10 % qty of Manufactureôs Recommended spares for operation and maintenance (with round off at the higher side with minimum one no.) of electronic cards for each type of each system, sub - system etc. of the RTU equipment shall be provided as mandatory spares. Mandatory spares shall be calculated based on cards of single RTU.

100 % spares shall be provided for consumables e.g. fuses, lamps, plugs, clamps etc.

For spares Vendor shall provide the address, contact person, fax and telephone numbers of the manufacturer for spare parts. ***The vendor shall warrant that spare part for the system would be available for minimum of 10 years after warranty period after system commissioning. After this period if the vendor discontinues the production of the spare parts, then he shall give at least 12 months' notice prior to such discontinuation so that Owner may order the requirements of spares in one lot.***

In the bid, the Vendor shall provide unit price (year wise and % escalation per year) of each Spare Module card, which shall be valid for the procurement of the spares for operation and maintenance in subsequent years.

b) Commissioning Spares

The commissioning spares shall be arranged by the vendor to cater to the needs/ requirement during installation, commissioning, site acceptance testing, trial run and warranty period. These spares will be the part of the tender. These spares shall be readily available with the vendor. If the spares not used they may be retained by the vendor for maintenance.

These commissioning spares are different from Mandatory spares and vendor shall not use mandatory spares as commissioning spares, whatsoever.

Vendor shall provide a list of commissioning spares (with Serial & Part number for each system, sub-system) at the time of offer and price of these spares will be included in main offer.

5. Quality Assurance Programme And Implementation Methodology

This shall include but not limited to preparation of detailed Quality Assurance Programme, quality control parameters for equipment manufacturing and implementation of the network, preparation of implementation methodology covering schedule of supply, installation, testing and commissioning. The Network design has to be approved by GAIL before actual manufacturing of the equipment.

GAIL shall carry out Factory Acceptance Test (FAT) for the offered equipment if necessitated by Engineer-in-charge. Vendor shall make necessary arrangement for the testing of the same in presence of Owner/ Ownerôs representatives before the dispatch of materials to the sites.

The system and sub system shall be accepted and taken over upon successful completion of Site Acceptance Tests (SAT) followed by Trial run (7 days). SAT plan shall be proposed by vendor and approved by Engineer-in-charge.

Details and methodology to be followed during FAT, SAT and Trial Runs have been indicated below.

6. Factory Acceptance Test (FAT)

FAT shall be carried out at Vendorôs factory and include all materials and equipment delivered and software pertaining to the RTUs, including the equipment, material and software supplied by the vendor. Tests shall be performed as per the procedures described in the FAT document and observations will be recorded and signed by representatives of Vendor as well as purchaser. The tests shall be performed to represent working conditions as closely as possible.

These will comprise of two types:-

a) Routine Tests- these tests are to be carried out on all items of equipment and are to prove that all components work, all wiring is correct and the functional requirements of the specifications are complied with.
b) Acceptance test ï These tests are to prove that the design and quality of components are such as to ensure the equipment will work over the full range of conditions. These tests need only be carried out on one piece of equipment of each type.

In order to successfully conduct the FAT it is advisable that Vendor conducts a PRE FAT test to ensure that the RTUs perform in compliance with the specifications requirements. These tests shall enable the Vendor to detect and correct most design, integration and performance problems before FAT. The signed and approved PRE-FAT reports shall be submitted to the purchaser .Based on these reports the clearance for conducting FAT shall be given by the purchaser.

Vendor shall invite the purchaser well in advance with in minimum of 1 week notice of the date on which the RTUs shall be ready for FAT.

Vendor shall functionally test all the hardware and software in the presence of the purchaser/consultantôs inspector in order to ascertain compliance with the contract document and approved drawings and documents.

The equipment shall be dispatched from factory only after the purchaser based on successful completion of Factory Acceptance Tests issues dispatch instructions. Vendor shall provide to the purchaserós representative with all reasonable facilities necessary to inspect the equipment as per specification requirement.

Vendor shall provide all assistance, instruments, specialists, labour and materials as required for conducting the tests.

Vendor to note that the acceptance of equipment or the exemption of inspection and testing shall in no way absolve Vendor of responsibilities to deliver the equipment meeting all the requirements specified in the specifications.

After successful completion of factory acceptance testing, equipments shall be sent to the site for installation. Equipment without factory acceptance certificates shall not be acceptable at site.

Test Requirements

All the tests considered necessary for successful execution of the work shall be mutually agreed upon and carried out at Vendorôs premises, testing laboratories and work sites of the purchaser.

Vendor shall submit to the purchaser a FAT Document detailing the test plans and procedures well in advance of the test schedule for all factory tests which shall be mutually agreed upon and approved by the purchaser.

To ensure a well engineered RTUs / system in compliance with this contract document, the factory acceptance test shall be performed.

7. Site Acceptance Testing (SAT)

The SAT document shall be prepared and submit in advance of COMPANY review and approval.

SAT shall involve integrated testing with GAILôs SCADA system. Site Acceptance Testing will be done based on the stipulations in the approved SAT document.

SAT for RTUôs shall be done inline with FAT, wherein simulated signals shall be replaced by actual field signals and integration with Telecom system has been carried out. SAT shall be conducted by the experienced engineering group of the vendor (earlier involved in system design, engineering, integration & FAT phase of the project).

Site Acceptance testing shall be based on Factory Acceptance testing but with live SCADA data.

8. Warranty

Vendor shall be responsible for the manufacturing in respect of proper design, quality, workmanship & maintenance of all equipments, accessories etc. supplied by the Vendor including all services, spares and consumables for the period as per commercial section.
During the warranty period, if required it shall be obligatory on the part of the Vendor to modify, upgrade or replace any hardware /software supplied & installed, supply of required spares and consumables and attend to the maintenance of the RTUs/ system,free of cost during startup and on line operation & maintenance of the supply and services within their scope of work.

The system shall be guaranteed to for a period of 12 months (One year) from the date of ñprovisionalò acceptance of the system by the owner and any failure in the warranty period shall be rectified by the vendor within the warranty period without any extra cost or financial implication to GAIL. This warranty shall survive inspection of goods and acceptance of the system.

Contractor's engineers and technicians, capable of trouble shooting and looking after the health of the system during the warranty period, shall be made available all through the period of 12 (twelve) months.

Details of Warranty Support

The details of services to be provided under warranty shall include but not limited to the following:

a) **Technical Support Service**

Technical Support Services that extends coverage for GAIL after handover of the system. This includes 24 x 7 (24hours x 7 days a week) on line support. GAIL shall utilize this service by intimating the Vendor of its unique customer ID in case of any contingency and Vendor in turn provide telephonic support. Depending upon the severity of the issue, engineer shall be sent by Vendor to the site.

b) **Advance Replacement Service**

Vendor, from its warehouse/ factory, will ship an equivalent unit (feature, function, fit compatible) in maximum 3 days without waiting for receipt of the defective part and the defective parts will be sent to Vendor immediately. The Hardware shipment shall be made by directly and all costs for this are to be borne by Vendor.

c) **Documentation Delivery Service**

Under Documentation delivery service Vendor is required to provide engineering practices and Technical Bulletins for updates at free of cost. All the latest software upgrades and updates for complete system are also required to be providing under warranty.

