



**GASONET SERVICES (RJ) LIMITED**

**Design, Supply, Installation, Testing, Commissioning, and 5 Years Comprehensive Operation  
& Maintenance of LNG Storage & Regasification station along with all  
necessary auxiliary units at Bikaner & Churu GA**

**RESONANCE ENERGY PVT LTD**

**TECHNICAL VOLUME II OF II**

***TENDER NO.: GSL/REPL/011/LNG***

**INTERNATIONAL COMPETITIVE BIDDING**

0	29/05/2023	DG	PG	AN
<b>Rev.</b>	<b>Date</b>	<b>Prepared By</b>	<b>Checked By</b>	<b>Approved By</b>



**Design, Supply, Installation, Testing, Commissioning, and 5 Years Comprehensive Operation & Maintenance of LNG Storage & Regasification station along with all necessary auxiliary units at Bikaner & Churu GA**



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GSL/REPL/011/LNG

Date: 29/05/2023

## **SECTION – I TECHNICAL SPECIFICATION**

**(Design, Datasheets, Term-sheets & Technical Specifications)**

**Project:** Design, Supply, Installation, Commissioning and 5 years of Operation & Comprehensive Maintenance of LNG Storage & Regasification station along with all necessary auxiliary units at Bikaner & Churu GA

**Item:** LNG Equipment & auxiliary units Tender

**No.:** GSL/REPL/011/LNG



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## **DESIGN BASIS**

### **1.1 LNG SATELLITE STATION WITH LNG, LCNG DISPENSING FACILITY**

The Bidder shall be required to do system design, develop detailed P&ID and detailed layout as per PESO guidelines. The complete system shall be designed for automatic operation with minimal human interference. However, there shall be human interface available in the PLC based control panel. The system shall be designed for most economic and reliable operations with Zero LNG boil-off even under no consumption condition. The system shall be designed in accordance with latest guidelines and other relevant codes/regulations/ laws applicable in India on the plot of land measuring approx.2000 m<sup>2</sup> as shown in Dwg. (Annexure-I). The equipment shown in attached Dwg. is only tentative, bidder should have to develop their own equipment layout and P&ID.

### **1.2 Major Applicable Codes:**

Static and Mobile Pressure Vessel (SMPV) Rules

(Unfired)Gas Cylinder Rules

NFPA 59A

OISD codes

PNGRB

regulationsPESO

guidelines

ASME BPV Code Sec

VIIIEN 13458-1

EN 13458-2

The Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Retail Outlets dispensing Petroleum, Auto LPG and CNG) Regulations, 2018” including draft Schedule 4 /PNGRB T4S standard dt 18.1.18 for LNG facilities.

In case of any discrepancies in the requirements of above codes, the most stringent requirement shall govern. Only latest edition of above-mentioned codes shall be followed.

### **1.3 MAJOR EQUIPMENT**

#### **1.3.1 LNG UNLOADING PUMP SKID**

The storage facility shall have 1 tanker unloading skid with 01 nos. of unloading pumps with the provision to accommodate second pump in future in the same skid. A suitable flow controller to be



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provided which will unload LNG from road tanker to storage tank with minimum 350 LPM flow and approx. 8-10 bar (g) differential pressure of LNG (or as required). The unloading skid shall have centrifugal pump suitable for LNG service and shall have a return line for tanker. Alternatively, the vendor can provide a submersible type pump with vacuum insulated sump. Suitable type strainer shall be provided at suction of the pump.

The unloading skid shall have automatic PLC based control system. The LNG unloading skid shall be provided with SS-braided LNG transfer hoses. The skid shall have required number of isolation valves, non-return valve, relief valve designed as per applicable codes and standards as required for safe and reliable operation. Instrumentation such as pressure & temperature gauges, transmitters etc. shall be provided as required for safe operation.

### **1.3.2 LNG STORAGE TANKS**

The LNG satellite station shall have (2 Nos. 56 KL ) gross capacities each vertical LNG storage tanks. The maximum allowable working pressure of inner storage tank shall be approx. 12 bar (g). The LNG storage tank shall be designed for a design temperature of -196°C to +49°C. The LNG storage tank shall have thermosiphon arrangement and shall have temperature sensors, pressure detection, level measurement etc. Two independent type level measuring instruments shall be provided and signal from the same shall be transmitted to the control room. Further, a separate and independent level indicator shall be used for ESD purpose. Suitable safety interlocks shall be provided. The LNG storage tank shall be designed to have minimum boil-off even during no consumption conditions.

LNG storage tank shall be designed, manufactured and designed in accordance with latest version of ASME BPV Code Sec VIII/ EN 13458-2. It shall be fit for LNG service and shall be designed to minimize LNG boil-off even during low/ no consumption.

The LNG storage tank shall be double-walled and insulated with suitable insulation such as perlite insulation under vacuum etc. The inner tank shall be made from X5CrNi1810/ SA 240 type 304 or equivalent/ superior material and shall be 100% radiographed. All internal piping/ fittings shall be seamless type and made from ANSI 304L (or equivalent). The piping shall be 100% radiographed and pressure tested. The outer tank shall be made from carbon steel or equivalent/ superior material. The outer surface of the tank shall be coated with polyurethane based paint of minimum 240µm DFT to avoid rusting/ corrosion.

Provision shall be made for independent as well as simultaneous operation of all the systems from any of the storage tank.



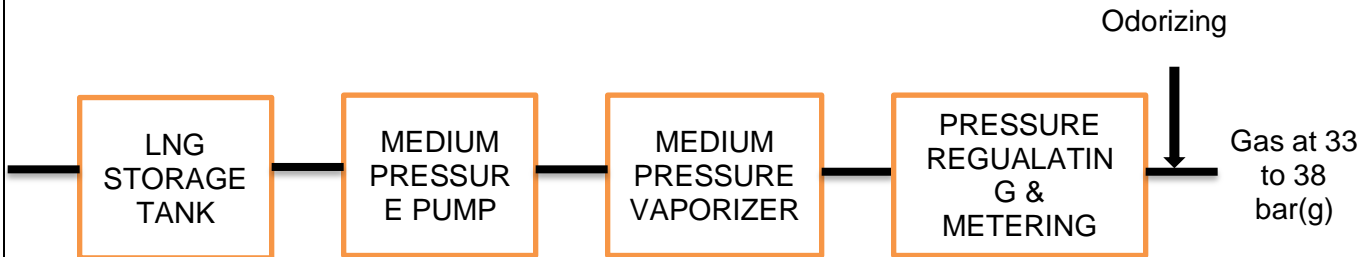
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### 1.3.3 MEDIUM PRESSURE RE-GASIFICATION SYSTEM



The above figure shows schematic for Medium pressure re-gasification system wherein LNG from storage tank is pumped to the required pressure via suitable pump and re-gasified using a medium-pressure vaporizer. The gas pressure is then regulated to 33 – 38 bar (g) pressure using pressure regulating skid with dual stream. Further two flow meters (1W + 1S) shall be provided in this system at downstream of PRS skid.

#### i. Medium Pressure Pump

LNG tank is connected with medium pressure pump which can pump LNG liquid up to maximum 70LPM each at 33 to 38 bar (g). There shall be 2 nos. of medium pressure reciprocating pumps (1 working + 1 standby) for Dodi. The pump shall have a normal suction pressure of 2 bar to max. 10 bar. The delivery pressure of pump shall be 33 to 38 bar (g). Suitable type strainer shall be provided at suction of the pump.

#### ii. Medium Pressure Vaporizer

Medium Pressure vaporizer shall be provided with a 100% standby for continuous duty operations. Each ambient air vaporizer shall be designed to work for 8 hours duty cycle and after that automatic change over to idle vaporizer to run re-gas plant on continuous duty operations. The change-over shall be automated with the help of PLC based control system and shall require no human intervention. The setup will be (1+1) for Bikaner .

Each medium-pressure ambient air vaporizer shall have a capacity of 2500 SCMH (each). The desired delivery pressure shall be 33 – 38 bar (g) after pressure control regulator. The inlet design temp for the vaporizer shall be from -196°C to +65°C.

The medium-pressure atmospheric vaporizer shall be ambient air heated and shall be designed in accordance with latest version of ASME SEC VIII, DIV I and shall be fit for LNG service.

#### iii. Pressure Regulating Skid



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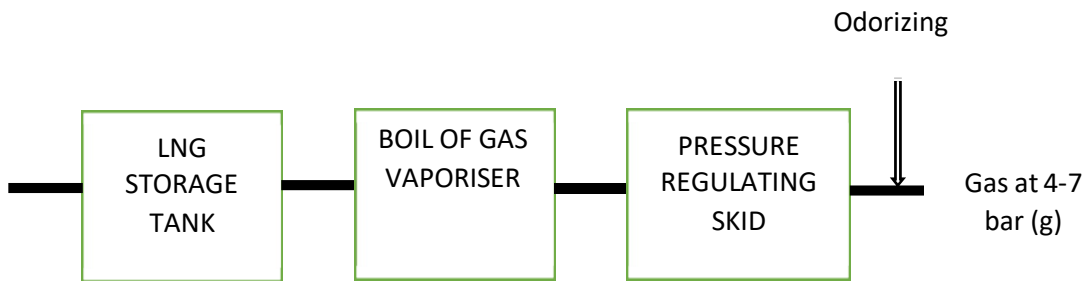


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Re-gasified natural gas shall be passed through pressure regulator skid which is equipped with twin stream pressure regulators and flow meters in each stream to get natural gas at 33 – 38 bar (g) pressure without any interruption.

### 1.3.4 BOIL OF GAS VAPORIZER



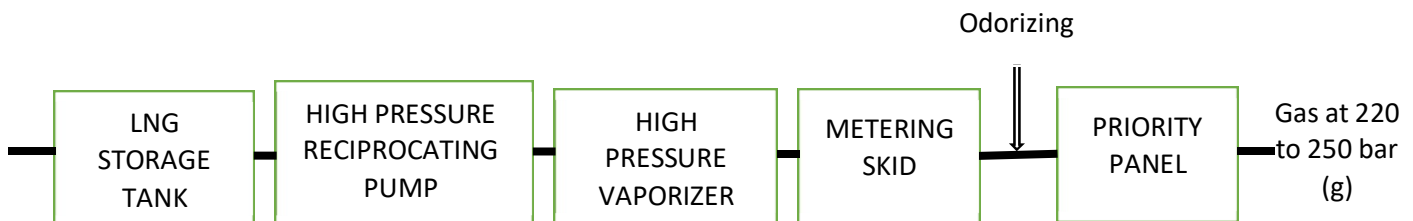
*Schematic for Low Pressure Re-gasification system*

The above figure shows schematic for Boil of Gas Vaporizer system wherein LNG from storage tank is directly re-gasified. The gas pressure is then regulated to 4 – 7 bar (g) pressure using pressure regulating skid with dual stream. Further two flow meters (1W + 1S) shall be provided in this system at downstream of PRS skid.

#### i. Pressure Regulating Skid

Re-gasified natural gas shall be passed through pressure regulator skid which is equipped with twin stream pressure regulators to get natural gas at 4 – 7 bar (g) pressure without any interruption.

### 1.3.5 HIGH PRESSURE LCNG SYSTEM



*Schematic for High Pressure LCNG system*

The above figure shows schematic for high pressure LCNG system wherein a LNG tank is connected with high pressure reciprocating pump which can pump LNG liquid to high pressure ambient air



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vaporizer for high pressure re-gasification LCNG application. The system shall be designed for CNG cylinder cascade filling at minimum 220 Bar (g). The CNG shall be odorized with an odorant consisting of 70-80% TBM + 20-30% MES as per requirements of PNGRB codes.

**i. High Pressure Reciprocating Pump**

LNG tank is connected with high pressure reciprocating pump which can pump LNG liquid at 33 LPM at min. 220 bar (g). There shall be 2 nos. of high pressure reciprocating pumps (1 working + 1 standby). The pump shall have a normal suction pressure of 2 bar to max. 10 bar. The delivery pressure of LCNG pump shall be minimum 220 bar (g). Suitable type strainer shall be provided at suction of the pump.

**ii. High Pressure Vaporizer**

Pressurized LNG is converted to high pressure CNG after passing through high pressure ambient air vaporizer and stored into the cylinder cascade of 3000 WL after odorization process. CNG cascade is further connected to CNG dispenser, through priority panel which will decide sequence of operation. Fixed CNG cascade has additional taping to fill other mobile CNG cascades. The high-pressure vaporizer shall have a maximum operating pressure of approx. 250-275 Bar (g) and shall be suitable for CNG cylinder filling at 250 Bar. It shall be designed for a capacity of approx. 1200SCMH each.

High Pressure ambient air Vaporizer shall be provided with a 100 % standby for continuous duty operations. Each ambient air vaporizer shall be designed to work for 8 hours duty cycle and after that automatic change over to idle vaporizer to run re-gas plant on continuous duty operations. The change-over shall be automated with the help of PLC based control system and shall require no human intervention. The setup will be (1+1) for Rajasthan.

The high-pressure vaporizer shall be ambient air heated and shall be designed in accordance with latest version of ASME SEC VIII, DIV I and shall be fit for service of LNG.

**1.3.6 CENTRALIZED CONTROL & MONITORING SYSTEM**

LNG storage and distribution plant operations should be controlled by centralized PLC and SCADA system for better and safe operations with manual interventions wherever applicable and with the provision for hook-up with controlled SCADA system of client. The offered control system (PLC & SCADA) should have provision to accommodate data and control for additional 30% of existing system. All solenoid valves should have provision for manual override. The control system should be user friendly, and menu driven.

PLC & SCADA System shall be supplied with licensed software required for accommodation of signals from field instruments / panels. PLC System shall comprise of fully wired free standing panels which include processors, power supply units, I/O cards, relay modules, communication modules, interfacing modules, I/O racks, Ethernet switches (manageable & stackable), serial modules, any kind of signal converters, Terminal Server / Data Concentrator, media converters, MCBs, TBs, fuses, surge



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protection devices, signal distribution cards, annunciators, lamps, hooter cum strobe, etc. ; HMIs (Engineering Workstation/ Operator Workstation) and licensed software for developing/ modification of logics ; consoles for HMI installation ; A3 color laser printer ; necessary LAN network & accessories ; chairs, etc. The PLC & SCADA system shall be included with independent control system of associated subsystem (i.e. odorizing system, metering system etc.)

In hazardous area applications, electronic/electrical instrumentation equipment shall be suitable for hazardous area classification as per IEC. These equipment shall be intrinsically safe conforming to CENELEC standard and certified by appropriate statutory bodies (ATEX, FM, BASEFA or equivalent). Intrinsically safe systems shall be designed using zener/ IS barriers. Where intrinsically safe design is not feasible, ex-proof equipment/enclosure, certified by statutory bodies like PESO Nagpur shall be supplied. Other acceptable safety procedures (e.g. increased safety procedure, pressurization etc.) shall be used, wherever applicable.

### **1.3.7 SAFETY SYSTEMS**

LNG satellite station shall be equipped with state-of-the-art safety systems and interlocks for safe and reliable operations. LNG satellite station shall be equipped with gas detection and fire/temperature detection sensors with emergency shutdown buttons at strategic locations as a proactive safety measure which is continuously monitored by centralized control system. Interlocks shall be designed for operation of the plant in most safe and reliable manner with minimal human intervention.

The LEL gas detectors shall be provided as required for detection of gas leakages if any. Further the plant shall be provided with fire water network, sufficient number of fire extinguishers and sand buckets.

LNG storage and distribution plant operations should be controlled by centralized PLC based system and SCADA system for better and safe operations with manual interventions wherever applicable

### **1.3.8 INTERCONNECTING PIPING, FITTINGS, VALVES**

The interconnecting pipes shall be double-walled vacuum jacketed. Piping, fittings, valves used shall be fit for LNG service.

### **1.3.9 ODORIZING SYSTEM**

The odorizing system shall be provided for the statutory requirement of PNGRB/ OISD to identify the leakage in the associated equipment/ during transportation of piped gas in the city area. Selected system shall meet all the requirements as per the enclosed technical specifications related to design safety and automatic dosing of odorant uninterrupted (with standby system in case of failure of main system). If common tank for storage and dosing for PNG and LCNG line consider; necessary safety equipments shall be considered as required. The Odorising system shall be designed for Automatic odorant dosing based on the flow rate with provision for standby system for dosing in case of failure of main system. Odorant tank shall be of Stainless Steel with necessary safety and design





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as per ASME Sec VIII guideline.

### **1.3.10 Nitrogen Purging System**

Nitrogen purging system will be required for the LNG unloading pump, dispensing pump and for the complete LNG network at various condition for the safe operation of the system. Required numbers of nitrogen cylinder with necessary piping/tubing connections at the various points as per P&ID shall be provided. Necessary measuring instruments, valves, fittings shall be provided for the complete nitrogen purging system. Nitrogen requirement for LNG storage tank pre-cooling during commissioning (one time requirement) shall be met by hiring a portable Nitrogen supply system as the quantity requirement will be more and cannot be met by cylinders.