9. Submission of Compliance Report

Vendor shall submit clause by clause compliance to the requirement of specifications with cross reference to the document submitted in the bid. The compliance form has to be submitted. Each of the pages shall be stamped and signed by the authorized representative of the vendor. Any of the clauses neither responded nor appropriately cross referred as per the submitted document shall be treated as Not Complied and liable for rejection.

10. Environmental Specification of Equipment To Be Supplied

The equipment shall operate satisfactorily under the following conditions:

- Ambient Temperature ï up to 55 degree Celsius; Humidity-5 to 95% RH
- All enclosed equipment structures to be supplied shall be constructed to allow free airflow to dissipate heat generated. Construction shall be such that ventilation grills will notbe obstructed when equipment is mounted in its installed position.
- All equipment to be supplied shall withstand international standards of vibration forindustrial application.

1 REMOTE TELEMETRY UNIT (RTU)

1.1 Vendor shall undertake full responsibility of supply of equipment and provide assistance to GAIL for integration of RTUôs with GAILôs centralized SCADA system with open architecture meeting the objectives, functional and specific project requirements.

1.2 The material to be delivered and works performed shall be to meet the project requirements detailed in this requisition.

1.3 **The supplied RTU should be seamlessly integrated with GAIL's Centralized SCADA system. The proposed RTU should be compatible with GAIL SCADA System and certificate issued by GAIL conforming compatibility of proposed RTUs with GAIL's SCADA System shall be submitted along with bid.**

The following make and model of RTU are compatible with GAIL's Centralized SCADA.

a) Yokogawa – Stardom
b) Semaphore – T-Box
c) Invensys – SCD5200
d) Synergy – Husky.

Refer Annexure-A for RTU specifications/ requirements.

1.4 Supply of all items/ equipments including cabinets, convertors (as required) etc, special tools & tests equipments(if any), software, Installation materials, etc, required to integrate and execute the project complete in all respects for achieving overall functional requirements. However if any additional items are required to integrate the RTU with the GAILôs centralized SCADA system for achieving overall functional/ operational requirements, Vendor shall supply the same without any cost and time implication.

1.5 Supply of loose Mandatory spare modules shall include at least 10% of all type of cards/ convertors/ power supply/ termination boards etc. Serial cards as part of mandatory spare should have Min. Two (2) RS232 & Two (2) RS485 ports. Vendor to note that mandatory spares, supplied to GAIL, shall not be available to them as part of commissioning spares.

1.6 Further the following services/ works shall be carried out by Vendor:

a) Development, testing and commissioning of necessary software for RTUs to interface with flow computers (FCs)/ Gas Chromatographs(GC) at respective locations (as per attachment-I) through serial link (RS485/232). Bidder to also refer serial link requirements specified in Annexure-A. The FC/ GC make, model and protocol shall be provided by GAIL. Necessary configuration/ development of software for writing GC analysis values to flow computers (which are interfaced with RTUs installed at same or other different locations) will be in vendor scope. It shall be possible to configure/write IED (local serial devices like Flow computer, GC etc.) interface in RTU for which necessary software tools be supplied.
b) Configuration of RTU for all I/O points including calculation points & IED points.
c) Offline testing of field signals using PDT from RTU to field including IEDs signals as the part of site services.
d) Powering on of RTUs and making it online with GAILôs SCADA system as part of site services.
e) Online testing of all field signals from GAILôs SCADA system in association with GAILôs SCADA vendor as part of site services
f) Any other work as per instruction of GAIL

1.7 Performing all works required for RTUs designing, engineering, testing, supply, installation, interfacing with the communication channel, IEDôs and instrumentation & electrical/ CP system etc., commissioning (with sufficient supply of commissioning spares including consumables during installation & commissioning activities), site testing, test run and putting into commercial operation of the RTUs complete in all respects.

1.8 Vendor shall furnish the following drawings/documents as a minimum for COMPANY review/ records. Prior to submitting the documents for COMPANY review/ records, the vendor shall review, duly sign & stamp all the documents and ensure compliance to the

requirements of the contract. The language used in all correspondence, documentation, literature, drawings, markings etc., shall be English. All the drawings and documents shall be verified by the vendor before presenting the same for COMPANY review. All these documentation shall be furnished in hard cover/ ring folders in A4 size (210mm x 297 mm). The contract document would be the Purchase requisition (after award of contract) and the same shall have higher precedence than all approved project documents. ñSOFT COPYò of all documents shall also be supplied. Vendor shall take care of the complete requirements of designing, and implementation of RTUôs for monitoring & control, taking care of list of electrical parameters etc covering the requirements outlined in this specification for project implementation

a) **Functional Design Specifications (FDS)**
FDS shall be custom defined to include the implementation aspects of MR requirements[Complete details of RTUôs ,their Interfacing, Integration and communication aspects between various subsystems including with Telecom system, communication protocol details, interfacing details with GC/ FC systems etc. with detailed technical catalogue of all RTUs, other items]

b) Engineering/ Construction drawings & documents
RTU cabinets general arrangement and overall dimension drawings (including foundation & base frame details, weights and clearances required) etc. Assembly and installation diagrams, installation & interconnection drawings, cabling schedule of RTUs (including for cables between TIC/ metering panel & RTU) and final termination details(in GAIL format).

c) Factory Acceptance Test (FAT)
Plans and procedure documents FAT document for RTUs shall contain test sections to test all the aspects of the RTUs as covered in PR, FDS and all other related drawings & documents.

d) Site Acceptance Test (SAT)
Plans and procedure documents SAT document for whole RTUs shall contain test sections to test all the aspects of RTUs as covered in PR, FDS and all other related drawings & documents, in addition to integrated testing with the GAILôs SCADA System

e) Documentation
This shall cover engineering manuals, user manuals, installation, operation & maintenance manuals for all software, hardware and equipments, handbook of inventory of all the equipments supplied and installed.

1.9 Final as-built documents/ drawings [2 sets of binders/ folders] and 2 sets of CDs shall be furnished prior to the commencement of warranty, after incorporating all modifications made at site. Final as-built documents/ drawings of RTUs with RTU related manuals and location specific cable termination details [one document per RTU location ôRTU Station folderô shall be made available and kept in the RTU cabinet for ready reference].

1.10 The vendor shall inform GAIL about RTU discontinuation one year in advance so that GAIL can procure the spares of RTUs to maintain it for its remaining useful life.

1.11 Necessary software tools for configuring/writing IDE interface in RTU shall be also supplied.

1.12 **Input/Output Requirement**

a) Each RTU must contain I/O cards to cater 16 AI points, 16 DI points & 8 DO cards as minimum. The RTU cards are to be supplied considering the complete I/O requirements of

RTU I/O count and 25% installed engineering spares (including relays) over & above the I/O count specified. The RTUs shall be fully engineered considering 25% installed engineering spares including processor loading.

b) Each RTU should have additional 25% Spare slots of the total installed serial and I/O cards slots. The spare slots to be covered with appropriate enclosure.

c) The Instrumentation FCs/ GCs (being procured by COMPANY separately) shall transfer their respective signals to/ from GAILôs SCADA system through serial communication interface with the respective RTUs.