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### (Detailed Scope of work)

Sl. No.	Item Description
1	<p>Design and supply of LNG vacuum insulated storage tank/s (<b>Size – 56 KL, MAWP – 12 Barg and Quantity – 2 Nos</b>)</p> <ul style="list-style-type: none"><li>- with isolation valves, instruments and interconnected piping</li><li>- Level and Pressure transmitter</li><li>- Emergency shut down Fire safe valves on Filling and delivery/pump lines</li><li>- Junction box for connecting the instruments and valves on tank</li><li>- 4 x 100% Safety valves</li><li>- Common vent stack</li><li>- PESO approval for the Design and TPI approval</li></ul>
2	<ul style="list-style-type: none"><li>- Unloading Hose Trolley with Hoses – 1 set for each pump for easy and safe hose handling ( Nitrogen purging &amp; pressurizing )</li><li>- Earthing reel for ensuring effective earthing</li></ul>
3	<p>LNG Medium pressure pump/s (<b>Quantity - 2 Nos and Flow rate – 2500 SCMh each with 33 - 38 bar</b>)</p> <ul style="list-style-type: none"><li>- with electrical control panel in control room</li><li>- Temperature sensors for pre cooling and dry run protection</li><li>- LP and HP side safety valves</li><li>- Medium pressure gauge and switch</li><li>- other instruments and interconnecting piping mounted on skid</li></ul>
4	<p>Design and supply of 02 Nos of atmospheric Medium pressure vaporizers to meet required duty cycle to supply PNG at 33 – 38 bar with instruments and isolation valves for auto switchover after 8 hrs for continuous operation. <b>2500 SCMh flow each</b></p>
5	<p>1 No of <b><u>PNGRB compliant</u></b> Pressure reduction system for delivery of PNG up to <b>2500 SCMh flow and pressure of 33 -38 bar(g)</b></p> <ul style="list-style-type: none"><li>- 2 x 100% regulation stream with Active monitor combination with isolation valves and pressure gauges</li><li>- slam shut off valve with isolation valve &amp; pressure gauge.</li><li>- Creep relief valve</li></ul> <p>All mounted on skid with cabling and junction box</p>
6	<p>Flow metering skid with RPD/Turbine type flow meter</p> <ul style="list-style-type: none"><li>- With pressure and temperature compensation</li><li>- flow totalizer and indicator</li></ul> <p>with bypass valve and interconnecting piping duly mounted on skid with required valves and instruments</p>



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7	All Interconnecting piping between skids and Equipment till PRS skid outlet within dyke wall including piping supports for MP PNG supply stream. Downstream piping from PRS skid up to plot boundary.
8	Design and supply of 01 Nos of BOGV (Boil of Gas Vaporizer) for boil of the gas coming after MPV & MPRS
9	1 No of <b>PNGRB compliant</b> Pressure reduction system for delivery of PNG up to <b>2500 SCM flow and pressure of 4 bar(g)</b> - 2 x 100% regulation stream with Active monitor combination with isolation valves and pressure gauges - slam shut off valve with isolation valve & pressure gauge - Creep relief valve All mounted on skid with cabling and junction box
10	Flow metering skid with RPD/Turbine type flow meter - With pressure and temperature compensation - flow totalizer and indicator with bypass valve and interconnecting piping duly mounted on skid with required valves and instruments
11	All Interconnecting piping between skids and Equipment till PRS skid outlet within dyke wall including piping supports for PNG supply stream. Downstream piping from PRS skid up to plot boundary.
12	LNG High pressure pump/s ( <b>Quantity - 2 Nos and Flow rate – 1200 SCM each with 250 bar</b> ) - with electrical control panel in control room - Temperature sensors for pre cooling and dry run protection - LP and HP side safety valves - High pressure gauge and switch - other instruments and interconnecting piping - mounted on skid
13	Design and supply of 02 Nos of atmospheric High pressure vaporizers to meet required duty cycle to supply CNG with instruments and isolation valves for manual switchover after 8 hrs. for continuous operation if required - <b>1200 SCM flow each</b>
14	PLC controlled Odoriser (for all streams) - with controlling valves - Odorant storage tank with level indicator - Air operated dosing pump - flow sensor - interconnecting piping duly mounted on skid - May be a common system or separate for each stream. (LP, MP & HP)
15	- Sequencing/Priority Panel for sequencing of CNG flow ( <b>Quantity – 1 Nos, 10 Lines</b> )



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16	All Interconnecting piping between Tank to Pump, Pump to HP vaporizer and HP vaporizer to PESO safe area boundary including piping supports.; Interconnecting piping from PESO area limit to prioritypanel/CNG cascade fill point;
17	Cascade fill point/LCV Post ( <b>Quantity – 1 Nos</b> ) - with Manual Valves and instruments - including 1no of Mass flowmeter per point and 1 no of earthing reel per point. - with Parker or equivalent make QC coupling
18	Total safety system inclusive of Special gas detection devices, low and high temperature sensors, LNG Cryogenic Gloves, ESS etc.as per PESO guidelines in PESO storage area.
19	Programmable logic controller (PLC) including SCADA with control panel - including software initial programming. - UPS for PLC power backup of 30 minutes  Licensed Personal computer for SCADA system
20	- Supply of all Electrical Cables from PLC to field instruments/Valves - Supply of cable trays, Electrical hardware , supports etc.  Supply of cable glands and other Electrical hardware
21	Supply of Air compressor (1 No) with Built in reservoir; Air distribution piping to all required components in PESO area and dispenser area.
22	Pump for removal of water from dyke with control mechanism
23	Fire extinguishers, sand buckets, warning signs. As required per PESO norms
24	Supply of Earthing lugs on each equipment, Spring loaded earthing reel 10mtr wire ( 1 No per unloading pump)
25	Supply of Supporting systems such as Fire water system consisting of 1 set of water tank/pump/hose as per PESO guidelines;
26	Obtaining all statutory approvals including PESO approval for the site and equipment's.
27	- Supply of all required Foundation bolts for tank and vaporizers; Supply of expansion bolts for skid and supports.
28	- Hazop Study, Emergency plan and safety report per MSIHC if required



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29	Installation of cables and cable trays between PLC panel and station components inside PESO storage area including all instrumentation
30	Installation and commissioning of system including piping, welding, cabling and pressure testing at site up to our Battery limit
31	Supply of Liquid Nitrogen for tank cooling during commissioning
32	Spares for commissioning
33	Supervision for unloading of tanks and Supervision of erection and commissioning of entire station.
34	Transport of Equipment to site and transit Insurance, Unloading and Erection, Provision for cranes for unloading, erection and installation for all LNG Station Equipment.
35	Assistance for all local approvals/ NOC for LNG facility
36	Supply of Utilities such as Electrical power, water, Air etc. and N2 gas for testing during commissioning.
37	Spare parts for normal operation
38	Detailed engineering and civil drawing, layouts to be provided by the bidder to GSL for carrying out the civil work as per the requirement. Bidder will have responsibility of the overseeing the construction of civil work supervision so to avoid mismatching with bidder requirement
39	Data Sheet & Layout drawing with available area attached in tender documents however bidder is free to have their own layout drawing & Data Sheet confirming to PESO standard & guidelines.
40	Bidders can visit the site at their own cost and convenience, Gasonet coordinator will always be available for any assistance.
41	Bidder to specify the make of supply item and must be in operation without any breakdown from last 5 year from the date of commencement.



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## **DATA SHEETS**



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**DATA SHEET FOR LNG UNLOADING PUMP**

Manufacturer Name	*
Medium	LNG
Installation	The pump must be suitable for installation with thermosiphon type tank submerged in a vacuum insulated sump (in case of submerged pump only)
Capacity	350 LPM
Suction pressure ( Normal/Max)	Static head of LNG tanker
Differential Pressure	08-10 Bar
Suction Nozzle Size	*
Discharge Nozzle Size	*
Design Temperature	*
Pump Material of Construction	AISI 304/ Equivalent Casting Grade
Pump Type	Vertical submersible/ centrifugal
Motor RPM	*
Voltage	415V 50Hz 3 Phase
Scope of supply	The pump skid shall be supplied complete with motor, base frame, other accessories, interlocks for precooling and dry run, safety /vent valves , strainer , Pressure gauge, VFD etc
CONTROL PANEL	1. All safeties, trips , overloads and control required for safe operation 2. NEMA 4 enclosure 3. Stop and start buttons 4. Protection against single phase 5. Gauges/Instruments for Volt Meter with Selector Switch, Amp. Meter with Selector Switch, Hr. run meter

\* Vendor to indicate



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**DATA SHEET FOR CRYOGENIC LIQUID STORAGE TANK**

Equipment Manufacturer		
Equipment	Inner Vessel	Outer Vessel
Stored fluid	LNG	Vacuum
Installation	Vertical	
Quantity	1 Nos.	
Actual Water Capacity (Gross)	56000 Liters for 56 KL (± 2%)	
Actual Water Capacity (Net)	49400 Liters (+ 2%)	
Empty Weight	*	
Diameter	*	*
Total Height	*	*
Material of construction	AISI 304	SA 516 Gr. 70 / IS 2062
Piping Material	SA 312 TP 304	
Valve Material	AISI 304 body and trim	
Design temperature in deg.C	- 196 °C to +49°C	- 20 °C to + 65 °C
Design, fabrication, inspection and testing	EN13458-2.	EN13458-2
MAWP	12 barg approx	Vacuum
Insulation (Interspaced) sensitize	PERLITE Under Vacuum	
Surface Treatment (Outer Vessel)	Shot Blast – SA 2 ½ Precoat – Inorganic Zinc Silicate – DFT 70-90 µm Inter Mediate Coat – Epoxy – DFT 70-90 µm Finish Coat – Polyurethane – DFT 50-60 µm Total Thickness of Paint – 240 µm	





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**DATA SHEET FOR LNG HIGH PRESSURE PUMP**

Manufacturer Name	
Medium	LNG
Installation	The pump must be suitable for installation with thermosiphon type tank
Capacity	33 LPM
Quantity	2 Nos. (1 working + 1 stand-by)
Suction pressure ( Normal/Max)	2 - 10 Bar
Delivery Pressure	220 Bar Minimum
Suction Nozzle Size	*
Discharge Nozzle Size	*
Design Temperature	*
Pump Material of Construction	AISI 304/ Equivalent Casting Grade
Pump Type	Positive Displacement
Motor RPM	*
Voltage	415V 50Hz 3 Phase
Scope of supply	The pump shall be supplied complete with skid, motor, motor slide rails, control panel, vee belts with guard, interlocks for precooling and dry run,safety /vent valves, strainer , HP gauge etc.
Control Panel	<ol style="list-style-type: none"><li>1. All safeties, trips , overloads and control required for safe operation</li><li>2. NEMA 4 enclosure</li><li>3. Stop and start buttons</li><li>4. Protection against single phase</li><li>5. Gauges/ Instruments for Volt Meter with Selector Switch, Amp. Meterwith Selector Switch, Hr. run meter</li></ol>

\* Vendor to indicate



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**DATA SHEET FOR HIGH PRESSURE ATMOSPHERIC VAPORIZER FOR LNG**

- 1) **GENERAL:**
- |                    |   |                     |
|--------------------|---|---------------------|
| Manufacturer Name  | : |                     |
| Type               | : | Ambient Air Heated  |
| Configuration      | : | Vertical            |
| Service            | : | Product Vaporizer   |
| Fluid              | : | LNG                 |
| Design Temperature | : | (-) 196°C to + 65°C |
| Outlet Temperature | : | *                   |
- 2) **DATA**
- |                            |   |  |
|----------------------------|---|--|
| Capacity of each vaporizer | : | 1200 SCMH                                    |
| Qty                        | : | 2 Nos  |
| Manufacturing Code         | : | ASME Sec VIII Div I                          |
| Duty Cycle                 | : | Continuous with change over at every 8 hours |
| Maximum Operating Pressure | : | *  |
| Design Pressure            | : | *  |
| Hydraulic Test Pressure    | : | *  |
| Inlet                      | : | ½" – SS NPT Female Socket                    |
| Outlet                     | : | ½" – SS NPT Female Socket                    |
- 3) **DESIGN:**
- |  |   |   |
|--|---|---|
| Fin cross section                          | : | * |
| Area Required (Calculation to be provided) | : | * |
| Area Provided                              | : | * |
- 4) **MATERIAL OF CONSTRUCTION:**
- |                       |   |                                  |
|-----------------------|---|----------------------------------|
| Fins                  | : | Aluminum A 6063 T5               |
| Pipe, Bends & Headers | : | *                                |
| Flanges               | : | *                                |
| Structural & Frame    | : | *                                |
| Bolts / Supports      | : | *                                |
| Nuts, bolts           | : | SS 304 Nyloc Anti Vibration Nuts |

\* Vendor to indicate



**Design, Supply, Installation, Testing, Commissioning, and 5 Years Comprehensive Operation & Maintenance of LNG Storage & Regasification station along with all necessary auxiliary units at Bikaner & Churu GA**



TENDER DOCUMENT NO:  
GSL/REPL/011/LNG

Date: 29/05/2023

**DATA SHEET FOR LNG MEDIUM PRESSURE PUMP**

Manufacturer Name	
Medium	LNG
Installation	The pump must be suitable for installation with thermosiphon type tank
Capacity	70 LPM
Quantity	2 Nos. (1 working + 1 stand-by)
Suction pressure ( Normal/Max)	2 - 10 Bar
Delivery Pressure	33 Bar Minimum
Suction Nozzle Size	*
Discharge Nozzle Size	*
Design Temperature	*
Pump Material of Construction	AISI 304/ Equivalent Casting Grade as per standard
Pump Type	Positive Displacement/Centrifugal
Motor RPM	*
Voltage	415V 50Hz 3 Phase
Scope of supply	The pump shall be supplied complete with skid, motor, motor slide rails, control panel, vee belts with guard, interlocks for precooling and dry run,safety /vent valves, strainer , MP gauge etc.
Control Panel	1. All safeties, trips , overloads and control required for safe operation 2. NEMA 4 enclosure 3. Stop and start buttons 4. Protection against single phase 5. Gauges/ Instruments for Volt Meter with Selector Switch, Amp. Meterwith Selector Switch, Hr. run meter

\* Vendor to indicate



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TENDER DOCUMENT NO:  
GSL/REPL/011/LNG

Date: 29/05/2023

**DATA SHEET FOR MEDIUM PRESSURE ATMOSPHERIC VAPORIZER FOR LNG**

- 1) **GENERAL:**
- |                    |   |                     |
|--------------------|---|---------------------|
| Manufacturer Name  | : |                     |
| Type               | : | Ambient Air Heated  |
| Configuration      | : | Vertical            |
| Service            | : | Product Vaporizer   |
| Fluid              | : | LNG                 |
| Design Temperature | : | (-) 196°C to + 65°C |
| Outlet Temperature | : | *                   |
- 2) **DATA**
- |                            |   |  |
|----------------------------|---|--|
| Capacity of each vaporizer | : | 2500 SCMH                                    |
| Qty                        | : | 2 Nos  |
| Manufacturing Code         | : | ASME Sec VIII Div I                          |
| Duty Cycle                 | : | Continuous with change over at every 8 hours |
| Maximum Operating Pressure | : | *  |
| Design Pressure            | : | *  |
| Hydraulic Test Pressure    | : | *  |
| Inlet                      | : | ½" – SS NPT Female Socket                    |
| Outlet                     | : | ½" – SS NPT Female Socket                    |
- 3) **DESIGN:**
- |  |   |   |
|--|---|---|
| Fin cross section                          | : | * |
| Area Required (Calculation to be provided) | : | * |
| Area Provided                              | : | * |
- 4) **MATERIAL OF CONSTRUCTION:**
- |                       |   |                                  |
|-----------------------|---|----------------------------------|
| Fins                  | : | Aluminum A 6063 T5               |
| Pipe, Bends & Headers | : | *                                |
| Flanges               | : | *                                |
| Structural & Frame    | : | *                                |
| Bolts / Supports      | : | *                                |
| Nuts, bolts           | : | SS 304 Nyloc Anti Vibration Nuts |

\* Vendor to indicate



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TENDER DOCUMENT NO:  
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Date: 29/05/2023

### PRESSURE GAUGES

Units:- Flow : Liquid-T/hr Gas-MMSCMD Steam- kg/hr Pressure- Kg/cm <sup>2</sup> (G) Temperature- C Level/Length-mm							
1	Type	Direct		Wetted parts material		---	
2	Mounting	Local		Element		---	
3	Dial size	150 mm		Lower body		---	
	Color	White (Nonrusting plastic with black engraving)		Non wetted parts		---	
4	Case material	SS 304		Process connection		---	
5	Bezel ring	Screwed		Size		---	
6	Window material	Shatter proof glass		Rating		---	
7	Enclosure	IP 55 / NEMA 4		Facing & Finish		---	
8	Pressure element	Bourdon tube		Capillary material		---	
9	Element material	SS 316		Capillary length		---	
10	Socket material	SS 316		Flushing & Filling		---	
11	Accuracy	1% FSD	16	Over range protection		130% of range	
12	Zero adjustment	Micrometer pointer (Internal)	17	Blow out protection		Required	
			18	Options			
13	Connections	½" NPT (M)		a) Snubber			
	Conn. Location	Bottom		b) Syphon			
14	Movement	SS 304		c) Gauge saver			
15	Diaphragm seal	---		d) Liquid filled casing			
	Type	---		e) 2 valve, 3-Way Manifold			
				f) Dampener			
			19	<b>Make &amp; Model</b>		*	
Tag No.	Range	Pressure		Design Temp.	Fluid	Location	Options <sup>#</sup>
		Operating	Design				
PG-**	*	*	*	*	*	*	e

**NOTES:**

- 1) \*\* Information to be supplied by the Vendor / Contractor.
- 2) Quantities shall be as per P&ID.
- 3) #Other options (if required) shall be provided by vendor to meet the site requirement.



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**Date: 29/05/2023**

### TEMPERATURE GAUGE

Units:- Flow : Liquid-T/hr Gas-MMSCMD Steam- kg/hr Pressure- Kg/cm <sup>2</sup> (G) Temperature- C Level/Length-mm									
GENERAL					FILLED SYSTEM				
1	Type	FILLED SYSTEM / Bimettalic			15	SAMA Class	V B		
2	Well	REQUIRED				Compensation	CASE		
3	Mounting	LOCAL			16	Bulb type	ADJUSTABLE UNION		
4	Dial size	150 mm				Bulb material	316SS		
5	Colour	WHITE (Non rusting plastic with black figs.)			17	Bulb union threaded to	½” NPT(M)		
6	Case material	DIE CAST ALUMINIUM (EPOXY PAINTED) / SS			18	Extension type	RIGID		
7	Window material	SHATTER PROOF GLASS			19	Bulb dia	8 mm (Min)		
8	Conn. Location	BOTTOM			20	Capillary material			
9	Accuracy	1% FSD				Armour Flexible			
10	Enclosure	WEATHER PROOF TO IS2147				Armour material			
	Enclosure class	IP 55 / NEMA 4				Capillary length			
11	Zero adj. Screw	MICROMETER POINTER (Internal)			21	Overrange protection	130% OF RANGE		
BIMETAL					THERMOWELL				
12	Stem:				22	Material	SS 316		
	Type				23	Construction	DRILLED BAR STOCK		
	Material				24	Process connection	1 ½” FLANGED		
	Size				25	Gauge connection	½” NPT (F)		
13	Stem diameter				26	Thermowell as per drg	Drg enclosed		
14					27	Options a)	LIQUID FILLED		
					28	<b>Make &amp; Model</b>	*		
Tag No.	Range	Temperature ( C )		Well Dimensions		Flange		Location	Remarks
		Operating	Design	U	T	Material	Rating/Face/Finish		
TG - *	*	*	*	*	*	SS 316	*	*	

**Note:**

1. ‘\*’ Information to be supplied by the Vendor / Contractor.
2. Vender shall furnish Make & Model No. with product catalogues.