1.13 **Panel Design Criteria**

GAIL shall provide 1 feeder of 230 V AC / 24 V DC (either of one) UPS at the location for powering the RTU. Vendor shall provide details of power consumption of each plug in unit, as well as typical and maximum power consumption of a node.

The MCBs shall be suitably rated for the circuits they protect.

Vendor shall ensure that each of the equipment is supplied with reliable and rugged SMPS to generate isolated and stable voltage levels required for equipment operation .All equipments shall be designed with a built in safety to protect against the effects of induced high voltages and lightning strikes. Card level transient suppressors shall be provided wherever necessary.

The power supply equipment shall be provided with protection against short circuit, over voltage, under voltage, and transients. Power supply units shall not generate excessive vibration or acoustic noise. The heat generated by the units shall be kept to be a minimum.

1.14 **Surge/ Lightening Protection, Transient Suppressors, RFI Filters**

RTUs shall be provided with surge/lightening protection for power supply and protection devices to ground against the effects of lightning strikes and induced high voltages. Card level transient suppressors shall be also provided wherever necessary.

1.15 **Earthing**

Each RTU panel shall be provided with continuous copper earthing lugs/strips. All these lugs/strips shall be properly secured to the AC mains earthing bus. All metal parts other than those forming part of an electrical circuit shall be earthed by connecting to the earthed bar in an approved manner and all earthing terminals and connections shall be of adequate dimensions. When apparatus or instruments are accommodated on the panel (as applicable), cubicle doors or swinging frames, flexible cables or braid shall be used for earthing these items; the door, hinges will not be accepted as means of earthing this part of the equipment.

1.16 **Safety Requirements**

The manufacturer or supplier of the equipment or apparatus shall ensure that the operational hazards are not there and total safety requirements are met. Vendor shall use sound engineering judgments to complete an installation that will perform the required function without compromising this aim. Provision shall be made to isolate various incoming signals to the cabinet, before gaining access to various cabinet internals. Shrouded terminals with warning labels shall be provided with these terminals being segregated from other incoming terminals.

1.17 **Cabinets, Cubicles, Racks and Control Panels**

All the cabinets shall be free standing enclosed type of RITTAL or equivalent make, with bottom entry for cable connections, fitted with concealed hinges with pull pins for door removal. All devices of solid state type shall be mounted on plug in card in cubicles. The general design shall subject to approval. Similar racks or cubicles shall, as far as possible, be employed for all apparatus. Racks and cubicles shall be complete with all necessary tag blocks, terminal blocks, cable glands and gland plates for small wiring and multi-core cables and earth bar strips with earthing connections. These shall be located in easily accessible position and so arranged that the terminals face the access direction for convenience during maintenance.

The RTU cabinetsô dimensions shall be [1000 mm height (900 mm height + 100 mm base plate), 600 mm width & 600 mm depth] however the final cabinet size will be decided as per the site requirement at the time of detail engineering. The panel shall conform to IP54.

All cabinets shall be with lockable front and rear doors and bottom cable entry and with gasket and fittings to keep out moisture, corrosive, salts, dust & gases. All doors, drawers, trays and other weight supporting parts shall be fabricated of metal adequately reinforced to limit vibration and ensure plane surfaces and shall be well housed and tidy in appearance. All fasteners including nuts, bolts, flat/ lock washers and screws shall be of SS. All doors shall have flush mounted handles with key operated mechanical door locking arrangement.

All frame and steel work of the cabinets shall be degreased, and then phosphate treated or coated with primer, followed by at least two undercoats and a final coat of matte finish enamel paint of Grey color (RAL 7035). The finish of the equipment shall be of the finest quality and capable of long and unattended service. The inside of the cabinets shall be Pale cream as per RAL 9001.

All the cabinets shall have documentation pockets located inside the front door & ónameplatesô correlating with the type and location of the cabinet The nameplate shall have letter height 12 mm, letter width 8 mm, label height 30 mm with letters in white colour and engraving on black background. Further all the equipments within cabinets shall be clearly identified with screw-on labels. The cabinets shall be provided with lifting eyes.

Vendor shall calculate the heat dissipation and where the calculations prove the necessity, and the air flow ventilation shall be assisted by integral low power silent running air extraction fans.

Each fan shall have separate dedicated assembly and shall be replaceable online without shutting down the cabinet in part or in complete. Each fan shall have its own dedicated isolator with fuse or circuit breaker. Each ventilation fan shall be fitted with a protection type finger guard. Inlet ventilation grills shall be fitted with dust filters

All the equipments shall be properly mounted to facilitate ease of maintenance. All individual equipment modules shall be easily accessible and removable. All internal wiring and cabling shall be installed in wiring ducts.

Additional power sockets shall be provided to accommodate test & maintenance equipment.

When cabinets are delivered at site, the vendor shall ensure that the paint is ónew ô with all marks removed and touched up.

The low power cabinet lights on front and rear side of the cabinet shall be provided, activated by respective front & rear door opening. The internal illumination shall ensure adequate illumination level for performing maintenance facilities.

1.18 **Equipments, Components and Terminals Identification**

All labels shall be clear, bold, concise and durable and fixed in a secure permanent manner .Labeling on equipments shall be in accordance with good ergonomic principles so that warning notices, controls, indications, test facilities, fuses, etc are sensibly placed and logically grouped to facilitate correct and unambiguous identification.

1.19 **Electromagnetic Compatibility**

All equipments shall be immune to electromagnetic interference generated by any nearby source. Where it is necessary to take specific measures on site in order to achieve the required degree of immunity (e.g. special earthing or screening arrangements), full details of these measures shall be submitted for approval.

2 CABLES

2.1 All cables between TICs/ Instrumentation Control panel / Metering Panel and RTUs / Convertors shall be PVC insulated, single pair (1.5 mm2)/ multi pair (0.5 mm2), twisted in pair individually (individual pair shielded applicable for analog input and output signals only) and overall shielded with aluminium mylar tape. Separate cables for analog and digital

cables to be used. Each pair of the multi-pair cable would be identified by the pair no. identification.

2.2 The LAN cable (CAT 6 Cable) from RTU to Telecom rack shall be minimum 15 meters long for each communication link complete with connectors at both ends.

2.3 Power cable for powering up of RTU shall be minimum 20 mtrs in the scope of vendor.

SCOPE OF INSTALLATION, TESTING AND COMMISSIONING

1.1 Vendorôs scope of supply and services shall include, but not limited to all the activities of project management, design, engineering, installation, integrating with existing SCADA system, commissioning, site testing, test run, insurance, forwarding, inland transportation etc. warranty, quality assurance and quality control of the system and documentation with turnkey responsibility and meet the requirements of the project, its objectives, functional & specific requirements described in the specifications and taking care of complete requirements of I/Os, other attachments etc.