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TENDER DOCUMENT NO:  
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**Date: 29/05/2023**

### RESISTANCE TEMPERATURE DETECTOR

**Units:- Flow : Liquid-T/hr Gas-MMSCMD Steam- kg/hr Pressure- Kg/cm<sup>2</sup> (G) Temperature- °C Level/Length-mm**

GENERAL			13	Cable entry	½" NPT (F)
1	Assembly as per drg.	Drg. enclosed	14	No. of entries	Single
			15	Enclosure type	Dual Chamber Weather proof to IP55 & Ex-proof (CCOE)
2	Type	RTD Class A	THERMOWELL		
ELEMENT			16	Material	SS 316
3	No. of elements	Simplex	17	Construction	Drilled bar stock
4	Calibration	As per DIN 43760	18	Process connection	1 ½" Flanged
5	Element material	Platinum (Pt 100)	19	Inst. connection	½" NPT (F)
6	Resistance at 0°C	100 ohms	20	Thermowell as per drg	Drg. Enclosed
7	Leads	Standard			
8	Sheath		TRANSMITTER		
	O.D.	8 mm	21	Quantity	
	Material	SS 316	22	Input	
9	Nipple & Union Material	SS 316	23	Output	
10	No. Of wires	4 Wire	24	Power Supply	
HEAD			25	Mounting	
11	Head Cover type	Screwed cap & SS chain	26	Enclosure class	
12	Material	Cast Aluminum	27	<b>Make &amp; Model No.</b>	*

Tag No.	Range	Temperature		Well Dimensions		Flange		Fluid	Qty
		Nor	Design	U	T	Material	Rating/Face / Finish		
TE_**	*	*	*	*	*	SS316	*	*	*

**NOTES:**

- 1) '\*\* Information to be supplied by the Vendor / Contractor.
- 2) Qty. shall be as per P&ID.



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Date: 29/05/2023

**TEMPERATURE GAUGE (SKIN TYPE)**

Units:- Flow : Liquid-T/hr Gas-MMSCMD Steam- kg/hr Pressure- Kg/cm <sup>2</sup> (G) Temperature- C Level/Length-mm									
GENERAL					FILLED SYSTEM				
1	Type	FILLED SYSTEM			15	SAMA Class	V B		
2	Well	REQUIRED				Compensation	CASE		
3	Mounting	LOCAL			16	Bulb type	ADJUSTABLE UNION		
4	Dial size	150 mm				Bulb material	316SS		
5	Colour	WHITE (Non rusting plastic with black figs.)			17	Bulb union threaded to	½” NPT(M)		
6	Case material	DIE CAST ALUMINIUM (EPOXY PAINTED)			18	Extension type	RIGID		
7	Window material	SHATTER PROOF GLASS			19	Bulb dia	8 mm (Min)		
8	Conn. Location	BOTTOM			20	Capillary material			
9	Accuracy	1% FSD				Armour Flexible			
10	Enclosure	WEATHER PROOF TO IS2147				Armour material			
	Enclosure class	IP 55 / NEMA 4				Capillary length			
11	Zero adj. Screw	MICROMETER POINTER (Internal)			21	Overrange protection	130% OF RANGE		
BIMETAL					THERMOWELL				
12	Stem:				22	Material	-		
	Type				23	Construction	-		
	Material				24	Process connection	-		
	Size				25	Gauge connection	-		
13	Stem diameter				26	Thermowell as per drg	-		
14					27	Options a)	LIQUID FILLED		
					28	Make & Model	*		
Tag No.	Range	Temperature ( C )		Well Dimensions		Flange		Location	Remarks
		Operating	Design	U	T	Material	Rating/Face/Finish		
TG – *	*	*	*	-	-	-	-	*	

**Note:**

1. ‘\*\*’ Information to be supplied by the Vendor / Contractor.
2. Vender shall furnish Make & Model No. with product catalogues along with the offer.
3. Mounting Pad to be provided with TG.





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### RESISTANCE TEMPERATURE DETECTOR (SKIN TYPE)

Units:- **Flow** : Liquid-T/hr **Gas**-MMSCMD **Steam**- kg/hr **Pressure**- Kg/cm<sup>2</sup> (G) **Temperature**- C **Level/Length**-mm

GENERAL		13	Cable entry	½” NPT (F)	
1	Assembly as per drg.	Drg. enclosed	14	No. of entries	Single
			15	Enclosure type	Weather proof to IP55, Ex-proof (CCOE)
			ELEMENT		THERMOWELL
3	No. of elements	Simplex	16	Material	--
4	Calibration	As per DIN 43760	17	Construction	--
5	Element material	Platinum (Pt 100)	18	Process connection	--
6	Resistance at 0 C	100 ohms	19	Inst. connection	--
7	Leads	Standard	20	Thermowell as per drg	--
8	Sheath				
	O.D.	6 mm	TRANSMITTER		
	Material	SS 316	21	Quantity	-
9	Nipple & Union Material	SS 316	22	Input	-
10	No. Of wires	4 Wire	23	Output	--
	HEAD		24	Power Supply	--
11	Head Cover type	Screwed cap & SS chain	25	Mounting	--
12	Material	Cast Aluminium	26	Enclosure class	--
			27	<b>Make &amp; Model No.</b>	*

Tag No.	Range	Temperature		Well Dimensions		Flange		Service	REMARKS
		Nor	Design	U	T	Material	Rating/Face/Finish		
TE-**	*	*		--	--	--	--	*	

**NOTES:**

- 1) ‘\*\*’ Information to be supplied by the Vendor / Contractor
- 2) RTD offered shall be of highest accuracy – TYPE – A
- 3) Mounting Pad alongwith accessories to be provided with RTD.
- 4) Qty. shall be as per P&ID.



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**Date: 29/05/2023**

**TEMPERATURE TRANSMITTERS**

**Units:- Flow :Liquid-m<sup>3</sup>/hr, Gas-MMSCMD, Steam- kg/hr, Pressure-Kg/cm<sup>2</sup> (G), Temperature- °C,Level/Length-mm**

1	FUNCTION	TRANSMIT	INDICATE BLIND <input type="checkbox"/>	11	POWER SUPPLY 24 V DC	
2	TYPE	ELECTRONIC	(SMART)	12	CONDUIT CONN. 1/2" NP TF	
3	CASE	MFR STD.		13	LINEARISATION UPSCALE DOWNSCALE <input type="checkbox"/>	
4	MOUNTING	DIRECT ON RTD/TC <input type="checkbox"/> YOKE OTHER		14	ACCURACY +/- 0.1% FSD	
5	ENCLOSURE	Dual Chamber EX. PROOF W. PROOF CLASS: IP - 65 INTRINSICALLY SAFE		15	RFI / EMI	REQD. PROTECTION
				16	LOAD	600 OHMS DRIVING CAPABILITY 24 V DC
6	AREA CLASSIFICATION	NEC, CLASS-1, DIVL. -1, GROUP C&D, CCOE		17	MAKE	*
7	INPUT	FROM RTD		18	MODEL NO.	*
8	OUTPUT	4-20 mA		19	OPTIONS	
				a)	Output Meter	WP & INTR SAFE
9	COLD JUNCTION COMPENSATION			b)	Mounting	for 2" Pipe
					Accessories	
10	BURN OUT PROTECTION			c)	SS Tag Plate	
TAG NO.	Temperature	RANGE		Temp.	SERVICE	OPTION #
	Nor.	SPAN	SET	Design		
TT-**	*	*	*	*	RTD (4 wire)	a, b, c



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**NOTES:**

- 1     \*\* INFORMATION TO BE SUPPLIED BY VENDOR/ CONTRACTOR.
- 2     THE DIGITAL OUTPUT METER SHOULD INDICATE THE TEMPERATURE IN DEG. C.
- 3     ENVIRONMENTAL COVER TO BE PROVIDED FOR EACH TRANSMITTER (DRAWING ENCLOSED ELSEWHERE IN BID DOC.) & WITH LOCKING ARRANGEMENT FOR METERING TRANSMITTERS.     ■
- 4     DUAL CHAMBER ENCLOSURE SHALL BE PROVIDED
- 6     MAKE OF TT SHALL BE AS PER VENDOR LIST.
- 7     \*Other options (if required) shall be provided by vendor to meet the site requirement.



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### PRESSURE TRANSMITTERS

Units:- Flow : Liquid-T/hr Gas-MMSCMD Steam- kg/hr Pressure- Kg/cm <sup>2</sup> (G) Temperature- C Level/Length-mm							
GENERAL			MEASURING UNIT				
1	Function	Transmit & Indicate	24	Service	Pressure		
2	Type	Electronic Smart P Based	25	Element	Diaphragm		
3	Case	Mfg. Std.	26	Body Material	Carbon Steel		
4	Mounting	Yoke	27	Element Material	316 SS		
5	Enclosure	Weather proof to IS2147 Explosion proof to IS2148, CCOE	28	Process Connections	½" NPT(F)		
	Enclosure class	NEMA 4 & NEMA 7		Process Conn. Locn.			
6	Elec. Area Class.	Zone-I, Gr.IIA & IIB, T3	29	Diaphragm Seal:-			
7	Intrinsically safe	Required		Type			
8	Air supply			Wetted Parts Matl.			
9	Power supply	24 VDC		Other Material			
10	Cable entry	½" NPT(F)		Process Conn.:-			
11	Accuracy	± 0.075% of SPAN		Size and Rating			
12	Repeatability	± 0.05%		Facing and Finish			
	TRANSMITTER			Capillary Material:-			
13	Output	4 – 20 mA DC, Two wire		Armour Flexible			
14	Trans. Power supply	24 V DC		Armour Flexible Matl.			
	CONTROLLER			Capillary length, mm			
15	Output			Flush / Filling Conn. with plug			
16	A/M switch			MISCELLANEOUS			
	No. of positions		30	Over Range Protection	130% of Range		
17	Set Point Adj.		31	<b>Options</b>			
18	Manual Regulator		a)	Output Meter	W.P. Intr Safe(note 2)		
19	Mode		b)	Mounting Accessories	For 2" pipe mounting		
	RECORDER		c)	3 -Way Manifold	Required		
20	Chart		d)	Zero elevn. & suppression	Required		
21	Chart Drive						
22	Moving Parts Matl.		32	<b>Make &amp; Model</b>	*		
23	Chart speed						
	Tag No.	Operating Pressure	Design Press.	Design Temp.	Range	Location	Options <sup>#</sup>
					Span	Set	
	PT- *	*	*	*	*	*	a,b,c,d

**NOTES:**

- 1) \*\* Information to be supplied by the Vendor / Contractor.
- 2) Over range protection shall be 130% of maximum static pressure.
- 3) Local Digital Output meter should indicate the line pressure in Kg/cm<sup>2</sup>g.
- 4) Environmental cover to be provided for each transmitter
- 5) Transmitter shall have zero elevation /suppression for the service specified.
- 6) <sup>#</sup>Other options (if required) shall be provided by vendor to meet the site requirement.



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### DIFFERENTIAL PRESSURE TRANSMITTERS WITH LOCAL DISPLAY

Units:- Flow : Liquid-m<sup>3</sup>/hr Gas- MMSCMD Steam- kg/hr Pressure- Kg/cm<sup>2</sup>(G) Temperature- C Level/Length-mm

GENERAL				MEASURING UNIT						
1	Function	<b>Transmit &amp; Indicate with Local Display</b>		24	Service	Diff. Pressure				
2	Type	Electronic Smart P Based		25	Element	Diaphragm				
3	Case	Mfg. Std.		26	Body Material	Carbon Steel				
4	Mounting	Yoke		27	Element Material	SS 316L				
5	Enclosure	Weather proof to IS2147 Explosion proof to IS2148, CCOE		28	Process Connections	½" NPT(F)				
	Enclosure class	NEMA 4 & NEMA 7			Process Conn. Locn.	Bottom				
6	Elec. Area Class.	Zone-I, Gr.IIA & IIB, T3		29	Diaphragm Seal:-	Not Required				
7	Intrinsically safe & Flameproof	Required			Type	---				
8	Air supply	N.A			Wetted Parts Matl.	---				
9	Power supply	24 VDC			Other Material	---				
10	Cable entry	½" NPT(F)			Process Conn.:-	---				
11	Accuracy	± 0.075% of SPAN			Size and Rating	---				
12	Self Diagnostics Facility	Required			Facing and Finish	---				
	TRANSMITTER				Capillary Material:-	---				
13	Output	4 – 20 mA DC, Two wire			Armour Flexible	---				
14	Trans. Power supply	24 V DC			Armour Flexible Matl.	---				
	CONTROLLER				Capillary length, mm	---				
15	Output				Flush / Filling Conn. with plug	---				
16	A/M switch				MISCELLANEOUS					
	No. of positions			30	Over Range Protection	130% of Range				
17	Set Point Adj.			31	<b>Options</b>					
18	Manual Regulator				a)	Intrinsically safe digital Output meter				
19	Mode				b)	5-way manifold-SS316 Body & Trim				
	RECORDER				c)	Mounting accessories for 2" Pipe Mounting – Material (SS 316)				
20	Chart				d)	Local display in Kg/cm <sup>2</sup> g				
21	Chart Drive				e)	SS Tag Plate				
22	Moving Parts Matl.			32	Load Driving Capability	Not less than 600 ohms				
23	Chart speed			33	<b>Make &amp; Model</b>	*				
	Tag No.	Diff Range Kg/Cm <sup>2</sup> g		Zero Elev.	Zero Supp.	Design Press.	Design Temp.	Control Action	Fluid	Options <sup>#</sup>
		Span	Set	mm H <sub>2</sub> O	mm H <sub>2</sub> O					
	DPT-*	*	*	*	*	*	*		*	a, b, c, d, e

**NOTES:**

- 1) "\*" – Information to be furnished by bidder.
- 2) Make of DPT shall be as per vendor list.
- 3) Environmental cover to be provided for each transmitter.
- 4) <sup>#</sup>Other options (if required) shall be provided by vendor to meet the site requirement.



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#### **DATASHEET OF ROTARY POSITIVE DISPLACEMENT METER**

- 1.0 Make: Vendor to Provide
- 2.0 Meter Type : Rotary Positive Displacement Meter
- 3.0 Standard : OIML Recommendation (OIML R137: Ch1) / EN 12480
- 4.0 Service : Ref. P&ID
- 5.0 Model: Vendor to Provide
- 6.0 Size & Rating : NOTE-5
- 7.0 Meter Head : IP65, 8 Digit
- 8.0 End Connection : Ref. P&ID & Flange confirming to ANSI 125/ASME B16.5 (Refer respective P & Id for details)
- 9.0 Flange to Flange Dimension : Vendor to Provide
- 10.0 Flow Range: Vendor to Provide
- 11.0 Typical Start Flow: Vendor to Provide
- 12.0 Pulsar : HF Pulses from RPD meter for Flow / Volume
- 13.0 Differential Pressure at Qmax : Vendor to Provide
- 14.0 Flow (at actual condition) : Ref. P&ID
- 15.0 Flow (at standard condition) : Vendor To Provide (**Note-1**)
- 16.0 Accuracy : +/- 2% from Qmin to 0.2Qmax and +/- 1% from 0.2Qmax to Qmax
- 17.0 Rangeability / Turndown Ratio : 1:100 (min.)
- 18.0 Maximum Index Reading (Local Counter) : 99999999
- 19.0 Material Construction:**
- 19.1** Body & Cover : Cast Aluminum Alloy (Tamper proof & corrosion resistant)
- 19.2** Impellers : Extruded Aluminum Alloy
- 19.3** Impeller Shaft : High Grade Alloy Steel
- 19.4** Bearing : High Carbon Steel



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**19.5** Gears (Timing & Reduction) : Steel Alloy

**19.6** Magnetic Coupling : Hard Ferrite Ceramic Magnet

**19.7** O-rings / Gaskets: Synthetic Elastomer

**19.8** Plastic Components : Not to be used in Meter

**19.9** Meter Internals shall be tested for low noise, frictionless, endurance for minimum 20 years life & external tamper proof.

**SERVICE CONDITON:**

20.0 Fluid : Ref. P&ID

21.0 Design Pressure : Ref. P&ID

22.0 Working Temperature : Ref. P&ID

23.0 Area Classification: Intrinsically Safe, Class 1, Div.1, Group D

24.0 **Qty** : Ref. P&ID

25.0 Maximum Operating Pressure :Ref. P&ID

26.0 Normal Operating Pressure :Ref. P&ID

27.0 Reverse flow Restrict :Essential (If not in-built non return valve to be supplied)

28.0 Approved To :Measurement Canada, NMI, PTB as per OIML

Specifications or equivalent

**Note :**

1. Flow capacity in SCMH is calculated considering Maximum Operating Pressure.
2. Bidder to provide 5 points Calibration Certificate and Accuracy at atmospheric pressure with air.
3. The selected meter shall be suitable for Custody Transfer.
4. Size & rating of meter shall be of pipeline size & rating where it is to be installed. In case, max. flowrate (at min. pressure) to be measured doesn't fall in the measuring range of pipeline size meter then higher size meter shall be provided.



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**DATASHEET OF LEL DETECTORS  
POINT TYPE INFRA RED GAS  
DETECTORS :**

Sl No.	Features	Requirements
1	Sensor type	Infrared sensor technology based explosion-proof Gas sensor with transmitter
2	Principle of operation	Multi-beam, dual compensated, non-focusing infrared absorption. Temperature compensation shall be in-built.
3	Function	Shall be able to detect hydrocarbon gases in the range of 0-100% LEL
4	Gas Detection	Configurable library having Methane, propane, propylene, Ethane, Butane, Hexane, Pentane & Benzene/R-LNG, covering Hydrocarbons (from C1-C12)
5	Calibration	Factory calibration at Methane or Propane
6	Range	0 to 100% LEL.
7	Construction	Flameproof, 316SS body with dust/weather protection for outdoor installation. No external terminal box shall be provided for further cabling (flying leads are not acceptable).
8	Optical performance	Correct operation upto 75% obscuration, the same shall be configurable with facility for dirty optics warning. Provision (heated optics) for detectors to be made to avoid condensation.
9	Input Power	24V DC nominal (18-30V DC)
10	Output	4-20mA DC (3-wire) ((isolated/non-isolated) rated at 600 ohms loop resistance at 24V DC) + (Optional) HART (shall have intrinsically safe port)
11	Overall accuracy	Better than +/- 3% of LEL
12	Repeatability	+/- 2% FSD
13	Zero drift	2 % FSD per year maximum.





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14	Response time	90% of gas reading in less than 5 Seconds.
15	Warm-up Time	2 minutes from cold start-up.
16	Visual Status display	Integral Unit Required, LED indication for – Normal, Fault condition & Gas detected condition complete with 4 Digit LCD Display.
17	Self-Check	Continuous self-check for immediate detection of internal failures
18	RFI /EMI protection compliance	EN50270:1999 Type 2 (EMC- electrical apparatus for the detection of combustible gas) /Electromagnetic compatibility directive 89/336/EEC.
19	Operating temperature	-40deg C to + 60 deg C
20	Humidity	0 to 95% RH
21	Cable entry	3/4 “ NPT (F)
22	Area classification	FM/ATEX certified for Explosion-proof (EExd) conforming to hazardous area classification to Class-I, Div-I, Gr. C & D (Zone-1, Gr. IIA/B). Temperature Class will be T5.
23	Approval	FM/ ATEX/ CSA/ CENELEC/ UL and PESO
24	Enclosure classification	IP66, NEMA 4 or better
26	Dimensions & Weight	To be provided by vendor.
27	Accessories required	Mounting kits, Canopy, Tag Plates, calibration kit, Rain & Dust protection cover, Splash guard, Ex proof & Weather proof double compression cable glands etc as required.
28	Configuration	Non-Intrusive configuration Required

Note: -

1. Two (high and high –high) common potential free outputs (suitable for 5A, 24 V DC rating & equivalent) for hook up with SCADA. Controller shall have two spare potential free outputs for future use.

2. Set of fully equipped calibration gas kit consisting of at least 2 (two) cylinders / bottles of calibration gas (of known mixture of air and gas), a pressure regulator with gauge, flexible tube / hose, adapter cap (to



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fit sensing head) shall be supplied to enable online calibration of Gas detectors.

NOTE: -

1. The Bidder shall indicate distance limitation if any between Sensor and Monitor.
2. RS – 485 port shall be provided in monitor / controller for RTU / SCADA.

### FIELD MOUNTED FLOW COMPUTER

1	Type	Microprocessor based electronic Flow Computer suitable for mounting in the field location in Hazardous area.
2	Function	The Flow Computer for measuring, monitoring Gas flow from single meters Run with a Gas RPD/Turbine meter. The FC measure actual gases volume, pressure and temperature and calculates compressibility factors of the gas and based on which calculates standard volume of gas. Computation of Gas Calorific values. The unit shall be complete in all respects to achieve this functionality.
3	Inputs	a) Pulse Input from RPD/Turbine Flow Meter for flow to integral smartMulti Variable Sensor. All interconnecting cable shall be screened and armoured. The cable and cabling accessories to be supplied by the vendor. b) Temperature signal from RTD (Pt-100 – 3/4 wires) thermal element with an accuracy of + 0.15 % of measured value with thermowell. All interconnecting cable shall be screened and armoured. The cable and cabling accessories to be supplied by the vendor. c) Pressure signal from built-in Pressure Sensor with an accuracy of + 0.1 % of measured value and a Range of 0-30 Kg/cm <sup>2</sup> g (*). Pressure sensors to be individually calibrated and characteristics stored within the flow computer. d) Other Standard inputs available.
4	Outputs port	a) RS 232 Serial Port for PC/LAPTOP connectivity b) RS 485 Serial Output port for RTU / SCADA c) RS 232 / 485 Serial Output port for GSM Modem
5	Output Measurement	a) Corrected flow rate: Sm <sup>3</sup> /hr. b) Corrected Totalised volume : Sm <sup>3</sup> c) Pressure : Kg/cm <sup>2</sup> g d) Temperature : °C e) Alarm output for unit malfunctioning g) Other Standard outputs available



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6	Isolation	All Inputs, Outputs and power supply shall be Individually Isolated.
7	Display	Alphanumeric large character LCD with selectable decimal, Displaying all units, messages, alarms etc shall be inEnglish.
8	Units of display	User configurable parameters like a) Corrected flow rate: Sm <sup>3</sup> /hr. b) Corrected Totalised volume : Sm <sup>3</sup> c) Pressure : Kg/cm <sup>2</sup> g d) Temperature : °C e) Energy ( Kcal) f) Yesterday's Flow ( SCMD) g) Non resettable total ( SCM) h) Days Total (SCMD) i) Co <sub>2</sub> /N <sub>2</sub> /Sp.gravity etc. etc.
9	Power supply	24 V DC / 230 V AC
10	Configuration Setup	To be done in factory for all flow computer fully taking into account the process conditions, sensor & flowmeter's characteristics and calibrations for direct on site operations.
11	Calculations standards	a) Volume Flow calculations: AGA7 (Latest). b) Compressibility : AGA 8 (Latest)/ GPA Field selectable Detailed / Gross I / Gross II Methods. c) Relevant standards



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12	Features	<p>a) Built in diagnostics to detect proper functioning.</p> <p>b) Data security through password/key-lock facility and volume conversion and configuration to be sealed.</p> <p>c) Parameters and programmed constants shall be stored in EEPROM / non-volatile memory.</p> <p>d) Facility for entry and accessing live and stored data through external Laptop/ PC.</p> <p>e) Shall have to store at least 35 days data (on hourly basis) for flowing pressure, temperature and corrected flow with date and time stamping.</p> <p>f) Shall have to store at least last 35 days cumulative corrected flow on daily basis</p> <p>g) The stored data above shall be retrievable by using Laptops. Suitable dedicated port shall be available on the flow computer for Laptops connection. Software required shall be supplied.</p> <p>h) Shall have addressing facility for identification by its address, for multi-dropping on a single telecom channel i ) The Time Function should be real time with accuracy +/- 0.01% for watchdog timer and Year / Month / Day and hour / Minute / Second format.</p> <p>j) Processor should be 32 bit CMOS Micro -processor and access should be password protected</p> <p>k) Flow calculation shall be internal selectable through software</p>
13	Hazardous area	Certified intrinsically safe for area classification IEC Class1 Division 2, Groups C & D, CCOE.
14	Site conditions	Temperature –20 – 65°C (Design), Hot, humid, tropical, saline environment. Vibration: Tested as per ISA s75-13-1989, Sec. 4.2 & 5.35, ECD susceptibility: Should meet IEC- 801-2, Level 3.
15	Enclosure	Weather Proof to IP 55 / NEMA 4 and Compatible formounting in Hazardous area as mentioned above.
16	Mounting	Outdoor
17	Accuracy	: 0.5 % or better (Bidder shall categorically indicate the system accuracy i.e. overall accuracy considering RPD/Turbine meter, PT, RTD etc.)
18	Accessories	<p>a) 5 way Valve manifold –SS( ½” NPTF) for processConnection.</p> <p>b) 2 “ pipe mounting brackets for Flow Computer (FC)</p>



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19	Make	Barton / Daniel / Bristol Babcock (*)
20	Model No.	*
21	Quantity	As per standard.
22	Tag no.	FQI- xxxx ( xxxx - As per respective P&Id)

\* By Vendor (Vendor must furnish decoding details & catalogue with model no.)

### **GSM MODEM**

- a) Dual Band 1200/1800 MHz(E 47)
- b) Input Current
- c) 20mA @ 12V Idle
- d) 100 mA @12V Avg.Tx.
- e) 560mA @ 12 V Peak Tx
- f) Operating Temperature: -25 to 55 Deg C.
- g) Input supply voltage: From Battery pack provided along with Flow Computer.
- h) Serial RS232 serial communication cable.
- i) Data Rates: 19200 bps.
- j) Data SIM Card : Mini SIM plug in/ removal
- k) Cellular data Service : Radip Link Protocol/ GPRS / Class BB (4+1)
- l) Antenna: Unity gain blade Antenna affixed directly to the module.
- m) LED indicator to give power and Network status.
- n) Suitable for mounting in the Hazardous area as indicated.**

#GSM Modem shall be compatible with client SCADA.

### **o) Notes:**

1. Original licensed software for retrieving the stored data, programming the flow computer using portable PC (Laptop), software based on Windows 2000/ XP shall be supplied in the form of CD's for each skid as per MR.
2. All the Hardwares and softwares to be supplied shall confirm the Engineering Units as mentioned in these specifications.
3. Flow computer documentation including product literature, software/hardware manual, operating manual, maintenance instructions, Certificates etc. shall be supplied as per vendor data requirement.
4. GSM Modem shall be provided in the flow computer for remote data configuration, remote data uploading (previous 35 days data) and remote data monitoring.
5. Following features shall be available in Field mounted flow computer:-
  - i) Energy measurement in functions and display.



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- ii) Memory allocations shall be as given below:-
- a) 512 K x 16 flash memory with non volatile copy of program code.
  - b) Programmable peripheral chip with EEPROM contains boot ladder code.
  - c) 256 K of SRAM with copy of program code and data/exact logs.
  - d) Flash memory preservation shall be achieved by 10 year data unpowered retention.
  - e) SRAM memory preservation shall be battery backed by Lithium Cell when mainpower is lost.
6. Field Mounted Flow Computer shall store previous 35 days data on hourly basis and cumulative corrected flow on daily basis.
7. Conduit connection of ½” NPTF with plugs shall be provided for output connection from Flow Computer.
8. Bidder/Supplier shall configure and update records in Flow Computer as per technical requirement and data sheet before Final Inspection call. The process parameter and the required measuring units are already specified in Data sheets/ Tender documents and it shall be made available in Flow computer. All the specified function and features shall be demonstrated during the Final inspection.
9. The communication speed of RS232 (for SCADA) serial communication port for flow computer shall be configurable from 2400 to 19,200 bps.
10. The Modbus communication protocol and message structure details to be used on the RS232 serial communication port (for SCADA) for Field mounted Flow Computer shall be supplied after placement of order shall furnish all details like pin configuration and tag number wise MODBUS address mapping list etc. for smooth interfacing of all communication links with RTU (SCADA in future).
11. Bidder/ Supplier shall provide all necessary hardware, software etc. in vendor's supplied systems and other details required for interfacing of their Flow Computers with Purchaser's RTU (SCADA). In addition to this, the communication software shall be supplied in CD for testing the communication link.
12. Bidder/ Supplier shall be fully responsible for proper integration of their supplied systems and also integration with purchaser's SCADA (RTU) systems at site and vendor shall provide all necessary assistance to purchaser's for establishing all the serial links with SCADA RTU fully functional & Operational.
13. The Flow Computers Terminal shall have minimum 1 Nos. of RS-485/RS232C Communication Ports for SCADA as specified in Data sheet,



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one no. RS-485/232 communication port for GC (Gas Chromatograph) OR for Laptop PC. The communication protocol shall be MODBUS and shall support reading & writing as follows:

- a) For reading function, CODE-3 or CODE-4 is required.
- b) For writing function, GC data into the flow computer function code to be 6 (Single) and 16 (Multiple) are required.
- c) As most of CLIENT RTU is 16 Bit registers, two registers are used for accommodating one 32-bit floating point no. Hence the flow computer (irrespective of size of the register) should be configured as 16-bit registers so that no-error is encountered in writing.



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**TERM SHEET - ANNEXURE I**

Sr. No	Description	Bidder	Gas Supplier	GSL
1	Gas sourcing & Procurement - MSPA with Gas Suppliers	-	✓	✓
2	Coordination with Gas Supplier (Producers & Terminals)	-	✓	✓
3	On site Civil & structural Construction works for LNG storage & regasification facility	-	-	✓
4	Allocation of Land to set-up facility	-	-	✓
5	Gas Truck Loading Arrangement of logistics at LNG Terminal	-	✓	-
6	Supply of Utilities such as Electrical power & water (Electrical power will be provided up to Electrical room Panel. )	-	-	✓
7	Electrical cabling work from GSL electrical room panel to LNG equipment / dyke wall/ Electrical panel for LNG setup.	✓	-	-
8	UPS for PLC power backup or any other purpose	✓	-	-
9	Earth pits with Earthing system in it at required locations; Earthing connectors/cables between equipment to earthing pits and to the control panel	✓	-	-
10	Supply Basic design of storage & Regasification Facility	✓	-	-
11	Arrange Transit insurance for equipment.	✓	-	-
12	Supply skilled operators 2x 12hrs shift for Re-gas facility	✓	-	-
13	Appoint a dedicated Operations Manager for CGD GA.	✓	-	-
14	Supply of regasification skid, tanks, Pump etc for LNG setup.	✓	-	-
15	Supply of Fire water system as per PESO guidelines	✓	-	-





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16	Supply of Fire extinguishers, sand buckets, warning signs & its periodic refilling & maintenance up to 5 years from date of commissioning.	✓	-	-
17	Personal computer for SCADA system & Software license	✓	-	-
18	Supply & Installation - O & M of Firefighting Equipment's Gas Detection Fire detector devices etc.	✓	-	-
19	Pump for removal of water from dyke	✓	-	-
20	Supply of Air compressor with inbuilt reservoir	✓	-	-
21	Provision for cranes for unloading, erection and installation for all LNG Station Equipment	✓	-	-
22	Supply skilled plant technicians and manpower for hose handling, testing & start-up as per standard operating procedure.	✓	-	-
23	Supply of Liquid Nitrogen for tank cooling during commissioning	✓	-	-
24	Air and N2 gas for testing during commissioning.	✓	-	-
25	Spare parts for normal operation of 5 years	✓	-	-
26	Hazop Study, Emergency plan and safety report for MSIHC if required, PESO license for use of Facility one time	✓	-	-
27	Obtain PESO approval before start of actual operation.	✓	-	-
28	Supply of all required Foundation bolts for tank and vaporizers	✓	-	-
29	Obtain & supply of PESO approved equipments	✓	-	-
30	Obtaining PESO approval for the site	✓	-	-
31	Appoint short term liaison team - PESO licence	✓	-	-
32	Documentation for compliance with PESO/OISD rule wherever required	✓	-	-



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33	Quality test certificates dossier for cryogenic pressure vessel with third party inspection agency certification (for inner vessel)(1 set) in English comprising of the following. a) Certificate form third party inspection agency for inner vessel b) Material Heat chart for inner vessel pressure parts c) Technical properties test report for production test coupon d) History sheet for inner vessel e) Material test report for pressure parts (inner vessel) f) Name plate photo copy g) Certificate of safety valve, pressure gauge, level gauge h) Vacuum report	✓	-	-
34	Standard O&M Manual (1set) in English for Tank, Vaporizer & Pump	✓	-	-
35	The equipment can be offered for pre-dispatch Inspection to customer's representative before shipment from vendor works. Inspection shall be as per vendor standard QAP approved by GSL.	✓	-	-



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**LIST OF VENDORS FOR BOUGHT-OUT ITEMS**

**I) L.E. L DETECTION SYSTEM**

- 1) Crowcon Detection Instruments Ltd
- 2) Detection Instruments (I) Pvt Ltd
- 3) Detector Electronics Corporation
- 4) Drager Safety AG & Co. KGAA
- 5) MSA – Mines safety appliances.
- 6) Oldham France S.A.
- 7) Honeywell

**II) CONTROL AND SIGNAL CABLES**

- 1) M/s ASSOCIATED CABLES
- 2) M/s DELTON Cables Ltd, India
- 3) M/s KEI Industries Ltd INDIA
- 4) M/s - Cords Cable Industries Ltd, India
- 5) M/s Polycab Wires Pvt Ltd, India
- 6) M/s T. C. Communication Pvt. Ltd., Delhi
- 7) M/s Suyog
- 8) M/s Thermo Cables

**III) ZENER BARRIERS/ISOLATORS**

- 1) M/s MTL
- 2) M/s P & F

**IV) PRESSURE TRANSMITTERS, TEMPERATURE TRANSMITTERS & DIFFERENTIAL PRESSURE TRANSMITTERS**

- 1) M/s Fisher Rosemount (Emerson)
- 2) M/s Yokogawa
- 3) M/s Honeywell

**V) SS TUBE, FITTINGS, VALVES, MANIFOLDS**

- 1) M/s Sandvik, Sweden
- 1) M/s Swagelok (USA)
- 2) M/s Parker (USA)



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**VI) JUNCTION BOXES, CABLES GLANDS & ESD PUSHBUTTON**

- 1) M/s EX-PROTECTA
- 2) M/s FLAMEPROOF CONTROL GEARS
- 3) M/s BALIGA
- 4) M/s FLEXPLO ELECTRICALS

**VII) PUSH BUTTONS/LAMPS:**

- 1) L&T
- 2) SIEMENS

**VIII) MCB'S:**

- 1) HAVELL'S
- 2) INDO ASIAN
- 3) MDS

**IX) RELAYS:**

- 1) OEN
- 2) JYOTI

**X) POWER SUPPLY UNIT:**

- 1) ELNOVA
- 2) APLAB

**XI) RPD METER**

- 1) Elster Handel.
- 2) M/s Itron (Formerly, Actaris / Schlumberger).
- 3) M/s Instromet.
- 4) M/s UGI Meter.
- 5) M/s Smithmeter.
- 6) M/s Dresser
- 7) M/s American Meter.
- 8) M/s Romet, Canada

**XII) TURBINE METER**



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- 1) Elster Handel.
- 2) M/s RMG (Germany).
- 3) M/s Rockwin
- 4) M/s Vemmtech.
- 5) M/s Itron (Actaris/Schlumberger).
- 6) M/s Daniel (USA)
- 7) M/s Barton Instruments (UK).

**XIII) INDICATORS**

- 1) M/s ABB
- 2) M/s EUROTHERN
- 4) M/s TATA HONEYWELL
- 5) M/s MASIBUS

**XIV) CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES**

- 1) M/s Keltron Controls Ltd., Kerala
- 2) M/s RITTAL
- 3) M/s Pyrotech
- 4) M/s Positronics Pvt. Ltd.

**XV) RTDs**

- 1) M/s General Instruments Ltd., Mumbai
- 2) M/s Nagman Sensors (Pvt.) Ltd.
- 3) M/s Pyro Electric, Goa

**XVI) PRESSURE GAUGES, TEMPERATURE GAUGES**

	1)	M/s AN Instruments Pvt. Ltd., New Delhi
	2)	M/s General Instruments Ltd., Mumbai
	3)	M/s WIKA
<b>XVII)</b>	<b><u>PLC</u></b>	
	1)	Rockwell Automation
	2)	ABB
	3)	Honeywell
	4)	Siemens
	5)	Ge Fanuc
	6)	Schneider



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7)	Modicon
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**XVIII) HMI**

- 1) Dell
- 2) Compaq
- 3) HP
- 4) IBM
- 5) Dynalog

**XIX) LEVEL/PRESSURE/DIFF. PRESSURE SWITCHES**

- 1) Nivo Controls
- 2) SB Electro Mechanicals
- 3) Bells Controls Ltd
- 4) Chemtrols Engg. Pvt. Ltd
- 5) Levcon Instruments
- 6) DK Instruments Pvt. Ltd
- 7) V. Automat Industries (P) Ltd

**XX) PRESSURE REGULATOR AND SLAM SHUT VALVE**

- 1) M/s Pietro Fiorentini S.P.A. (Italy)
- 2) M/s Emerson Process Management (Singapore)
- 3) M/s RMG-Regel Messtechnik (Germany)
- 4) M/s Nirmal Industrial Controls (India)
- 5) M/s Gorter Controls (Netherlands)
- 6) M/s Dresser

**XXI) SOLENOID VALVE**

- 1) ASCO
- 2) Rotex
- 3) Herion Werke
- 4) ASCO Joucomatic

**XXII) ULTRASONIC LEVEL TRANSMITTER**

- 1) E&H
- 2) Emerson
- 3) Khrono Marshall
- 4) Chemtrols



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**XXIII) LEVEL TRANSMITTER ( FLOAT & TAPE)**

- 1) S.B.Electromechanicals
- 2) Nivo Controls
- 3) E &H.