1.2 Performing all works required for designing, engineering, testing, supply, installation, interfacing with the communication channel, IEDôs and instrumentation & electrical systems etc. commissioning (with supply of commissioning spares including consumables), site testing, test run and putting into commercial operation of the system complete in all respects.

1.3 Supply of all cables between respective equipments, telecom cables, power supply & power distribution cables etc. covering the complete requirements as specified are also included in Vendorôs scope. In addition supply of cables, glands, corresponding suitable cable connectors and interconnection of cabling and accessories including cable routing between the following cabinets/ equipments are also included in Vendorôs scope, and to be carried out by the Vendor. The activities of signal identification at site, cable laying& routing, cable termination, ferruling, glanding, dressing at TIC/ metering panel / Instrumentation Control panel / FC/ GC end, RTU end, telecom rack end etc. are in Vendorôs scope.

a. Between RTUs & Telemetry interface cabinets/ Instrumentation Control panel / Metering Panel
b. Between RTUs & Telecommunication equipments
c. Between RTUs and serial devices i.e. FC/GC (serial link interface)

Notes:

a) Distance between TIC/ Instrumentation Control panel / Metering Panel & RTU shall be tentatively considered as 15 mtrs. However, these distances shall be firmed up during detailed engineering or prior to FAT.
b) Distance between FC/GC and RTU shall be tentatively considered as 25 mtrs. However, these distances shall be firmed up during detailed engineering or prior to FAT.
c) The LAN cable (CAT 6 Cable) from RTU to Telecom rack shall be minimum 15 meters long for each communication link complete with connectors at both ends. However, these distances shall be firmed up during detailed engineering or prior to FAT.
d) The interconnecting cables with rigid PVC conduit for straight runs of cable and Flexible cable conduits for ends shall be provided over the interconnecting cables {to provide mechanical strength and rodent protection} shall be included accordingly.

1.4 Performing all Configuration / Augmentation in existing / new RTUs, database updation/ preparation, graphics updation/ preparation, other modifications the supply and installation of new cards as mentioned elsewhere in the document in the existing RTU if required and further configuration of the RTU for getting the additional data in RTU and further providing assistance to GAIL/SCADA Subvendor for integration of the additional parameters in GAILôs SCADA system.

1.5 Development, testing and commissioning of necessary software for RTUs to interface with flow computers (FCs)/ Gas Chromatographs (GC) at respective locations through serial link (RS485/232). The FC/GC make, model and protocol shall be provided by GAIL. Necessary configuration/development of software for writing GC analysis values to flow computers will be in vendor scope

1.6 The total & spare I/Os /slots in the existing TIC/RTUs to be verified / assessed during site survey by Vendor.

1.7 The modification of wiring / cabling dwgs. Of existing RTUs on account of addition of I/O signals for new facilities

1.8 In case of addition of signals to an existing RTU, the installation of necessary convertors at specified location, wiring, termination of the additional signals from TIC/Instrumentation control panel to RTU/Convertors along with supply & installing additional termination boards as required for the same, configuration of existing & additional I/O signals (both hardwired & serial) in the existing RTU, commissioning of existing RTU/ convertors (alongwith the additional signals) and also providing necessary assistance to GAILôs SCADA Vendor.

1.9 Prior to installation, all equipments shall be checked for completeness as per the specifications of equipment required for a particular station. Installation shall be carried out in accordance with the installation manuals and approved installation drawings in the best workmanship.

1.10 Vendor shall bring all installation tools, accessories, special tools, spares part etc. at his own cost as required for the successful completion of the job.

1.11 If during installation and commissioning any repairs are undertaken, the maintenance spares supplied with equipments shall not be used for the repair. Vendor shall arrange his own spare parts for such activities till the Owner has finally accepted the system. A detailed report & log of all such repairs shall be made available by the vendor to Owner/Engineer and shall include cause of faults and repair details, within 2 weeks of fault occurrence.

A detailed time schedule for these activities shall be submitted by Vendor to Owner/Engineer to enable their representatives to be associated with the job.

1.12 Vendor shall include all installation materials required for proper installation of the equipments. These shall include but not be limited to, all connectors, inter-bay and inter equipment cables, power supply cables and connectors, power distribution boxes, anchoring bolts, nuts, screws, washers, main distribution frames, audio distribution frames, voice frequency cables, junction boxes etc.

1.13 The installation of equipments shall be done as to present neat and clean appearance in accordance with approved installation document drawings. All inter bay, power supply and other cables shall be routed through wall mounted cable trays. No cable shall be visible. All through wall openings, trenches etc. shall be properly sealed to prevent the entry of rodents, insects and foreign materials. Power supply cables shall be taken from DC bus or panel in the electrical room and DCDB shall be provided in the Telecom room by the vendor.

Pre-Commissioning

1.14 On completion of installation of equipments, the Vendor on his own shall check the correctness and completeness of the installation as per Manufacturerôs manual and approved installation documents.

1.15 A list of Pre-Commissioning test (same as approved by the Owner/Engineer for site acceptance testing) and activities shall be prepared by vendor and the test shall be carried out by the vendor on his own. After the tests have been conducted to the Vendorôs own satisfaction, the vendor shall provide the test result for review by Owner/Engineer and then offer the system for Site Acceptance Testing.

1.16 During pre-commissioning, if any fault occurs to any equipment or system, vender shall identify the same and provide report/history of all faults to the Owner.

1.17 During installation and pre-commissioning of the telecom system, vendor shall have enough number of commissioning spares so that the installation is not held up because of non-availability of commissioning spares.

1.18 Vendor shall ensure that the spares meant for operation and maintenance is not used during installation and commissioning.

2. General Information for Project Execution

2.1 Vendor shall arrange sufficient manpower and material for installation and commissioning of the network at all locations.

2.2 Vendor shall arrange for the temporary power supply during installation, testing and commissioning of the network.

2.4 Vendor to coordinate/ support with GAILôs centralized SCADA Vendor / GAIL during project execution for successful project implementation and for meeting the MR specifications & requirements :

a) Establishing communication between GAILôs SCADA system and RTUs.
b) Providing the final indexing of all I/O points for each RTU to enable GAILôs SCADA vendor to configure the SCADA database.
c) providing Field I/O details (list of I/O points along with ranges, alarm limits, engineering units, status corresponding to open/close contacts, indexing details in the RTU etc.) for configuring in GAILôs SCADA as per GAIL standard IO list format (format shall be provided by GAIL). However corresponding details like instruments ranges, alarm limits, engineering units shall be provided by GAIL.

2.5 Vendor to Coordinate with Instrumentation (metering) vendor/ serial devices vendor/ pipeline laying contractor during project execution for successful project implementation and for meeting the MR specifications & requirements.

2.6 The civil works associated with the installation of supplied equipments at the stations.

2.7 The electrical works associated with the installation and commissioning of the equipment (RTUôs), earthing of equipments at all sites, powering of equipments at all sites, termination of cables as required.

2.8 Coordination with electrical vendor/contractor during project execution for successful project implementation and for meeting the MR specifications &requirements.