**Note-1**

Bidder to offer all the items as per above list only **subject to submission of Certification and approvals and meeting the technical requirements.**

**Note-2**

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

- a) The vendor/ supplier should not be in the Holiday list of CLIENT.
- b) Should have supplied at least 50% of required quantity or minimum 1 number whichever is higher of maximum size and rating of item(s) as required for intended services.

The successful bidder is required to enclose documentary evidences (PO copies along with relevant approved documents, Inspection Certificate, Type approval certificates, Vendor Registration Certificates, performance certificates, statutory certificates, undertaking for not in Holiday list, etc.) within 30 days from date of Placement of Order.



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**TECHNICAL  
SPECIFICATION  
FOR  
SELF ACTUATED PRESSURE CONTROL  
VALVES AND SLAM SHUT VALVES**





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### **TECHNICAL SPECIFICATION FOR PRESSURE CONTROL VALVES AND SLAM SHUT VALVES**

1. Set point of the Gas pressure regulators/ Monitor (PCVs) and Slam Shut Valves (SDVs) shall be adjustable. Vendor shall furnish the adjustable range of the Gas pressure regulators and slam shut valves.
2. The Gas pressure regulator and slam shut valves shall be provided in redundant pressure regulation stream as primary pressure regulating stream and secondary pressure regulating stream as per P & IDs. It is intended to provide slam shut valves on upstream of self-actuated pressure control valves at gas receiving points for tight shut off at increasing pressure beyond a preset limit, to take care of self-actuated pressure control valves failure. The slam shut valve of primary regulating stream shall close at its set pressure in case of failure of primary operating regulator & monitor and the secondary regulating stream shall come in operation. The automatic switchover shall be achieved with appropriate staggered setting of Pressure regulator/monitor and slam shut valves. Vendor shall select the appropriate set points such that the switch-over is smooth without affecting the safety of the system and gas supply to consumers is also not interrupted.
3. Each pressure regulator / monitor shall be designed for maximum gas flow rate at the minimum inlet arrival pressure. Gas pressure regulators shall be with very high range-ability since high fluctuations in flow demand are expected and also the inlet pressure may vary considerably.
4. Pressure regulators/ monitors shall be self-actuated pilot operated with regulation accuracy of better than +/- 1% of set point.
5. The construction of the Regulators / monitors shall be such that there will be no continuous gas bleeding.
6. Leakage class for pressure control valve & slam-shut valve shall be class-VI as per ANSI B16.10
7. Vendor to note that the noise level for each Regulator shall be less than 85 dBA at one meter away from the valves. Vendor shall provide noise treatment to limit the noise level and include silencers or expanders as required in their scope of supply. Vendor to provide Noise calculation giving full details and standards used and any assumptions considered in calculation (This calculation shall be submitted along with the bid).
8. Slam shut valve shall be self-contained type requiring external control line such that the line pressure acts directly on the diaphragm.



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9. Closing time of slam shut valve shall be less than 2 seconds for all sizes of the valves. Actual closing time of the valve shall be furnished by vendor along with the bid.
10. Slam shut valves shall be provided with position indicator and shall have separate limit switches for open and close positions. Limit switches shall be with DPDT, snap acting microswitch with contact rating 1 A @ 24 V DC. Limit switch enclosure shall be weather proof to IP 55 and flame proof (Ex'd') suitable and certified for area classification IEC Zone 1, Gr. IIA, IIB, T3. Cable entry shall be ½" NPT without flying leads.
11. Resetting of slam shut valves shall be manual only.
12. Slam shut valves shall be provided with a mechanical indicator to indicate valve open or close position.
13. Slam shut valve shall have a set point accuracy of  $\pm 1\%$  over the whole operating range.
14. Any By-pass valve provided for the slam shut valve shall be spring closing type.
15. Velocity at pressure regulating valve may increase beyond 20 meter per second however in the downstream pipe it shall be within 20 meter per second. Actual velocity shall be indicated by vendor.
16. Vendor shall furnish the flow rate versus trim lift curve to justify the valve rangeability and valve regulation characteristics.
17. The PCV & SDV shall be designed in such a way the noise generated by this equipment shall not interfere with the performance of the meter.
18. The self-actuating Pressure regulating valve shall be designed as per EN334 and Pressure Equipment Directive PED 97/23/EC covering the production quality assurance.
19. The Slam shut valve shall be designed as per EN14382 and Pressure Equipment Directive PED 97/23/EC covering the production quality assurance.

### **General**

- Programmable logic controller (PLC) shall be dual redundant hot standby PLC with dual processors and single I/O for all process I/O as specified.
- The CPU for PLC shall have minimum of 32-bit processor to enhance the



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processor speed.

- Programmable logic controller (PLC) system shall be programmable, modular microprocessor based safety system, which shall be used for implementation of safety shutdown/interlocks and terminal operation monitoring.
- The system shall be designed "fault avoidant", as a minimum by selecting high-grade components of proven quality and proper design of system electronics. The system shall be highly reliable, high-integrity safety system on both qualitative and quantitative technologies. Redundancy shall be provided as a minimum, as per this specification to improve system availability, reliability and safety. Due consideration shall be given to the environmental conditions particularly for field mounted subsystems.
- The system shall be modular in construction and expandable in future by adding additional modules, which shall be easily accessible for maintenance and repair. The modules shall be suitable for inserting in 19" rack / DIN rail mounting. The types of modules shall be kept to minimum possible in order to have interchangeability and low spares inventory.
- The PLC shall have a very high noise immunity in order to ensure safe and reliable operation when subjected to electrical radio frequency interference and electromagnetic disturbances expected in a plant. The design of system electronics shall be in compliance with the electromagnetic compatibility requirements as per 'IEC-801- Electromagnetic compatibility for Industrial Process Measurement and Control Equipment'.
- The system shall have extensive set of self-diagnostics hardware and software for easy and fast maintenance of PLC. Routine checks should run automatically at frequent intervals for identifying any fault in software or hardware. Diagnostics shall be required at local module as well as operator interface console level.
- Operation of the PLC shall be completely unaffected by a momentary power loss of the order of 20 milliseconds.
- The scan time of programmable controller shall be of the order of 100 milliseconds. Scan time of PLC is defined as the cycle time taken by the system to read input, process input executing logic, and update control output for all the logic configured within the system. Other activities like



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diagnostic routines, output/dump of data to peripherals, or any other activity, which consume processor time, shall also be accounted while computing scan time.

- On-line replacement of any module shall be possible in such a way that the removal and addition of the module shall be possible without de-energizing the system. Further, there shall not be any interruption in the system while replacing a faulty module except for the inputs/outputs, which are being handled, by that module.
- The process control system shall be based on open system architecture i.e the system shall have inherent capacity to integrate and exchange information with other brand system devices and platforms via industry standard communications, platforms and protocols such as MODBUS, Profibus, Foundation Fieldbus, OLE for Process Control (OPC) or Ethernet TCP/IP.
- The system shall be able to support various types of field buses. As a minimum, profibus DP, Modbus should be available. At least up to 4 lines per controller should be operated simultaneously. Ideally even different types of field busses should be operated simultaneously on the same controller.

### **Spares philosophy**

Following minimum spare shall be considered in the system:

- i. A minimum of 25 % spare I/O channels shall be installed and wired.
- ii. Wherever relays are used to interface process input/outputs with PLC 25% additional relays shall be provided and wired.
- iii. A minimum of 25% spare terminals shall be provided with internal wiring.
- iv. The processor shall have the capability to execute logic for I/O's including installed spares.
- v. 25% of the memory shall be spare.
- vi. Minimum 25% spare capacity (after Loading of Software Application) to be provided for primary memory of processor.

**System Configuration:** The system shall consist of following major subsystems:

### **Input /Output subsystem**



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The I/O modules shall be mounted in the I/O racks located in control room i.e. I/O modules shall be general purpose unless otherwise specified. I/O devices interface with PLC shall be at I/O racks only.

The maximum number of input/outputs per module shall be limited as follows:

SN	Type of Configuration	No. Of I/Os
1	I/O Sub-system	16/32 for Digital inputs 08 for Analog inputs 08 for Analog outputs  16/32 for Digital outputs

- Each I/O shall be electrically isolated from external control circuit by suitable means. The minimum isolation level between I/O and logic circuit shall be 1000 VDC. I/O status indication shall be provided for each I/O module.
- Each I/O shall be protected against reversal of polarity of the power supply voltage to I/O .
- Each DI module shall have LED for each I/O channel to indicate the status of each input/output.
- Each input shall be provided with filters to filter out any noise in the input line or noise because of input contact bouncing.
- PLC inputs shall be provided with potential free/dry contacts unless otherwise specified.
- All the inputs shall preferably be double ended i.e. two wires per input and not common return for all inputs.
- The interrogation voltage (24V DC / 230 V AC) to the input/output contact shall preferably be powered from separate redundant power supply units and shall not be a part of PLC.
- Output contacts from the PLC shall be potential free/dry contacts with contact ratings as given below. Wet contracts/ powered contacts/TTL outputs etc., shall not be acceptable. Suppression device for each output contact is to be provided.



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- The output contact rating shall be as follows

Sr. No.	Applicable for	VOLT	Current Rating
1.	All output cards for driving 230VDC 0.5A Solenoid valves and alarm annunciator.	24VDC	2.0A
2.	All output cards for driving LT motors/pumps/solenoids	230VAC	5.0A

- Input type shall be intrinsically safe with barriers for analog input modules and explosion proof type for digital input modules. Only Active Barriers shall be employed for achieving galvanic isolation, wherever applicable.
- Each Input/output shall be short-circuiting proof and protected by fuse. Visual indication of fuse down/blown must be provided for each output as a preferred choice.
- The I/O modules; interface modules shall be of the same make/manufacturer & same family as the principal manufacturer of processor system.

### **Processor System**

- The offered processor type shall have a minimum reference capacity to handle 2000 real time I/O. Redundancy shall be provided such that in case of failure of the primary processor, the secondary processor shall take over automatically without any time lag. Both processor shall access the inputs simultaneously. The changeover shall be bumpless and the system shall be safe. Redundancy shall be provided for complete processor subsystem including CPU, memory, power supply & host system communication interface.
- Memory shall be non-volatile. However, in case volatile memory is provided, rechargeable battery backup shall be provided for a minimum of one year to keep the stored program intact. A battery drain /pass indication shall be provided. The size of the memory shall be sufficient for storage of the program instructions required by the logic schemes.
- In case of failure of complete processor system i.e. both processors system,



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outputs shall take fail-safe automatically.

It shall be possible to generate the first out alarm output by the PLC in case where a group of parameters are likely to trip the system.

### **Communication Sub system**

The communication subsystem shall be a digital communication bus that provides reliable and high speed data transfer between the processor subsystem & I/O subsystem.

Redundancy in communication subsystem shall be as follows unless otherwise specified.

- Communication Interface between each I/O rack & the dual processor system shall be via separate dedicated dual redundant communication link in multi-drop mode. Daisy chained redundant communication bus to establish interface between I/O racks & processor system shall not be acceptable.
- The communication interface between each processor subsystem and host system shall be dual redundant consisting of two separate communication interface modules located in / from each individual processor rack and two individual communication links, with each one configured in redundant mode. **Use of PLC processor CPU port for establishing host interface connectivity shall not be acceptable.**
- In case of redundant communication subsystem on the failure of the active device the redundant device shall take-over automatically without interrupting the system operation.

Information about the failed device shall be displayed locally as well as the console. It shall be possible to manually switch-over the communication from main bus/device to redundant bus/device without interrupting the PLC functions.

The mechanism used by the system for error checks and control shall be transparent to the application information/program. Error checking shall be done on all data transfers by suitable codes. All communication interfaces shall be galvanically or optically isolated.

### **Self-diagnostics**

The system shall have an extensive set of self-diagnostic routines which shall be able to identify the system failures at least up to module level



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including redundant components and power supplies through detailed CRT displays report print outs and logic programming.

- At the local level, failure of a module in any subsystem shall be identified by an individual LED.
- Self-diagnostics shall be provided to detect faults (which make the contacts in fail safe mode) in the input and output modules. Each module shall have separate arrangement for self-diagnostic facility. This may be achieved by automatically running the testing software at cyclic intervals.
- Testing software shall be capable of detecting faults in case of normally closed system as well as in normally open system.
- Feedback shall be provided internally from the output voting logic system to detect any latent faults of the system.

#### **Power supply distribution**

PLC system shall be powered with 230 V AC +/- 10%. Power pack shall be 100% redundant with safety factor of 1.5. The distribution network for AC power supply shall be designed such that a single power fault in any branch system shall not cause a trip of the entire system. The distribution network for interrogation voltage shall be designed such that a single fault in any branch shall not cause trip of the logic other than where the fault has occurred. Sequential starting of various load centers shall be provided whenever specified.

#### **PLC System Cabinets**

All PLC system cabinets shall be completely wired with all modules in place. Inside cabinet wiring shall be done using ribbon type pre-fabricated cables.

All the cabinets shall be free standing, enclosed type and shall be designed for bottom entry of cables through gland plates of preferably 3 mm thickness. Cabinet structure shall be sound and rigid and shall be provided with removable lifting lugs to permit lifting of the cabinets.

Cabinet shall be fabricated from cold rolled steel sheets of minimum 2 mm thickness suitably reinforced to prevent warping and buckling. Doors &





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side panels shall be fabricated from cold rolled steel sheet of minimum 1.5mm thickness. Cabinets shall be thoroughly debarred and all sharp edges shall be grounded smooth after fabrication. Panel shall be confirming to degree of protection minimum as per IP-31.

Cabinet finish shall include sand blasting, grinding, chemical cleaning, and surface finishing by suitable filter and two coats of red lead primer by spray. After drying, final paint shall be applied. This can either be NC or epoxy depending upon the customer requirements. Outside color shall be light grey as per IS 631/RAL7035. Inside of the panel shall be painted with high gloss white color. Base channel shall be painted black. Non-welded panel shall be powder coated.

Each cabinet shall be approx. 2100 mm high (excluding 100-mm channel base), 800 mm deep, Width shall be suitably decided depending on requirement and considering ease in maintenance Max 800 mm for Single door and Max 1200 mm for Double door in general. Construction shall be modular preferably to accommodate 19" standard electrical racks.

All cabinets shall be of same height. Maximum swing out for pivoted card racks, doors and drawers shall be limited to 600mm. However, standard design of cabinets from approved PLC manufacturers shall be acceptable.

Cabinets shall be equipped with the front and rear access doors. Doors shall be equipped with lockable handles and concealed hinges with pull pins for easy door removal. Cut-outs shall be properly shaped and devoid of sharp edges. They shall be made by nibbling process or by drilling and filling. Gas cutting under any circumstances shall not be used for making cutouts.

In order to remove dissipated heat effectively from cabinets, vent louvers backed by wire fly screen shall be provided in cabinet doors. Further two ventilation fans shall be provided.

Illumination shall be provided for all cabinets by incandescent lamps, which shall be operated by door switch.

Equipment within the cabinet shall be laid out in an accessible and logically segregated manner. Cable glands shall be provided for incoming and outgoing cables to prevent excessive stress on the individual terminals. All metal parts of the cabinet shall be electrically continuous and shall be provided with a common grounding lug.

The front doors for the PLC cabinet shall have toughened glass / acrylic window for visual ergonomics.



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### **Earthing**

Each cabinet, console and other equipment supplied as a part of PLC system shall be provide with an earthing lug. All these lugs shall be properly secured to the AC mains earthing bus.

All circuit grounds, shields and drain wires of control cables shall be connected to the system ground bus which shall be electrically isolated from AC mains earthing bus. This bus shall be typically of 25 mm wide and 6 mm thick of copper.

All barriers, if used, shall be securely grounded. Safety barrier ground wire shall be capable of carrying a maximum fault level current of 0.5 A at 250 V r.m.s per barrier.

Note : all panels shall have earth leakage detection system installed which shall prevent earth leakages current.



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## **SPECIFICATION FOR INSTALLATION OF INSTRUMENTS**



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**INSTALLATION, TESTING AND CALIBRATION OF  
INSTRUMENTATION AND CONTROL  
SYSTEM**

**1.0 SCOPE**

**1.1** The purpose of this specification is to define the general requirements for the installation, installation materials, testing and calibration of instruments and control system.

**1.2** The work shall be carried out in accordance with the codes, standards and recommended practice listed in this specification and in accordance with local 'Statutory regulations'.

**1.3** For installation of instruments and control system, of the new material where quality is of the prescribed standards, and which is in every way fit for its intended purpose shall be used.

**1.4** Unless otherwise specified all the materials shall be indicated in this specification except where it is not compatible with fluids being handled. In such cases the selection of the material shall be approved by Consultant/GSL.

**1.5** Only the best trade practices shall be used. All the work shall be carried out in neat, workman like manner and to the satisfaction of Consultant/GSL.

**2.0 STANDARDS OF MATERIALS**

**2.1** Instrument process piping / tubing upto and including the first block valve and 'in-line' instrument equipment shall conform to the line class or vessel rating concerned instrument piping or tubing after the first lock valve may use alternate materials consistent with service conditions. In general, they shall conform to the following specification as a minimum.

**2.1.1** Stainless tubes shall be fully annealed and cold drawn seam less as per ASTM A269 TP316 with size 1/2"OD x 0.65" WT (wall thickness).

**2.1.2** Monel tubing shall be fully annealed seamless as per ASTM B165 with size 1/2"OD x 0.35"WT.

**2.1.3** Carbon steel pipe shall be 1/2" seamless and shall be as per ASTM A106 Gr B min of sch 80 & dimensions as per ANSI B36.10.



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- 2.1.4 Seamless stainless steel pipes shall be as per ASTM A 312 Gr TP 316L Sch 80S, dimensions as per ANSI B 36.19. Instrument air supply piping from the main instrument air header shall be galvanized heavy class pipes to IS 1239.
- 2.2 Individual pneumatic signal and air supply tubing shall conform to the following specifications:
- 2.2.1 Stainless tubes shall be used in general and shall be fully annealed and cold drawn seamless as per ASTM A269 TP 316 with 6mmOD x 1mmWT.
- 2.2.2 Copper tubing where specified shall be seamless 6mmOD x 1.0mmWT soft annealed as per ASTM 868.74a cd No. 122 (DHP) sheathed with PVC 1.0mm thick coloured Black.
- 2.3 All fittings shall be as a minimum of 100 rating except for tube fittings. The fittings shall have threading as per B2.1 and socket weld connections as per B 16.11. These shall conform to the following specifications in general.
- 2.3.1 Tube fittings shall be flare type compression fittings Swagelok or equivalents make double ferrule and pressure seat type.
- All tube fittings in impulse lines shall be rated to 5000 PSIG at 38°C.
- 2.3.2 Carbon steel pipe fittings shall be forged as per ASTM A105 stainless steel pipe fittings shall be as per ASTM –182 Grf 316L
- 2.4 Valve shall have normally Globe body and shall be fabricated out of Bar-stock and rated to min. of 1500. These shall be screwed bonnet type with 13% GSS trim and plug shall be integral with the stem. Face to face dimensions shall be approx. 80mm. End connections shall be socket weld to ANSI 16.11 and threaded to B2.1
- 2.5 Multibore tubing shall have a maximum 19 single polyethylene tubes, 6mmOD x1mm numbered for easy identification. The bundle shall be marked with inner and outer fire resistance PVC sheath. They shall carry a pair of telephone wire 0.6mm diameter flexible.
- 2.6 Single pair and multi pair extension cables for Thermocouples shall be matched and calibrated in accordance with ISA MC 96.1. Conductor size shall be AWG for single pair and 20 A for Multipair.
- 2.7 The cable shall be armoured, each twisted pair shall be individually shielded with aluminum Mylar tape and a tinned copper drain wire. The wires and the



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cable shall be colour coded as per ISA recommended practices.

**2.8** Instrument Electrical cables shall conform to the following specifications:

2.8.1 Instrument electronic signal cables single pair/ Multipair shall have copper conductor, twisted in pair and individually shielded with Aluminum Mylar tape with drain wire. In multipair cables, each pair shall be armoured with inner and cut PVC sheath. Minimum conductor size shall be 1.5 mm<sup>2</sup>.

2.8.2 Control Cables for control signal, alarms actuating devices and solenoid valves of the interlock and shutdown valves shall generally be 1.5 mm<sup>2</sup> copper conductors armoured with inner and cut PVC sheath.

2.8.3 All power supply cables shall have copper/Aluminium conductor depending upon the conductor size. The cables shall be armoured with inner and cut PVC sheath. The cables shall be sized adequately. Minimum conductor size shall be 2.5 mm<sup>2</sup>.

2.8.4 2-core armored cable shall be used for illuminator on level gauges.

2.8.5 The material and construction of all electrical cables shall conform to IS- 1554Part I or appropriate equivalent code and standard.

### **3.0 INSTALLATION OF INSTRUMENTS**

#### **3.1 Instrument Mounting**

3.1.1 No instrument shall be installed in such a way that it bends for support on the impulse piping or electrical connection on it.

3.1.2 Pressure gauges and temperature indicator shall normally be mounted directly on line. However direct on line mounting shall be avoided where vibrations are likely to be present.

3.1.3 Local mounted instruments shall be mounted on brackets, panels or placed on a suitable pedestal. Transmitters shall be mounted on 2" pipe supports where practical. Instruments to be mounted on steel columns, masonry structure etc. These shall not be mounted on heating equipment, pipelines and structures.

3.1.4 Blind transmitters shall be mounted at 130mm above graded platform. Local controllers, indicating transmitters and indicating instruments shall be mounted at approximately 1500 mm.



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3.1.5 All the instruments shall be accessible from grade, ladder or platform etc. Pressures gauges and other local indicating instruments shall be readable from grade or operating level and if used for manual control shall be visible from the related valve.

All the instruments shall be located such that they don't impede the process operation.

3.1.6 Local mounted instruments which are not available in weather proof housing shall be mounted inside a weather proof case.

3.1.7 Items such as pilot valves, solenoid valves etc. shall be located local to its point of application or near to the device being actuated by them.

3.1.8 For blind transmitters output meters shall be mounted on instrument supports.

3.1.9 Filter regulators shall be mounted on the instrument supports below pneumatic transmitter or on the control valve yoke.

3.1.10 Instruments or instrument lines shall not be supported on hand rails, in general.

3.1.11 The use of process piping to support instrument lines shall be avoided as far as possible.

3.1.12 The instrument impulse piping shall be kept as short as possible.

3.1.13 Instruments and impulse lines shall be protected against mechanical damage.

3.1.14 In case of capillary tube instruments, capillary tube is to be supported and protected against mechanical damage.

3.1.15 Orifice meters shall not be installed on the top of orifice fittings. On horizontal lines orifice pressure taps shall be located as follows:

- a) On top for air and gas service
- b) Horizontal for liquid and condensable vapor service.

**3.2 Instrument Piping & Tubing.**

**3.2.1 Impulse Piping/tubing**



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- 3.2.1.1 The primary instrument block valves for all instruments shall be as per piping specifications.
- 3.2.1.2 3-Valve manifold in general shall be integral type. For pressure gauges, 2-valve manifolds shall also be acceptable instead of isolation valve, drain valve and pipefittings.
- 3.2.1.3 Differential or static pressure sensing lines shall not exceed 6 mtrs. (20 feet) in general for direct connected or locally mounted instruments.
- 3.2.1.4 All impulse lines shall be run with a slope not less than 1 in 12 except where otherwise specified. Direction of slope is to be downward from the process for liquid service and upward from the process for gas service.
- 3.2.1.5 Tubing shall be joined by compression fittings.
- 3.2.1.6 Piping shall be joined by pipe fittings/flanges as per the piping specifications.
- 3.2.1.7 All instruments pipes and tubes shall run in horizontal and vertical planes only and shall run with minimum number of changes in direction, consistent with good engineering practices and neat appearance.
- 3.2.1.8 Tubing shall be bent with correct size tube bender as far as possible to avoid use of fittings. Hot bending shall be totally avoided.
- Tube cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided in order to avoid the fittings.
- 3.2.1.9 All tubing shall run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped.
- 3.2.1.10 Tubing shall be arranged so that the unions can be tightened without distorting lines.
- 3.2.1.11 Instrument tubing or piping shall not run on trays intended for cables and shall not share the same transit.
- 3.2.1.12 No pipe or tube shall be left with mechanical strain on them.
- 3.2.1.13 A mechanical ferrule seater shall be used on tubing for 140 kg/cm<sup>2</sup> (2000 psi) or more.
- 3.2.1.14 Pipe bushings shall not be used.





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- 3.2.1.15 Pipe plugs shall be fabricated out of bar stock and shall have hex-head.
- 3.2.2 Air/Signal Tubing
  - 3.2.2.1 Signal Transmission tubes shall be laid on perforated trays prefabricated out of min 2.5 mm. thick steel plates. The width of the tray shall be selected as per the number of tubes to be laid.
  - 3.2.2.2 Where tubing is run in permanent enclosures, it should be ensured that entry and exit of such enclosures is clean and smooth.
  - 3.2.2.3 Tubing run in permanent enclosures shall not have joints, except at special junctions' boxes provided for this purpose.
  - 3.2.2.4 Where permanent enclosures are left with space for instrument tubing to be laid at some later date, a galvanised pull wire of adequate size shall be left in the tray.
  - 3.2.2.5 Where the length of transmission tubing exceeds 60 mtrs (200ft) necessity of installing signal booster relays shall be considered.
  - 3.2.2.6 In case of `Skidded' equipment or vessels with instrumentation, where off-skid alarms shutdown or control functions are provided the signal tubes shall be terminated on the control bulk head near the skid boundary.
- 3.2.3 All threaded pipe joints shall be joined after applying Teflon tape. It should be applied in a manner to ensure that the tape does not spill over the end of the male fitting. No other pipe joining compound shall be used except on high temperature service where graphite sealing compounds shall be used.
- 3.2.4 All reasonable precautions shall be taken to prevent foreign materials entering pipelines or tubing before and during erection.
- 3.2.5 Pipes and tubes installed but not connected, shall have the ends clad in approved fashion to prevent the entry of foreign material. For a period upto one-week adhesive tape may be used, for longer periods, caps or plugs shall be used.
- 3.2.6 Piping/Tubing supports
  - 3.2.6.1 Piping and tubing shall be adequately supported and fixed at a distance not exceeding that in the following table:

Table

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Single tubing/Piping

Max. distance between supports



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3/8" OD or less	Continuous
1/2" to 3/4" Nom. size	2 meters (6ft.)
3/4" to 1" Nom. size	3 meters (9ft.)
Multitube bundle	3 meters (9ft)

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3.2.6.2 All field mounted instrument air tubing shall be supported with galvanised steel angles or channels of minimum 1/8" thickness fabricated to present neat appearance.

3.2.6.3 All instruments tubing supports shall be galvanised prior to installation

3.2.6.4 Trays shall be properly supported either from any rigid steel structure or concrete member. In case of non-availability of above, a suitable support shall be fabricated.

**3.3 Instrument Air Supply Distribution**

3.3.1 Piping material for instrument main and branched air headers upto the isolation valve at each take-off from main or branch header shall conform to piping specification.

3.3.2 The air header size shall be established in accordance with the table below, unless otherwise specified, for a header pressure of 4 to 8.5 kg/cm<sup>2</sup>

Max number of users	Nominal pipe size	
upto 5	1/2"	
upto 10	3/4"	
upto 25	1"	
upto 80	1-1/2"	
upto 150	2"	
upto 500	3"	



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- 3.2.3 All take off for branch lines are to be from the top of the main header with block valves equal in size to the branch line. All low point shall have a 1/2" valve installed as a drain and blow down point.
- 3.3.4 A minimum size of 1/2" pipe shall be run to the instrument with a 1/2" valve for each user. Tubing from the isolation valve to the instrument shall be 6.0 mm.
- 3.2.5 Union shall be provided at convenient location in the air header.
- 3.3.6 Filter regulator shall be provided for individual field mounted consumer and shall be complete with an output gauge.
- 3.3.7 In case of skid mounted equipments or vessels which incorporate instrumentation requiring pneumatic supply, on skid supply piping shall terminate at the skid boundary location and size of the supply connections shall be noted on the vendor approval drawings.
- 3.4** Installation of multitude and Multicore cables.
- 3.4.1 Multicore/ Multitube cables shall generally be installed on trays or ducts and properly clamped. At bends minimum radius shall be maintained as per cable manufacturer's standards.
- 3.4.2 All cables shall be rigidly supported on structural steel and masonry. Drilling of steel member should normally be avoided. However, if the drilling of steel must be resorted to, it must be drilled where minimum of weakening of structure will result cables shall be support at every 500 mm. At every vertical drop these shall be clamped at more frequent intervals max of 300mm.
- 3.4.3 Directly buried cables shall be laid underground in excavated cable trenches. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced and arranged with a view of heat dissipation and economy of design construction of trenches laying of cables and filling up of trenches shall be as per relevant standard.
- 3.4.4 Each underground cable shall be provided with identifying tag of load securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground.

Before cables are placed, the trench bottom shall be filled with a layer of sand. The cables shall be covered with 150 mm of sand on the top of the largest dia. Cable tube and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall be laid flat and the balance portion of the trench



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shall be filled with soil, compacted and levelled.

- 3.4.5 At each road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables don't slack and get damaged by pipe ends after back filling.
- 3.4.6 At the entry into concrete blocks loops shall be provided at either end to prevent any damage to cable.
- 3.4.7 The cable entry to control room shall be suitably filled and sealed after laying of cables so as to achieve a positive sealing against the entry of gas/water.
- 3.4.8 All wiring, tubing, cables, Junctions boxes and auxiliary equivalent shall be suitably identified as per applicable codes and practices. All piping and tubing shall be tagged with slip-on or clip on wire marker at both ends.
- 3.4.9 Jointing of cables is generally not permitted. Cables shall be cut after the exact site measurements at the cable drums shall be so selected before cutting the lengths as to avoid any unnecessary wastage.
- 3.4.10 Low signal cables like alarms, analyzers cables, special cables for turbine meter, thermocouple compensating cables etc. shall be laid separated from power supply cables in ducts/trenches/trays.
- 3.4.11 Electric signal lines for electronic transmitters to receive and to final control element shall be continuously shielded with the shield grounded at the same point as the signal circuit generally at the control instrument.
- 3.4.12 Separate junction boxes shall be used for intrinsically safe cables.
- 3.4.13 Different intrinsically safe system e.g., systems having different rounds shall not be run in the same multicore cable, in general.

Recommended minimum separation distance between twisted pair signal leads and AC Power Lines.



Voltage (Volts)      Current (Am) in (cm)



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0 to 125	0 to 10	12" (30)
125 to 250	0 to 50	15" (38)
250 to 440	0 to 200	18" (46)
5KV & Up	200 Amp. & Up	24" (61)

Different intrinsically safe circuits e.g., circuits having different voltage levels, of the same intrinsically safe system shall not be run in the same cable unless each conductor insulation is at least 0.25mm or no hazard can result from interconnection.

- 3.4.14 The physical separation of power and signal cables shall be as per API 550 Part I Section VII. Cable in intrinsically safe circuits shall preferably be not run in the same tray where-- on intrinsically safe circuits cables are being run. If these are being run in the same tray, a metallic earthed separately shall be provided.
- 3.4.15 For temperature controllers, single pair thermocouple extension cable or cable for resistance thermometer, shall be laid directly from the element to the transducer in the control room without intermediate terminal blocks.
- 3.4.16 In case of skid mounted equipment or equipment which incorporate skid instrumentation like alarms, shutdown or control function shall terminate signals or control junction box near skid boundary for connection of off skid equipment.
- 3.4.17 No wire shall be terminated or left with mechanical strain within any conductor.
- 3.4.18 Splices shall be made only at terminals, in instruments or approval equipment/ junction boxes using lugs and screwed connections. No intermediate splices shall be made in cable trays or in conduct. Number of junction boxes in any cable path shall be limited to only one.

**3.5 Installation of Zener barriers**

- 3.5.1 Zener barriers shall be installed in the circuit to make the system intrinsically safe provided:
  - a) There is no energy storage system in excess to the minimum permitted by the barrier design on the hazardous side of the barrier. The same shall be met by taking intrinsically safe transmitters and



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selecting the cable electrical parameters like inductance L/R ratio & capacitance in accordance with the maximum parameters given in barrier specifications.

- b) No power source exceeding the voltage rating of Zener barrier shall be connected on safe side of the Zener barrier.
- c) No outside power source including other intrinsically safe circuits shall be connected to the hazardous side of the barrier.

3.5.2 Zener barriers shall be located as close as possible to the field wiring entry point in the control room.

3.5.3 Single barrier is bolted directly to copper bus bar and multiple barriers on the barrier mounting plates. Copper bus or barriers mounting plates shall be isolated from the panel frame.

3.5.4 The signal ground system for intrinsically safe system shall be separate from power ground system and shall be connected to the signal ground reference point. The maximum resistance allocable between the farthest point on intrinsically safe barrier ground bus and signal ground reference point shall be less than 1 ohm.

3.5.5 Field wires shall directly terminate at the barriers and not through intermediate terminals.

**3.6 Installation of Analyzer / Gas Chromatograph**

3.6.1 Installation of all analyzer shall be in general, as per API 550 Part II.

3.6.2 The analyzer housing at its installation shall meet all safety requirements as per classifications.

3.6.3 Sampled process fluid, if not returned to the process shall be disposed to a safe location. Piping shall be provided so that vapors can be vented to a safe location and liquids shall be drained in a clean and orderly fashion to a safe place. Toxic vapors shall not be vented to atmosphere.

3.6.4 Analyzer shall be located as near to the sampling point as possible.

3.6.5 Analyzer equipment must be protected from the following:

- a) Hot equipment
- b) Severe ambient temperature changes
- c) Shock
- d) Mechanical damage
- e) Vibration



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3.6.6 If a separate vent for the analyser is used, the location of that vent shall be in area of minimum air Turbulence. If the vents of different analysers are vented into a common vent, a back pressure regulator shall be used.

3.6.7 Vent piping shall be designed to prevent condensate from accumulation in low point and obstruct a free vent flow.

**3.7 Ducts, Trays and Supports**

3.7.1 Main cable duct shall be of bottom open type with flat/angle --- construction with side sheet and top cover of 3.2 mm thickness.

3.7.2 The ducts and trays shall be properly supported at regular intervals. Wherever insert plates are not available, support on concrete structure or ceiling shall be fixed with a minimum of 10 mm expansion bolts. Angle supports for ducts shall be fabricated from minimum of 40 mm angle.

3.7.3 All supports shall be neatly cut with hacksaw only and not with gas cutting. Free ends of angle supports shall not have sharp ends and shall be properly rounded off.

3.7.4 Ducts and supports shall be painted with one coat of Red oxide Zinc chromate primer conforming to IS-2074 after cleaning to remove scale and then painted with

2 coats of final enamel paint as given below:

- a) Duct - Dark admirably Grey as per IS0632.
- b) Supports - Black.

**3.6 Instrument Steam Tracing**

3.6.1 Steam for Tracing of instruments shall be taken from main steam header take off valve through carbon steel pipes supported at regular intervals.

3.6.2 Steam tracing around individual instrument shall be by copper tube of 1/8" diameter.

3.6.3 Piping or tubing for steam tracing shall be installed in such a way as to avoid condensate pockets.

3.6.4 After steam tracing, the line is connected to drain funnel through steam trap.



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### 3.7 Identification of Lines and Instruments

3.7.1 All site mounted instruments, junction boxes, air headers, tubing and wiring terminations shall be labelled or tagged.

3.7.2 Instruments shall be furnished with stainless steel name tags containing Tag no., manufacturer's name, and model no. serial number. This tag number shall be approximately 3"x1" size and shall be attached to the instruments with -- gauge stainless steel wire.

3.7.3 Unused cable entries in junction boxes and field instruments are to be plugged.

## 4.0 **TESTING**

### 4.1 Instrument Impulse piping/Tubing

4.1.1 All process impulse lines shall be disconnected both from the instrument and vessel/piping end and flushed with water.

4.1.2 After thorough flushing the impulse lines shall be isolated from the instruments and pressurised hydraulically to 1.5 times the maximum working pressure corrected for ambient temperature. They shall then be isolated from the pressure source and the pressure reading on a test pressure gauge shall not fall at a rate exceeding one psig/hour.

In case no isolation valve is provided near the instrument, impulse piping/tubing shall be pressurised along with the instrument to the maximum pressure of scale in case of pressure transmitter and max. Operating pressure in case of differential

pressure instrument with equalising valve open

4.1.3 In special conditions where hydro- testing is not permissible due to service requirements, testing shall be carried out by using compressed air/nitrogen.

4.1.4 The external displacer type instruments and cage type level switches shall be tested to 1.5 times the operating pressure using air/nitrogen after thorough flushing.

### 4.2 Instrument Air lines/signal tubing.

4.2.1 Instrument air lines/signal tubing shall not be hydrostatically tested.





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- 4.2.2 Instrument air tubing shall be disconnected upstream of all filter regulators and blown down to remove water, slag and mill scale, from lines at 7.0 kg/cm<sup>2</sup> G for fifteen minutes.
- Air filter shall be taken in line and tubing shall be disconnected at instrument end, and blown for 3 minutes to remove traces of dirt.
- 4.2.3 Testing of instrument air shall be carried out with instrument air at 7 kg/cm<sup>2</sup> G up to the upstream of the filter regulator after thorough flushing. All lines shall be checked with soap solution and bubbler unit for possible leak at joints.
- 4.2.4 All signal tubing shall be checked with 1.5 kg/cm<sup>2</sup> after proper flushing. After pressuring, source shall be cut off and rate of fall in pressure shall be less than IPSL for each 100 feet of tubing for a test period of 2 minutes as per instrument society of American RP 7.1 'Pneumatic Control Circuit Pressure Test'
- 4.3** Cables
- 4.3.1 All wiring shall be checked to ensure that it is correctly connected and properly grounded.
- 4.3.2 All cables shall be checked for continuity proper connection and insulation testing.
- Insulation test shall be carried out on all wiring with a certified megger after disconnecting the cables at both ends.
- 4.4** All the results of the above mentioned testing shall be recorded and submitted for check.