2.9 **Installation Materials**

All installation materials such as AC and DC power cables, instrument signal cables, telecom cables, serial link cables, LAN cables, interconnecting cables between various equipments and peripherals, earthing cables, data cables, cable trays, interposing relays, connectors, isolators, switches, conduits, fuses, terminations, gland plates, mounting accessories and other items required but not mentioned herein shall be provided by the vendor.

Annexure A

REMOTE TELEMETRY UNITS (RTUs)

1. GENERAL

1.1. The RTUs shall be microprocessor based, programmable units with processor, memory, power supply unit & communication cards and I/O cards complete in all respects. All RTUs shall be modular and from the same model product line with identical capabilities. The RTUs main processor shall employ minimum 32 bits word length for CPU processing. The RTU memory shall be adequate to cover the complete requirements of RTUs I/O count including serial points & also taking care of the RTU specifications.

1.2. The I/O cards shall not be combined for the functionalities i.e. each card shall perform dedicated functionality wrt analog input, analog output, digital input, digital output, pulse input.

1.3. Vendor shall undertake full responsibility of supply of equipments and provide assistance to GAIL for integration of RTUôs with GAILôs centralized SCADA system with open architecture meeting the objectives, functional and specific project requirements.

1.4. Cabinet light on the front and rear side of the RTU shall be provided (activated on the respective door opening for case of maintenance). The lamps shall be low power consumption.

1.5. RTU SUBSYSTEMS

1.5.1. The RTUs shall comprise the following subsystems:

- Central processor with system software
- analogue input
- Contact (digital) input
- Analogue output
- Contact (digital) output
- Communications
- Serial ports
- Power supply
- Diagnostic (on-line from GAILôs SCADA System and off-line diagnostics)

The RTUs shall be configured such that failure of any part of an RTU subsystem (module) shall not directly affect the integrity of the unit, as a whole.

1.5.2. The RTU system software shall provide the overall management of the supervision, monitoring and control function within the RTU. The common logic shall also manage the local PDT, communications, comprehensive diagnostic facilities and RTU startup procedures.

1.5.3. DIGITAL INPUTS

Typical specification of Digital Input Modules to be supplied is as given below:

Input Type	Min. 16 Volt free contacts (2 wire isolated)
Contact Wetting	2mA per input at 24V DC
Resistance recognized	Not exceeding 1 Kilo Ohms as a closed contact
Resistance recognized	Not less than 50 Kilo Ohms as an open contact
Isolation	Using optocouplers
Insulation resistance	20M ohms at 500V DC inputs to logic

Debounce circuitry	10 m/sec
Indicators	Loop & state LEDs for each DI point
Voltage withstand Capability	1.5 KV RMS
NO/NC contacts	Mixing of NO/NC contacts to be possible in the same card

1.5.4. DIGITAL OUTPUTS

Typical specification of Digital Output Modules to be supplied is as given below:

Output Type	Max. 16 relay contacts, individually isolated
Indicators	LED indication for each DO point
Relay Type	Miniature power relay, hermetically sealed
Contact arrangement	1 NO + 1 NC relay contacts configuration
Contact Rating	Potential free contact rating of output interposing relay for each DO point(Contact rating 48 V DC, 2A;230 V AC, 5A and relay contact to be of noble metal) [Vendor to provide interposing relays with LED indicator for each DO point]
Isolation	2KV RMS Contacts to Logic
DO command activation	2 sec. Pulse (Normally the NO potential free contact shall close for 2sec. duration). The pulse duration shall be user configurable. For repeat DO output requirement, permanent DO shall be provided
Security	Output contacts shall be short circuit proof and protected by suitable mechanism like fuse with suitable visual fuse blown indication provided.

1.5.5. ANALOG INPUTS

Typical specification of Analog Input (AI) Modules to be supplied is as given below:

Input Type	Isolated Current Inputs with Min.16 points per AI card
Ranges	4 - 20 mA
Multiplexer	Vendor standard
ADC Type	12 bit binary. [Each analog input card will have its dedicated A/D converter].
Series Mode rejection	Greater than 30 db at 50 Hz
Common Mode rejection	Greater than 100 db at 50 Hz
Roll over error	1 bit
Temperature Coefficient	0.005% per degree C
Accuracy	± 0.1% of range including drop in resistor (the drop in resistor to be high precision 0.02% or better)

1.5.6. ANALOG OUTPUTS

Specification of Analog Output Modules is as given below:

Output type	Min. 4 completely Isolated current (4-20 mA) outputs. The external isolator if required, for isolated O/P shall be included for each AO point
DAC Type	12 bit binary

DAC Span	10V or 5V
Output Range	4-20 mA DC
Isolation	Each output shall be isolated from logic and the others to 500 Volts
Loading	1K ohm for Current outputs
Differential Linearity	1/2 L.S.B
Temperature coefficient	0.01% FSD per degree C
Accuracy	± 0.1% of range
Retentivity	Set-point value to be held by AO card till updated by new set-point value from GAILôs SCADA System

1.5.7. COMMUNICATIONS

a) The RTU shall support both internal and external communications functions.
b) The communications network internal to the RTU shall be designed and implemented in such a way that the passing of data and commands between modules shall not be prevented by the failure of any module not directly involved in the communication exchange. In addition, the internal network shall not become overloaded under the heaviest traffic possible in an RTUôs configuration.
c) The LED indications shall be provided in the RTU to check the health of RTU communication.
d) RTU shall have dual Ethernet ports (with each port to be configurable independently) for TCP/IP communication with GAILôs SCADA system on multidropped environment (shared LAN). Also no other ports in the card to be used for any purpose other then communication to GAILôs SCADA system and RTU configuration. Separate serial card(s) shall be used for interfacing IEDôs.
e) The RTUs shall have the provision to be polled for data by SCADA system, independently and simultaneously on both communication ports.

RTU FEATURES

1.5.7.1. The RTU shall support the following:

a) Scanning of Input and Output.
b) Operator initiated discrete control action with check before execute and time out feature.
c) Operator initiated discrete control with sequencing and interlocking.
d) Derivation of calculated digital points based on logical functions AND, OR, NOT etc. from digital and analog points.
e) Derivation of calculated analog points based on arithmetic functions +, -, /, *, sq. root etc. and driving external hardware. Calculation shall be performed in RTU in engineering units with 16 bit floating point accuracy.
f) FC/GC systems (IEDs) interface for serial data.
g) RTU resident accumulator points driven by analog points.
h) RTU should have diagnostic feature for hardwired I/Os, DNP/IEC and IED communication.
i) All the field/IED parameters should be configurable at RTU end.

1.5.7.2. Automatic time synchronization of Remote telemetry units shall be implemented from GAILôs SCADA system.

1.5.7.3. The RTUs shall have a self-diagnostic feature (without uploading/ downloading RTU configuration to PC/ Laptop) and software watchdog timer devices to monitor & report the healthiness of CPU, memory, power supply, comm. interfaces (both DNP/ IEC communication with GAILôs SCADA system & serial communication) and Input/ Output modules at the local level. Further the RTUs shall support remote diagnostics from GAILôs SCADA System so that all these status shall be transmitted to GAILôs SCADA System for displaying in the RTU status graphic.

1.5.7.4. It shall scan and acquire parameters from process as per programmed scan cycles.

1.5.7.5. RTUs shall be intelligent in support of the following:

a) It shall process the analog data for high-low limit violations as per stored limit tables and communicate the same to GAILôs SCADA System along with time stamping. The high and low alarm limits settings for any process variable in RTU shall always remain synchronized with SCADA downloaded database high and low limits settings.
b) Linear conversion to engineering units and input filtering.
c) To support download configuration to RTUs from the GAILôs SCADA System online and off-line.
d) Time stamping of all analog exception reports and digital state changes.
e) Conversion of raw data to normalized value (e.g. 0 to 1.0) for communication shall also be acceptable.

1.5.7.6. The RTU shall have the following capability: -

a) RTU shall be capable of updating process parameters data and configuration data in its own built-in memory. In the event of failure of GAILôs SCADA System or break of communication link, the RTU shall continue to scan all parameters and update its database.
b) RTU shall retain in its database the complete analog & digital information of the field till it is completely and correctly read by GAILôs SCADA System, in order to take care of no loss of data, in case of failure of communication, SCADA server, communication via other location The RTU shall scan the field and the memory buffer is to be sized to store all the changing data (i.e. new exception report for the data every poll time) and GAILôs SCADA System receive the same without any loss of data and alarms in the GAILôs SCADA system.
c) Further to take care of long term communication outage with GAILôs SCADA System, the RTUs shall be designed to also scan the field and store in the memory time-stamped 5000 analog events and 1000 digital events during the period of communication outage for retrieval by GAILôs SCADA System subsequently. The RTU memory sizing shall be adequate for the same. In case additional memory cards are required to meet this requirement, same shall be provided by the vendor. RTUs buffer shall be circular buffer with new events replacing old events.
d) The RTU system shall have the facility to attach to each digital event signal a time tag generated by the RTU local clock to enable the occurrence to be recorded and transferred to GAILôs SCADA System.

1.5.7.7. The selected RTUs shall be of fit-for-purpose type with very low power consumption and state-of-art technology.

1.5.7.8. RTU shall be programmable using IEC 61131 programming languages. The RTU should be completely configured for all the I/O points available in the RTU irrespective of the field termination.

1.5.7.9. RTU shall support extended I/O capability and multiple communication ports.

1.5.7.10. It shall be possible to have highest priority for alarms, in order for the same to be sent to GAILôs SCADA System.

1.5.7.11. It shall provide óCheck Before Execute' feature as part of RTU protocol before execution of command.

1.5.7.12. Every control associated with RTU shall report the status of the point after control execution. In case the status has not changed within fixed specified time it shall report to GAILôs SCADA System for not having executed the control.

1.5.7.13. RTU shall not generate any false control signal due to CPU power supply on-off conditions.

1.5.7.14. RTU shall support communication protocol supporting report by exception to prevent unnecessary data communication when the data is not changing and also support downloading of Exception value dead band (each Analog input wise) from the GAILôs SCADA System.

1.5.7.15. It shall provide error detection and control feature for data communication with GAILôs SCADA System to ensure data integrity.

1.5.7.16. It shall have dedicated RS232 / Ethernet port (this shall be in addition to the serial ports as indicated in Attachment-I) for connecting a pluggable Programmable Diagnostic Test unit (PDT) as diagnostic and programming aid to trouble shoot and configuration tool for RTU and I/O boards.

It shall be possible to exercise all the functions of the RTU without disconnecting the RTU from process. The configuration facility shall be password protected to prevent unauthorized access to the configuration data

1.5.7.17. The RTU shall be able to store the configuration data and the process database upon power failure. Upon restoration of the power, RTU shall resume the normal operation automatically. Low battery indication in the RTU shall be able to be telemetered to GAILôs SCADA System as diagnostic data.

1.5.7.18. The failed RTU once put online shall initiate service request to GAILôs SCADA System for re-initialization and configuration data shall then be downloaded from GAILôs SCADA System to RTU.

1.5.7.19. Separate on/off power supply switch and fuse shall be supplied with each RTU. Vendor shall indicate power consumption for all the RTUs. Adequate isolation of input, output and power supply circuits shall be provided along with over voltage and short circuit protection. Terminations for connections of power supply should be of standard industrial type.

1.5.7.20. The hardwired RTU signals as per Attachment-I shall be available from/to Metering panel/ Instrumentation control panel or Telemetry Interface Cabinets (TICs) (as applicable). FC signals shall be interfaced with the RTU using RS-485 MODBUS serial interface. Vendor shall include all necessary cables, glands and services to install the RTUs and interconnect the inputs/ outputs with the FC (control room/ porta cabin mounted FC, field mounted FC, remote FC interfaced through OFC) / TIC / Instrumentation Control panel/ Metering Panel along with interfacing with Telecommunication system. The I/O point wires shall not be directly terminated on the RTU I/O boards. Terminal blocks/ panel is to be provided in the RTU cabinet. RTU should be internally wired between IO cards and terminal blocks for all the IO points in all the IO cards in the RTU (irrespective of field termination). Terminals for all spare

cable cores shall also be provided. In addition 25% spare terminals shall be fitted to all rails per type with in the cabinet. The terminals shall be suitable for secured connection of 1.5 mm2 cables. Vendor shall detail the wiring harness between the RTU and the terminal block area. Vendor shall supply and install suitable ducting, brackets and supports for all wiring and ensure in the layout to provide maximum separation between groups of wiring carrying analog signals, digital signals and power supplies. Easy access to cabinet wiring for maintenance purposes is to be ensured.

1.5.7.21. The electronics in the RTU cabinet shall consist of plug-in PCB's or units with Gold plated edge connectors that utilize a wiping action for connection for PCB's to the back frame wiring. The PCBs and RTU components shall be designed for high temp. rating and low power consumption so that air exchange with the ambient environment will not be required. This is to ensure that RTU performance is not affected due to its internal heat dissipation and the environmental conditions.

1.5.7.22. The RTU equipment shall function continuously without requiring any preventive maintenance.

1.5.7.23. It shall be possible to output any AI & DI point value available in real time database at GAILõs SCADA System, as AO & DO to any RTU respectively. The wiring of AO & DO to the TIC/ Instrumentation control panel / Metering Panel shall be complete. The DO command contact closure shall be configurable. However no separate program or logic will be acceptable at RTU end for the same.

1.5.7.24. It shall be possible to configure DO contact duration open or close for the duration as required corresponding to the DI status. In case permanent type of DO card is required in the RTU I/O count, the DO status is maintained corresponding to the DI status for the repeat parameters. The relay contact configuration shall be provided up to the RTU terminal block and thereafter up to the TIC/ Instrumentation control panel / Metering Panel.

1.5.7.25. Vendor to ensure that open/ close status of valves (open state first wired and thereafter close state) be wired consecutively in the RTUs.

1.5.7.26. Identification labels for RTUs, RTU card files, power distribution boards, terminations, identifications of serial interfaces ports for FC, PDT connections; telecom channel interfacing etc complete in all respects properly correlating with the drawings is to be ensured by the vendor.