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**4.5** All the in line instruments like orifice plates, turbine meters, Rotameters, Target meters, vortex meters, control valves, safety valves etc. shall be removed and

spool pieces shall be provided prior to the flushing of the lines.

## **5.0 CALIBRATION OF INSTRUMENTS**

**5.1** All instruments shall be calibrated strictly as per manufacturer's instructions prior to the installation. In addition to calibration of instruments, setting of safety devices like process switches, safety valves etc. and simulation testing of all interlock and shutdown system shall be carried out.

**5.2** In general, all tests shall simulate, as closely as possible, design process condition by the use of manometers, potentiometers, deadweight testers, test pressure gauges etc. Pour point calibration shall refer to the input signal to an instrument equivalent to 0, 25, 50, 75, 100% of instrument range upscale (rising) and 75, 50, 25, 0% of instrument (downscale) (falling). All instruments unless otherwise noted shall be calibrated in upscale and downscale direction and if necessary, adjusted until their accuracies conform to those limits state by the manufacturer.  
Upon completion of these tests, the instruments shall be drained, completely.

### **5.3 Temperature Instruments**

**5.3.1** Temperature Gauges Filled type and Bi metallic dial type Thermometers shall be four-point bench checked for proper operation and calibration using a temperature bath prior to installation.

**5.3.2** Temperature Elements and Temperature Transmitters.  
Temperature Elements and Transmitter shall be four-point bench calibrated using a temperature bath precision meter or precision gauge prior to installation.

### **5.4 Pressure Instruments**

#### **5.4.1 Pressure Gauges**

**5.4.1.1** Direct connected bourdon type pressure gauges shall be dead weight tested or tested against a test gauges prior to installation.

**5.4.1.2** Receiver type pressure gauges shall be four points calibrated using a precision gauge and precision air regulator.

**5.4.1.3** Pressure and Differential Pressure Transmitters.



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Pressure and differential pressure transmitters shall be four points calibrated using a hydraulic or dead weight tester or a precision pneumatic calibrator prior to the installation. A precision output meter or gauge shall be used to monitor the output.

5.5.1 Orifice plates shall be checked visually for the name plate and for an upstream sharp edge. Bore dia. shall be checked for compliance with the specification.

5.5.2 Differential pressure type of flow instruments shall be four points calibrated using precision pneumatic calibrator or a manometer and precision regulator. A precision output meter or gauge shall be used to monitor the output of the transmitter.

5.5.3 a) Rotameters shall be installed as received. A check shall be made to confirm that shipping stops have been removed and float has been installed.

b) Where rotameters have transmitting mechanism, the float shall be raised and lowered mechanically and output shall be checked. Vendor calibration data/ curve shall be checked.

c) A check shall be conducted with plumb for a vertical installation.

5.5.4 Turbine meters, Annubar, positive displacement meters, vortex meter, ultrasonic flow meter, etc. shall be installed as received.

5.5.5 Target meters shall be checked for calibration using calibration weights. Output shall be monitored using precision output meter.

5.6 Level Instruments

5.6.1 Level Gauge Glasses

Gauge glasses shall be installed as received installation of illuminators, frost protectors and other accessories shall be checked.

5.6.2 Displacer Type, Level Transmitter

- Displacer type level transmitter shall be checked by raising and lowering mechanically the displacement and checking the pilot or transmitter action. Check transmitter without put gauge or meter for smooth and full output change.

- A check shall be conducted with plumb for a vertical installation.

5.6.3 Differential pressure type level transmitter Differential pressure type level transmitter shall be calibrated with pneumatic calibrator at four points prior to installation. A precision meter or gauge shall be used to monitor



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the output of the transmitter.

- 5.6.4 Tank level gauges
- a) Tank level gauges shall be checked by raising and lowering mechanically the displacer and checking the indicator on the gauge board.
  - b) Check for proper liquid seal prior to installation in case of liquid seal tank gauges.
  - c) In case of servo type gauges, the displacer is hoisted from the tank into the calibration chamber.
- 5.7 Control Valves, shutdown valves and self-actuated valves
- 5.7.1 All diaphragm and piston operated control valve shall be stroked pneumatically using a pressure regulator and pressure gauge against the spring range specified on the name plate of the valve.
- 5.7.2 Mechanical seating and travel of the valve stem shall be checked against the side indicator and the name plate
- 5.7.3 Valve positioner shall be calibrated with the control valve in accordance with the name plate data and specifications with the help of pneumatic calibrator or gauge with precision regulator. Zero position or fully close position of the valve shall be a live zero i.e., the plug shall be just off the seat at the minimum setting.
- 5.7.4 Volume bottles, where used shall be checked for proper filling. The signal line shall be bled to zero pressure and failure action shall be confirmed.
- 5.7.5 Control valve accessories such as handwheels, boosters, relays etc. shall be checked operationally. Declutch able handwheel shall be operable both with and without an air signal to the diaphragm.
- 5.7.6 Self-actuated control valves shall be installed as received, checking inlet and outlet points and name plate data. Regulators with external pressure connections shall be inspected for proper installation.
- 5.7.7 Butterfly shall be checked carefully to see that the vane moves freely into the upstream and downstream piping. Proper vane movement to stroke shall be confirmed.
- 5.7.8 All control valves and regulators shall be removed from the line prior to flushing and during hydro testing.



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5.8 Safety Relief Valves

5.8.1 Safety relief valves shall be installed as received after carefully checking the nameplate data. Pilots, if used, shall be checked carefully for installation on the proper safety valve.

5.8.2 Valves, which are installed in such a manner as to permit on line testing, shall be pressure tested after installation to determine proper operation and setting. Compressed air or nitrogen shall be used for testing of safety relief valves.

5.9 Switches

5.9.1 Level Switches shall be actuated mechanically for switch operation but shall not be calibrated for level setting.

5.9.2 Pressure switches shall be calibrated using hydorlic or dead weight tester or precision air regulator and gauge. The setting/trip point shall be checked using a continuity tester.

5.9.3 Temperature switches shall be calibrated using a temperature both prior to installation and set to the required alarm/ trip point using a continuity tester.

5.10 Receiver Instruments

5.10.1 Receiver Indicator/Recorders

5.10.1.1 Pneumatic indicators/ Recorders shall be calibrated using pneumatic calibrator/precision pressure regulator and gauge.

5.10.1.2 Electronics indicators/ Recorders shall be calibrated using a current generator and a precision meter.

5.10.1.3 Chart drive assembly shall be checked for proper operation.

5.10.2 Controllers

5.10.2.1 Proper balancing of the controller shall be checked as per the manufacturer's catalogues.

5.10.2.2 Controllers shall be checked for manual and Auto operation and Transfer. The transfer from manual to Auto and vice versa shall be bumpless and smooth.

5.10.3.1 Manual loader station Output of the manual loader shall be checked with a precision meter.



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5.10.4.1 Multipoint Temperature Recorders

Each point shall be calibrated using a temperature simulator/ decade box for RTD / voltage generator and precision meter for the thermocouples.

5.10.4.2 Point synchronization shall be checked.

5.10.5 Pneumatic receiver switches shall be calibrated using precision air regulator and gauge. The setting/alarm/trip point shall be checked using continuity tester.

5.10.6 Trip Amplifiers Trip amplifiers shall be calibrated using a temperature simulators or voltage generator and precision meter for thermocouple or Resistance box for RTD's. The required setting/ alarm point/ trip point shall be checked using a continuity tester.

5.10.7 Receiver Switch module Receiver switch modules shall be calibrated using a current source and a precision meter. The required setting/alarm/trip point shall be checked using a continuity tester.

5.10.8 Alarm and Annunciator system

5.10.8.1 Alarm and annunciator system shall be checked for visual and audio alarm operation using dummy signals. Full alarm sequence of each alarm point shall be checked.

5.10.8.2 Each point shall be checked for proper engraving.

5.10.9 Shutdown System

5.10.9.1 Operation of final actuating elements shall be checked for proper operation using dummy signals.

5.10.9.2 All timers, push buttons and switches shall also be checked for their proper operation.

5.11 Analytical Instruments

5.11.1 Check the full analyzer system including sample handling system for leakage.

5.11.2 Check the full sample handling system for its proper operation. Calibrate and check completely all analyzers using zero and span samples as per vendor catalogues.



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- 5.12 Flow computer / Volume corrector
- 5.12.1 Corrected flow values shall be checked for various D.C. inputs and pressure and temperature variations for upscale and downscale ranges.
- 5.13 The list of test and calibration instruments with traceability certificates shall be submitted to Consultant/GSL for approval before carrying out the tests / calibration of instruments at site.
- 5.14 The formats / description of tests / calibration of all instruments shall be submitted to Consultant/GSL for approval.
- 5.15 Daily / weekly reports shall be submitted during execution of work at site.



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## **SPECIFICATIONS FOR INSTRUMENT VALVES & MANIFOLDS**





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1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of Instrument Valves & Manifolds which includes the following types: -

- a) Miniature instrument valves
- b) Instrument valve manifolds
- c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

- ANSI B 2.1 - Pipe threads
- ANSI B 16.11 - Forged steel fittings-socket welding and threaded.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc, the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of Valves & Manifolds which shall provide the following information:

- a) All the details regarding the type, construction, materials etc. of the items.
- b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, type wise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these in the bid.

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manual etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required



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number of reproducible and prints shall be dispatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Instrument Valves (Miniature)

2.1.1 The instrument valves shall be globe pattern-needle valves forged/ bar stock with inside screwed bonnet.

2.1.2 Body and trim material shall be 316 SS unless otherwise specified.

2.1.3 The valve body rating shall be 3000 lbs unless specified in piping material specification which shall govern in case it is specified.

2.1.4 The end connection shall be 1/2" NPTF to ANSI B2.1.

2.1.5 The packing material shall be teflon unless otherwise specified.

2.1.6 The hand wheel material shall be carbon steel zinc plated.

2.1.7 Flow direction shall be marked on the body.

2.1.8 The valve dimension shall be as follows:

- a) End to end dimensions 76 mm (approximately).
- b) Height in fully open condition - 135mm maximum.

2.2 VALVE MANIFOLDS

2.2.1 3-Valve & 5-Valve manifolds:

2.2.1.13 Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54 mm (2-1/8") centre to centre connections and 41.3 mm (1-5/8") bolt to bolt distance. The manifold shall contain two main block valves and an equalizing by-pass valve. The valves shall be needle valves. They shall use self aligning 316SS ball seats.

2.2.1.25 Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line.

2.2.1.3 The manifold shall be suitably for mounting directly on the stanchion (2" pipe).

2.2.1.4 All bonnets shall have teflon packing unless otherwise specified.

2.2.1.5 The material of construction shall be 316 SS unless otherwise specified.



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2.2.1.5 The material of construction shall be 316SS unless otherwise specified.

2.2.1.6 The flanges shall be integral part of the block.

2.2.1.7 The process connection shall be 1/2" NPTF to ANSI B2.1.

2.2.1.8 The manifolds shall be supplied along with mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B ASTM A 194 GR 2H respectively. rings shall be teflon and other accessories shall be cadmium plated.

2.2.1.9 Vendor shall furnish the material certificate for body.

2.2.2 3 Way 2 Valve Manifold for pressure gauges.

2.2.2.1 The manifold shall be designed for use with pressure gauges.

2.2.2.2 The valve shall be a ball valve.

2.2.2.3 The body shall be either straight or angle as specified in data sheets.

2.2.2.4 The body and trim material shall be 316SS, packing material shall be teflon unless otherwise specified.

2.2.2.5 The inlet connection shall be 3/4" plain end (female) for socket weld as per ANSIB 16.11.

2.2.2.6 The gauge connections shall be with union nut & tail piece threaded 1/2" NPT (F).

2.2.2.7 The drain connection shall 1/2"NPTF.

2.3 Instrument Air Isolation Valves

2.3.1 The valves shall be full bore ball valves.

2.3.2 Body material shall be Nickel or Cadmium plated carbon steel.

2.3.3 Trim material shall be 316SS.

2.3.4 The end connection shall be 1/2" NPTF to ANSI B2.1 unless otherwise specified.

2.3.5 The packing material shall be teflon.

2.3.6 The handle/wrench material shall be cadmium or nickel plated carbon steel.

2.3.7 The valve body rating shall be ANSI 800 lb.

2.3.8 End to end dimensions shall be 70mm (approximately).



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3.0 TESTING

3.1 The instrument valves (miniature) shall be hydrostatically tested at 200kg/cm<sup>2</sup> gat 38°C.

3.2 All manifolds (3 valves, 5 valves and 3 ways, 2 valves) shall be hydrostatically tested at 200 kg/cm<sup>2</sup> at 38C.

3.3 The instrument air valves shall be hydrostatically tested at 15.0 kg/cm<sup>2</sup>g at 38°C and at 10.5 kg/cm<sup>2</sup>g with dry air.

4.0 SHIPPING

4.1 All threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.



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## **SPECIFICATION FOR JUNCTION BOXES & CABLE GLANDS**



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1.0 *General*

1.1 **Scope**

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, nameplate marking, testing and shifting of junction boxes & cable glands which include the following types:

- a) Electrical junction boxes.
- b) Pneumatic junction boxes
- c) Cable glands (whenever specified)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

- ANSI B 2.1 : Pipe threads
- IS-5 : Colours for ready mixed paints and enamels
- IS-2147 : Degrees of protection provided by enclosures for Low voltage switchgear and control gear.
- IS-2148 : Flame proof enclosure of electrical apparatus.

1.1.3 In the event of any conflict between specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same should proceed with the manufacture of the items in questions.

1.2 **Bids**

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of junction box and cable gland which shall provide the following information:

- a) All the details regarding the type, construction, materials, housing, entries, etc.
- b) All dimensions in millimetre.
- c) Sketch for each type of JB with dimensional details showing the terminal and entries arrangement.
- d) Mounting details.
- e) Vendor shall furnish certificate from statutory body for explosion proof enclosure, indicating the gas group and temperature class.

1.2.2 All the material specifications for various parts in the vendor's specification sheets shall be to the same standards as those in purchaser's data sheets (e.g. BS IS, etc.)

1.2.3 Vendor shall attach a list of items, tag number wise, summing up all the deviations from the purchaser's data sheets, if there are any. Also vendor shall furnish reasons for these deviations.



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1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of JB/cable glands and its accessories covered in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

1.3 Drawings, Data and Certification

1.3.1 Detailed drawings, data, catalogues required from the vendor are indicated in vendor data requirements sheets. The required number of reproducible and prints shall be dispatched to the address mentioned, adhering to the time limits indicated.

1.3.2 After placement of purchaser order, vendor shall submit certified drawings and specifications sheets for each type of JB/cable gland which shall include the following:

- a) Detailed dimensional drawings
- b) Weight of each in grams/Kg.
- c) Certificate from statutory body suitable for installation in Specified hazardous area.

2.0 *Junction Boxes*

2.1 Junction boxes shall be either of the following type as specified in data sheets.

- I. Weather proof junction boxes.
- II. Weather proof & Explosion proof junction boxes.

2.2 The enclosure shall be as per IS-2147 for weather proof junction boxes and for Explosion proof it shall be as per IS-2148 suitable for the area classification specified.

2.3 Number of entries and locations shall be as per data sheets.

2.4 Junction boxes shall be provided with telephone sockets and plugs for connection of hand powered telephone set.

2.5 Electrical Junction boxes

2.5.1 Material shall be die-cast aluminum of minimum 5 mm thick (LM-6 alloy)

2.5.2 Explosion proof junction boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head/hexagonal head screws.

2.5.3 Weather proof junction boxes shall have doors which shall be hinged type and these shall be fixed with cadmium plated countersunk screws.

2.5.4 Explosion proof junction boxes shall have a warning engraved/integrally cast



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on the cover as given below:

"Isolate power supply elsewhere before opening"

- 2.5.5 Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.
- 2.5.6 All terminals shall be suitable for accepting minimum 2.5 sq. mm copper conductor, in general. However, for power supply distribution boxes, terminal detail shall be as per job specification/Data sheets.
- 2.5.7 Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines.
- i) 50 to 60 mm between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25mm for each additional 25 terminals.
  - ii) 100 to 120mm between terminals for upto 50 terminals and additional 25mm for each additional 25 terminals.
  - iii) Bottom/top of terminal shall not be less than 100 mm from bottom/top of the junction box.
- 2.5.8 Terminals shall be marked as per the various types indicated in data sheets.
- 2.5.9 Shall be provided with external earthing lugs.
- 2.6 Pneumatic junction boxes
- 2.6.1 Pneumatic junction boxes shall be made of 3mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.
- 2.6.2 Single tube entries shall be suitable for 6mm O.D. copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in data sheets.
- 2.7 Painting
- 2.7.1 Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale.
- 2.7.2 Two coats of lead-free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.
- 2.7.3 The colour shall be as specified in data sheets.
- 3.0 *Cable glands & plugs, Reducers/Adaptors*





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- 3.1 Cable glands shall be supplied by vendor whenever specified.
- 3.2 Cable glands shall be double compression type for use with armoured cables.
- 3.3 The cable glands shall be of Nickel plated brass.
- 3.4 The cable gland shall be weather proof. Whenever specified they shall be explosion proof and certificate from statutory body shall be furnished.
- 3.5 Cable glands shall be supplied to suit the cable dimensions indicated along with tolerance indicated in data sheets. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the above tolerances of cable dimensions.
- 3.6 Reducers/Adaptors shall be supplied as per details indicated in data sheets. They shall be nickel plated brass. These shall be weather proof in general. These shall also be explosion proof wherever specified and certificate from statutory body for explosion shall be furnished.
- 3.7 Plugs shall be provided wherever specified. They shall be of Nickel plated brass.
- 3.8 Plugs shall be certified explosion proof when used with explosion and junction boxes.
- 4.0 *Name Plate*
- 4.1 Each junction box shall have an anodised aluminium name plate permanently fixed to it at a visible place bearing the tag no. & enclosure. The name plate shall also bear the stamp of certifying agency with certificate number.
- 4.2 *Shipping*
- 4.3 All threaded openings shall be suitably protected to prevent entry of foreign material.
- 4.4 All threaded components shall be protected with plastic caps to prevent damage of threads.
- 5.0 *Rejection*
- Vendor shall furnish his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.