1.5.7.27. In the RTU cabinet copper strips mounted on the insulated studs shall be included for system earth. The copper strip mounted on the conductive studs shall be included for the cabinet earth. The earth wiring shall be completed on the same basis within the RTU cabinet.

1.5.7.28. The incoming power can be upto 2C, 24 mm2. The terminations in the RTU should be suitable accordingly. The cable sizes for the main power distribution within the RTU shall be 2.5 mm2, for earth wiring 2.5 mm2, digital input/ digital output wiring 1.5 mm2 and analog input/ analog output wiring 0.5 mm2 as a minimum.

1.5.7.29. Different colour codification shall be followed for various types of wiring. The suggested wiring colour code is:

- 48V DC or 24V DC	Yellow
0 V	White
DI	Blue
DO and Relay	Orange

Analog	Grey
Cabinet Earth	Green
System Earth	Green with yellow stripes

1.5.7.30. In addition to the internal DC distribution, the connectors with the switches and fuses for powering plant simulator shall also be provided in the RTU cabinet at suitable location.)}. The field instruments shall be powered from the RTUs with each field loop to be independently switched via a dedicated fuse.

1.5.7.31. At the RTU, failure of a module in a subsystem shall be identified by an individual LED display.

1.5.7.32. Each I/O shall be protected against the reversal polarity of the power voltage to I/O.

1.5.7.33. The RTU time stamped analog & digital data shall be sent to GAILôs SCADA System.

1.5.7.34. For Communication protocol between RTUs & GAILôs SCADA system, RTUs should support DNP 3.0(TCP/IP) protocol. However, the following standard communication protocols shall also be supported by the RTUs :- DNP 3.0, IEC 60870-5-101 and IEC 60870-5-104 protocol

1.6. SCAN RATES

The local scan rates for individual I/O modules shall be such that the time-tagging resolution and system performance requirements are achieved.

The consideration of scan times shall include the acquisition of data, processing and updating of the RTU database. The overall RTU local scan shall be defined as the time required to acquire field data and to acquire FC data and update the RTU database and the same shall be much faster than RTU poll time by GAILôs SCADA System.

1.7. DIGITAL OUTPUT SUBSYSTEM

The contact output subsystem shall provide momentary 2 sec (user configurable) closure of potential free contact relay output for the operation of pumps (if applicable) & valves.

It shall not be possible for the RTU to energize an output that has not been selected for control.

The duration of each contact closure shall be pre-selectable (normally 2 seconds contact closure) and all contacts shall be voltage free. If repeat output is required permanent type DO card shall be included. An RTU restart, following an RTU power failure, shall not reset the output circuits, shall not generate false control signal and shall cancel any pending control selection.

1.8. SET-POINT CONTROLS

All analog output control functions shall utilize the select-check-operate control sequence associated with set point control.

1.9. SERIAL LINK REQUIREMENT

The interconnecting RS485/ RS232 cables and connectors for each of the RTU location and for each of the serial ports, with complete line drivers, software drivers & connectors at both ends and interfacing requirements in built for communication with FCs (supplied by COMPANY) shall be included in the vendorôs scope. Vendor shall develop, configure and establish the communication for retrieval of data from the FCs, which support Modbus Protocol for serial link connectivity for all the RTUs in the pipeline network. The RTU serial ports shall support

different baud rates and it shall be possible to vary the baud rate of each port in order to optimize the communications i.e. they should be independently and individually configurable at all respect.

a) The serial links shall support transmission of all types of data and status bits including 16-bit, 32-bit, signed, unsigned, integer and floating point data type. The Purchaser shall furnish the make & model no. of FCs. Vendor shall assume full responsibility for obtaining the full protocol information, memory map, details of connectors etc. from the FCs suppliers. Further necessary connectors (ensuring compatibility), interconnection, interfacing, engineering required for retrieval of the data from the FCs to make the link fully operational shall be in the vendorôs scope. It is the vendoróś responsibility to coordinate with the suppliers of FCs as intimated and establish the communication for transfer of data & control with them to meet the complete functionality.

b) The RTU memory sizing shall be adequate for required nos. of serial points as per RTU I/O Count & the no. of serial ports for each RTU.

c) The FCs data shall be scanned by the RTU much faster than RTU poll time by GAILôs SCADA System.

1.10. Minimum below mentioned ports to be available in the RTUs

ÅTwo Ethernet (Electrical) ports for communication with GAILôs SCADA System
ÅTwo RS485 ports for interfacing with FC (Flow computer)
ÅOne RS232 / Ethernet port(Vendor to decide) for PDT interfacing
ÅOne RS232 spare port
ÅFour RS485 spare serial ports
ÅOne Ethernet (Electrical) spare port

Annexure B

Specification for Managed Industrial converter

Make: Moxa/Advantech / Phoenix Contacts

Ethernet Interface
Number of Ports: 2
Speed: 10/100 Mbps, auto MDI/MDIX
Connector: 8-pin RJ45
Magnetic Isolation Protection: 1.5 KV built-in

Serial Interface
Number of Ports: 2
Serial Standards: RS-232/422/485 Selectable
Serial Line Protection: 15 KV ESD protection for all signals

RS-485 Data Direction Control: ADDC® (automatic data direction control)

Serial Communication Parameters
Data Bits: 5, 6, 7, 8
Stop Bits: 1, 1.5, 2
Parity: None, Even, Odd, Space, Mark
Flow Control: RTS/CTS and DTR/DSR (RS-232 only), XON/XOFF

Baudrate:
110 bps to 230.4 Kbps
Serial Signals
RS-232: TxD, RxD, RTS, CTS, DTR, DSR, DCD, GND
RS-422: Tx+, Tx-, Rx+, Rx-, GND
RS-485-4w: Tx+, Tx-, Rx+, Rx-, GND
RS-485-2w: Data+, Data-, GND

Software
Network Protocols: ICMP, IP, TCP, UDP, DHCP, BOOTP, Telnet, DNS, SNMP V1, HTTP, SMTP
Configuration Options: Web Console, Serial Console, Telnet Console, Windows Utility
Physical Characteristics
Housing: Metal
Environmental Limits
Operating Temperature: 0 to 70°C (32 to 131°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

Input Voltage: 12 to 48 VDC / 230 VAC

Standards and Certifications
Safety: UL 60950-1, EN 60950-1
EMC: CE, FCC
EMI: EN 55022 Class A, FCC Part 15 Subpart B Class A
EMS: EN 55024

MTBF (mean time between failures):
200,000 hrs

Annexure C

Specification for Managed Industrial Switch

Make: Moxa / Advantech / Phoenix Contacts

Communications

- **Standards:** IEEE802.3, IEEE802.3u, IEEE802.3z, IEEE802.3x, IEEE802.3ad, IEEE802.1d, IEEE802.1w, IEEE802.1p, IEEE802.1Q, IEEE802.1x
- **LAN**: 10/100Base-T(X),
- **Fiber Port**: 100Base-FX (SC/ST connectors) using 1310/1550 nm, fully equipped.
- **Transmission Distance Ethernet** : Up to 100m **Single-mode Fiber**: Upto 30km
- **Fiber**: 9/125 Micro meter
- **Transmission Speed** Up to 100Mbps

Interface

- **Connectors** 8 x RJ-45 ports, 2 x SC/ST type fiber optic connectors
- **LED Indicators System**: PWR, R.M., P-Fail10/100T(X): Link/Activity, Duplex/Collision
- **Console** RS-232 (RJ-45)

Network Management

- **Configuration** Web browser, Telnet, Serial console, TFTP, SNMPv1/v2c/v3, Port Speed/Duplex Configuration
- **VLAN** IEEE 802.1Q, GVRP, Port-based VLAN
- **Redundancy** X-Ring (Recovery time < 10ms at 30pcs full loading ring structure), Dual Homing, Couple Ring, 802.1w/D RSTP/STP
- **Security** IP Access security, port security, DHCP Server, Port and IP Binding, 802.1X Port Access Control
- **Traffic Control** IGMP Snooping/Query for multicast group management Port Trunking, Static/802.3ad LACP Rate limit and storm control IEEE 802.1p QoSCoS/TOS/DSCP priority queuing IEEE 802.3x flow control
- **Diagnostics Port** Mirroring, Real-time traffic statistic, MAC Address Table, SNTP, Syslog, Email Alert, SNMP Trap, RMON

Mechanism

- **Enclosure** IP30, metal shell with solid mounting kits
- **Mounting** DIN-rail, Wall

Power

- **Power Consumption** Max. 10 W
- **Power Input** 24/230 VDC,

Protection

- **Power Reverse**
- **Overload Protection**

MTBF

- 200,000 hrs

Annexure D

Specification for Ethernet to Serial Convertor

Make : Moxa / Advantech / Phoenix Contacts

Ethernet Interface
Number of Ports: 1
Speed: 10/100 Mbps, auto MDI/MDIX
Connector: 8-pin RJ45
Magnetic Isolation Protection: 1.5 KV built-in

Serial Interface
Number of Ports: 1
Serial Standards: RS-232/422/485 Selectable
Serial Line Protection: 15 KV ESD protection for all signals
RS-485 Data Direction Control: ADDC® (automatic data direction control)

Serial Communication Parameters
Data Bits: 5, 6, 7, 8
Stop Bits: 1, 1.5, 2
Parity: None, Even, Odd, Space, Mark
Flow Control: RTS/CTS and DTR/DSR (RS-232 only), XON/XOFF

Baudrate:
110 bps to 230.4 Kbps
Serial Signals
RS-232: TxD, RxD, RTS, CTS, DTR, DSR, DCD, GND
RS-422: Tx+, Tx-, Rx+, Rx-, GND
RS-485-4w: Tx+, Tx-, Rx+, Rx-, GND
RS-485-2w: Data+, Data-, GND
Software
Network Protocols: ICMP, IP, TCP, UDP, DHCP, BOOTP, Telnet, DNS, SNMP V1, HTTP, SMTP
Configuration Options: Web Console, Serial, Console , Telnet Console, Windows Utility
Physical Characteristics
Housing: Metal

Environmental Limits
Operating Temperature: 0 to 70°C (32 to 131°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

Input Voltage: 12 to 48 VDC

Standards and Certifications
Safety: UL 60950-1, EN 60950-1
EMC: CE, FCC
EMI: EN 55022 Class A, FCC Part 15 Subpart B Class A
EMS: EN 55024

MTBF (mean time between failures):
200,000 hrs

Annexure E

Standard Specifications for Serial RS232/RS485 to Optical Converter	
Make : Moxa / Advantech / Phoenix Contact	
• Optical Fiber Side	
Fiber Connector	2 SC/ST Optical Ports
Wavelength	Single-mode: 1310 nm
Cable Requirements	Single-mode: 8.7/125, 9/125, 10/125 εm
Transmission Distance	Single-mode: 40 km (in 1310nm)
Tx Output	Single-mode: > -5 dBm
Rx Sensitivity	Single-mode: -25 dBm
Point-to-Point Transmission	Half-duplex or full-duplex
Ring Transmission	Half-duplex
• RS-232/422/485 Side	
Connector	Terminal Block
RS-232 Signals	Tx, Rx, GND
RS-422 Signals	TxD+, TxD-, RxD+, RxD-, GND
RS-485-4w Signals	TxD+, TxD-, RxD+, RxD-, GND
RS-485-2w Signals	Data+, Data-, GND
Baudrate	50 bps to 115.2 Kbps
ESD Protection	15 KV for all signals
Distance	RS232: 5-10 mts; RS485: 1000 mts
• Physical Characteristics	
Weight	Light-weight
Dimensions (H x W x D):	Small size
• Environmental Limits	
Operating Temperature	Standard Models: 0 to 60°C (32 to 140°F)
	Wide Temp. Models: -40 to 75°C (-40 to 167°F)
Storage Temperature	-40 to 75°C (-40 to 167°F)
Ambient Relative Humidity	5 to 95% (non-condensing)
• Power Requirements	
Input Voltage DC	9 to 48 VDC
AC	External AC Power Adapter
Power Consumption	8 watts max
Power Line Protection	2 KV Burst (EFT), EN61000-4-4
	2 KV Surge, EN61000-4-5
Voltage Reversal Protection	Protects against V+/V- reversal
Over Current Protection	1.1 A (protects against two signals shorted together)
• Standards and Certifications	
Safety	UL 60950-1
EMC	CE, FCC

EMI	FCC Part 15 Subpart B Class B, EN 55022 Class B
EMS	EN 61000-4-2 (ESD) Level 3,
	EN 61000-4-3 (RS) Level 2,
	EN 61000-4-4 (EFT) Level 2,
	EN 61000-4-5 (Surge) Level 2,
	EN 61000-4-6 (CS) Level 2,
	EN 61000-4-8 (SFMF) Level 1
Green Product	RoHS, CRoHS, WEEE
• MTBF (mean time between failures)	
Time	Minimum 500,000 hrs
• Warranty	
Warranty Period	5 years minimum

Annexure F

Industrial RS-232 to RS-422/485 converters

RS-232 Side	
Connector	DB9 female
Signals	TxD, RxD, RTS, CTS, GND
RS-422/485 Side	
Connector	Terminal Block
Signals	RS-422: TxD+, TxD-, RxD+, RxD-, RTS, CTS, GND RS-485-4w: TxD+, TxD-, RxD+, RxD-, GND RS-485-2w: Data+, Data-, GND
RS-485 Data Direction Control	ADDC® (automatic data direction control)
Serial Communication	
Baudrate	50 bps to 921.6 Kbps
ESD Protection	15 KV
Optical Isolation	2 KV
Operating Temperature	-20 to 70°C
Power Requirements	**230 VAC/ 24 VDC**
Voltage Reversal Protection	Protects against V+/V- reversal
Over Current Protection	Protects against two signals shorted together
MTBF (mean time between failures)	
Time	Minimum 3,000,000 hrs