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## **SPECIFICATION FOR SIGNAL CABLES**



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1.0 GENERAL

1.1 Scope:

This specification together with the job Specifications attached herewith forms the requirements for design, materials manufacturing, testing and shipping of PVC insulated signal cables.

1.2 Standards:

The cables shall conform to the latest editions of the various standards mentioned in the specification.

In case of any conflict between any standard and this - specifications thematter shall be referred to the purchaser before proceeding with the manufacture of the cables.

1.3 Bids:

1.3.1 Vendor's quotation shall include the following as a minimum.

Completed job spec. Pair identification method, type test certificates, technical literatures, various testing methods and cross sectional dimensional drawings. All information/data shall be in English language.

1.3.2 Vendor's quotation shall include a list of deviations if any from purchaser's specifications and shall also indicate the reasons for such deviations for consideration to arrive at mutually agreed deviations. However, vendor shall note that no deviation shall be accepted in respect of the permissible limits of resistance capacitance and L/R ratio of cables.

1.3.3 Vendor shall quote unit price per meter for each type of cable.

1.4 Instructions to Bidder:

1.4.1 The quantity indicated against each type of cable in the job specification may vary by  $\pm 25\%$  at the time of placement of order. Vendor shall confirm that there shall be no price implication on this account in unit prices type wise.

1.4.2 Drum length for each type of cable shall be 500 to 1000 meters. Vendor shall indicate the maximum drum length possible for each type of cable in his bid. Exact requirements of drum length will be specified after purchase order during detailed engineering and vendor shall confirm that the same shall not affect the price or delivery schedule. The actual produced drum length shall not vary by more than  $\pm 5\%$  from the value indicated in the purchase order.

1.4.3 Tolerance over the total ordered length shall be as follows:



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± 5% for total length less than 5 km  
± 2% for total length 5 km or more

- 1.4.4 Cable dimensions furnished by vendor in his bid shall be firm. Vendor shall comply with all the values during execution.
- 1.5 All cables shall be suitable for laying in open air, corrosive hydrocarbon plant atmosphere, direct sun and in trenches. The cable shall also be designed for prolonged use in tropical atmosphere.
- 1.6 On demand vendor shall furnish documents such as invoice and test certificates to prove the quality and composition of the materials used for manufacturing the cable to the satisfaction of client/ consultant or authorised representative during various stages of expediting and inspection.
- 2.0 *Construction:*
- 2.1 Type 1  
(Single pair/triad shielded cable)
- 2.1.1 Each core shall be 1.5 sq. mm made of 7 stranded annealed electrolytic copper conductors. Each strand shall be 0.53 mm dia.
- 2.1.2 Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS-5831 Type C. Thickness shall be 0.5 mm minimum.
- 2.1.3 Each wire shall have twisted cores and No. of twists shall be not less than 10 per metre. Colour of cores insulation shall be black blue in a pair and black, blue and brown in a triad.
- 2.1.4 Individual pair and triad shall be shielded. Shield shall be Aluminium backed by Mylar/polyester tape bonded together with the metallic side down helically applied with either side - 25% overlap and 100% coverage. Minimum shielded thickness shall be 0.05mm. Drain wire shall be 0.5 sq.mm multistrand bare tinned annealed copy conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.
- 2.1.5 Inner and outer jacket shall be made of extruded flame retardant 90°C PVC to IS 5831-Type ST2 Oxygen index of PVC shall be 30. Temp. Index shall be over 250° C.  
Inner jacket color shall be black. Outer jacket color shall be black except for cable to be used in intrinsically safe systems it shall be light blue.
- 2.1.6 Armour over inner jacket shall be of galvanized steel wire/flat as per IS-1554 part-I.



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- 2.1.7 A pair or triad identification shall be with numbers at interval of not more than 250 mm as per vendor's standard.
- 2.1.8 Tolerance in overall diameter of cable shall be within  $\pm 2$ mm over offered value for cables with OD less than 30mm and  $\pm 3$ mm for cables with OD more than 30mm.
- 2.2 Type-II  
(Multipair / Multitriad cable with individual pair shield and overall shield)
- The cable shall be same as single pair shielded cable except conductor sizes shall be 0.5 sq.mm made of 16 strands of annealed electrolytic copper conductor. Each strand shall be of 0.2mm dia.
- Additional feature shall be as follows:
- 2.2.1 Overall shield shall be of Aluminium backed up by Mylar/polyester tape helically applied with the metallic side down either side - 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075mm Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the Aluminium side of the overall shield.
- 2.2.2 Overall twist of all pair/triads shall be as per vendor's standard.
- 2.2.3 A pair of communication wire shall be provided for multipair/multitriad cables. Each wire shall be 0.5 sq. mm of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
- 2.3 Type-III  
(Multipair/Multitriad cable with only overall shield)
- These cables shall be same as type-II cables except that the individual pair/triad shall not have shielding.
- 2.4 Type-IV  
(Multipair/ multitriad cable with individual pair shield and overall shield)
- The cable shall be same as Type II except conductor size shall be 1.5 sq.mmmade of 7 stranded annealed electrolytic copper conductor. Eachstrand shallbe 0.53 mm dia.
- 2.5 Type-V  
(Multipair/ Multitriad cable with overall shield only)



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The cable shall be same as type IV except that the individual pair/triad shall not have the shielding.

3.0 *Electrical Characteristics*

3.1 Maximum d.c. resistance of the conductor of the completed cable shall not exceed 12.3 ohms/km at 20° C for cables with 1.5 sq.mm conductor and 39.7 ohms/km at 20°C for cables with 0.5 sq.mm conductor.

3.2 Capacitance

3.2.1 Mutual Capacitance

The mutual capacitance of the pairs or adjacent cores shall not exceed a maximum of 250 pF/Meter at a frequency of 1 KHz.

3.2.2 Capacitance between any core or screen.

The capacitance between any core or screen shall not exceed a maximum of PF/Meter at a frequency of 1KHz.

3.3 L/R ratio of adjacent core shall not exceed 40 micro henry/ohm for cables with 0.5 sq. mm conductor.

3.4 The drain wire resistance including shield shall not exceed 30 ohms/km.

3.5 Electrostatic noise rejection ratio shall be over 76 dB.

4.0 *Testing*

4.1 Type test: Cable shall be flame retardant to IEC 332 Part III Cat. A. For qualification certificates from third party or client /consultants authorised representative for this test shall be furnished by vendor for cables similar to those being offered.

4.2 Routine tests: (To be carried out by vendor during various stages of manufacture. Purchaser shall review the related documentation).

4.2.1 Insulation and jackets: All tests as per IS-5831 except insulation resistance, voltage and spark test shall be as per BS-5308. Part-II(1986)

4.2.2 Armour test as per IS-3975.

4.2.3 Conductor resistance.

4.2.4 Cable capacitance and L/R ratio.



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## **SPECIFICATION FOR INSTRUMENTATION**



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1.0 GENERAL

1.1 INTRODUCTION

1.1.1 This part of the technical specifications covers in general, definitions, standards, scope of works, specifications of work, documentation, scope of supply of materials and scrap and excess materials and different requirements to be adhered to during the course of execution of instrumentation works.

1.1.2 Instrumentation works shall be performed in accordance with this technical specification and various other drawings and schedules supplied during the execution and time to time instructions from Engineer-in-Charge or his authorised representative(s) during the progress of the work.

2.0 DEFINITIONS

2.1 MANIFOLDS

2.1.1 For close coupled instruments "Manifold" shall mean complete piping of instruments from first block valve upto the instruments, if the distance of the Instrument is within 2 feet (0.6m), from the Instrument tapping. If the distance of instrument is more than 2 feet (0.6m) from primary tapping such as orifice, then the installation is to be considered under remote installation.

2.1.2 For remote mounted instrument, "Manifold" shall mean the assembly of nipples, valves and fittings around the instrument to form a block and bleed or by pass manifold or drain manifold as the case may be. These shall be generally according to the hook up drawings enclosed with tender. Wherever the instruments are with 3--way-valve manifold, this definition shall not be applicable as 3-way manifold forms part of instrument.

2.2 FIRST BLOCK VALVE

First block valve shall mean the valve/valves that are mounted directly on equipment, columns, pipe, standpipe etc. and shall be operated to isolate the instrument and connected instrument piping from the above items.

2.3 SUPPORTS

Supports shall mean the MS angles, flats, channels that are generally provided to support the main cable ways, cable ducts, junction boxes, angle trays, perforated trays, instrument piping, signal tubing, instrument air supply lines etc., at specified intervals from the structures, concrete column etc. to keep all items firmly secured against vibration, warping, bending etc.

2.4 SCRAP





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2.4.1 Salvageable scraps

Salvage scrap shall mean lengths of tubes, pipes, multicables, other cables etc. that can be used one time or other at later date and normally they are recovered from the cut-pieces of tubes, pipes, multicables, cables, etc.

2.4.2 Non Salvageable Scrap

Non salvageable scrap shall mean the lengths of tubes, pipes, multicables, cables, etc. that cannot be used at all one time or other.

2.5 Standards

The instrumentation erection and calibration works shall be carried out generally in accordance with various international and Indian standards in instrumentation listed below but not limited to the following:

2.5.1 API -RP-550 Manual on Practices for instrumentation.

2.5.2 ISA standards and Practices for instrumentation

2.5.3 Instrumentation hook-up standards enclosed.

2.5.4 Instrumentation supports standard enclosed.

2.5.5 Manufacturer's standards and Practices.

3.0 **SCOPE OF WORK**

3.1.0 The Scope of work shall consist of supply of instrument items (as per schedule of quantities/rates and SCC), instruments, their erection, testing, calibration and commissioning and making it ready for commercial operation. The scope covers various jobs listed under the schedule of quantities/rates. However to ensure proper execution and completeness of instrument--work any or all of the following shall also form the part of the scope and shall be covered in the quoted rates.

3.1.1 Fabrication of pipe nipples, including threading whenever required.

3.1.2 Fabrication of seal pot/syphon/drain pot as per standards. Filling of seal pots with filling liquids as per instructions from Engineer-in-charge.

3.1.3 Back/seal welding of screwed fittings as required by standards.

3.1.4 Laying of cable underground including excavation, sand filling, brick laying and back filling.

3.1.5 Connection of purging devices for instruments to the systems provide as per



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drawings.

- 3.1.6 Civil works including the casting of foundation as per requirements for instruments supports where paved surface do not exist.
- 3.1.7 Minor civil works like chipping of pavement and grouting on the pavements the instrument panels/supports/stanchions, and chipping and refilling of the pavement for conduits.
- 3.1.8 Sealing of cables/ tube entries into the control room after laying and testing of all tubes, cables etc.
- 3.1.9 Degreasing of handwheels of control valves, stud bolts, nuts of side and bottom flange of control valves, orifice plates, other primary elements flanges, oxygen service impulse lines, instruments as per manufacturers instructions and other items as required by Engineer- in-charge.
- 3.1.10 Rotation of control valve bonnet wherever required.
- 3.1.11 Reversing the action of control valves either the replacement of springs, accessories or in positioner wherever required.
- 3.1.12 Minor modification/repairs required to be done on the instruments namely, changing the dial, glasses for pressure gauges, temperature gauges and other instruments, replacement of rotameter tubes, level gauge glasses, replacement of damaged signal tubes, threads, couplings etc.
- 3.1.13 Painting of all structural supports for trays, pipes, junction boxes, instruments, etc, as per painting specification.
- 3.1.14 Identification with approved colour of paint the instruments/impulse, lines manifold connected with alarm/trap circuit. Also, punching of tag numbers on items shall be carried out as per instructions of Engineer-in-charge.
- 3.1.15 Coordination with mechanical and other sub-contractors for proper installation of line/ vessels/ equipment mounted instruments like control valves, orificeassemblies, turbine meters, PD meters, level transmitters, level gauges, level switches etc. which involves removal of instruments, disconnection of tubes/cables, reconnection for alignment proper installation etc.
- 3.1.16 Drilling holes on all panels, shut down cabinets, power supply cabinets, control panels pneumatic enclosures etc., for cables/ multitubes/ glands/ groomats.
- 3.1.17 Grounding of shield of all shielded cables to respective instruments earth bus provided in the control room/local panel/thermocouple head.
- 3.1.18 Laying and termination at both ends between instrument earth buses provided in



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control room/ local panel to instrument earth pit provided by others.

- 3.1.19 Supply of all types of consumables required for the execution of the job.
- 3.1.20 Submission of monthly material appropriation statements for cables, piping materials fittings, including the quantity issued and expended in standard proforma.
- 3.1.21 Completion of owners drawings/documents, as per the execution of work at site.
- 3.1.22 Preparation and submission of as built drawings as required.
- 3.1.23 Start-up and commissioning.
- 3.1.24 Submission of final material appropriation statements for all the materials issued by the owner.
- 3.1.25 Any other work not mentioned above, but required for the proper execution of the works.
- 3.1.26 Where requested by owner/Engineer-in-charge or his authorised representatives, all or any of the works detailed above and schedule quantities shall also be performed on package units, local panels/cabinets/gauge board installed by owner or by others.
- 3.1.27 Sealing of safety valves/switches with standard lead seals after final setting in the presence of Engineer-in-charge.

#### **4.0 DESCRIPTION OF WORK**

##### **4.1.0 INSTRUMENT PIPING**

4.1.1 All primary piping shall be installed in the best workman like manner and shall follow installation standards in each case. Where there is no installation standard, the instruction of the Engineer-in-charge shall be followed.

4.1.2.1 Horizontal and vertical lines shall be installed using levels and plumo bobs.

4.1.3 Unless otherwise specified in the drawings pipelines shall have a slope of 8% on the horizontal runs.

4.1.4 All welding shall be carried out as per welding procedures and codes with electrodes approved by Engineer-in-charge. Only qualified welders approved by Engineer-in-charge shall carry out welding. Charges for non-destructive testing like radiography, Dye penetration tests, post heat treatment tests and stress relieving shall be carried out on the basis of actual man hours spent towards these works and man-hour charges with cost of all materials, test equipments, etc.



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shall be used. However, any materials like electrode, equipments, testing charges for various tests, etc., required for the initial qualification of the welder/welders shall be or the scope of the contractor.

4.1.3.1 Pipe shall be bent using pipe benders only and any bending will be totally rejected. Pipes shall be cut using pipe cutting device. Hot cutting will not be allowed.

4.1.6 Piping for steam tracing shall be installed according to the standards and avoiding condensate pockets.

4.1.7 All threaded joints shall be jointed with Teflon tape and no other pipe jointing compound shall be used except on high temperature service where graphited sealing compounds shall be used.

4.1.8 All primary piping shall be properly supported at regular intervals of 1.0 meters. Angle supports shall be fabricated from 40mmx40mmx5mm MS angles as minimum.

**4.2.0 PVC COVERED/BARE TUBE (COPPER/SS/ALUMINIUM)**

4.2.1 Single copper/SS/Aluminium tubes shall be laid as per standards on trays. Fabricated out of 2.5 mm thick perforated steel plate. The width of the trays shall be selected as per the number of tubes laid. Tubes shall be clamped to the trays at every 300 mm using clamps made of galvanized steel/Aluminium strips. The practice of flattening tubes for clamping purposes shall be avoided. In case of PVC covered tubes, any exposed portion at ends and connection shall be neatly taped to appropriate thickness.

4.2.2 Trays shall be properly supported either from any rigid steel structure or concrete member as detailed under trays and supports below.

4.2.3 All male/female tube connectors shall be installed with Teflon tape only. Identification tag plates/ferrules shall be provided on either side of copper tubing as per tubing/junction box schedules. Ferrules shall be single sleeve type with letters and numbers neatly printed.

**4.3.0 INSTALLATION OF MULTITUBES AND MULTICORE CABLES**

4.3.1 Multiple cables/ multitubes shall always be installed on ducts/trays and properly clamped. At every vertical drop to junction boxes, they shall be clamped at more frequency intervals (Maximum of 300mm). They shall be connected inside junction boxes strictly according to the number system as mentioned in cable schedule. At bends minimum radius shall be maintained as per manufacturer's standard. The angle tray supports shall be fabricated from 40mmx40mmx5mm angles minimum size.



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4.3.2 Identification tags shall be provided on either end of multi tubes, multicore cables as per cable/tubing/cable schedules. Engraved tag plates or PVC ferrules shall be used for identification of tubes/cables.

4.3.3 All Multitube and Multicables shall be cut after the exact site measurements are taken between ends and the cable/tube drums shall be selected before cutting the lengths so as to avoid any wastage.

4.3.4 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

4.3.5 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

**4.4.0 INSTALLATION OF INSTRUMENTS**

4.4.1 All instruments shall be generally installed on supports as per installation standards in each case, and shall be accessible.

4.4.2 Receiver gauges shall be mounted on instrument support itself as per tubing hook up standards.

4.4.3 Filter regulators shall be mounted on the instruments support itself below the instruments or on the control yoke.

**4.5.0 INSTRUMENT AIR SUPPLY**

4.5.1 The main instrument air header in each area is laid by other contractor. Air supply from the main air header take off valve to individual instrument shall be through either galvanized steel pipe or 1/4" OD PVC covered copper tube or SS tubes.

Individual take off valves shall always be located on top of the main air header. Unions shall be provided at convenient locations. There shall be one isolation valve at each instrument end. The galvanized pipe shall be supported at a minimum interval of 1000 mm with 40mmx40mmx5mm MS angles. Final connection to be instrument shall be copper/SS tubing as per tubing hook up standards.

4.5.2 Teflon tapes shall be used on all threaded joints.

**4.6.0 INSTRUMENT STEAM TRACING**

4.6.1 The main steam header in each area is laid by the other contractor. From the main steam header take off valve, steam to individual instrument shall be taken



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through carbon steel pipes supported at regular intervals. Steam tracing around individual instruments shall be to copper tubes. After steam tracing, the line is connected to the drain funnel through individual steam trap/condensate return header/tapper point as the case may be.

4.6.2 Electrical tracing shall be done by others.

4.7.0 **PERFORATED TRAYS AND SUPPORTS**

4.7.1 The perforated trays / angle trays shall be properly supported at a regular interval of max. 1000mm from insert plates or steel structures. Wherever insertplates are not available supports on concrete structures on ceiling shall be fixed with aminimum 10mm diameter expansion bolts. Angle supports for perforated trays/angle trays shall be fabricated from 40mmx40mmx5mm M.S. angles minimum size.

4.7.2 All supports shall be cut with hacksaw and any work executed by gas cutting for cutting and drilling holes will be totally rejected. Free ends of angle support shall not have sharp edges and shall be properly rounded off.

4.7.3 Perforated trays/angle trays shall be used for branching cables and tubes frommain trays. Perforated trays shall be used for branching cables and tubes frommain trays. Perforated trays shall be fabricated out of 2.5 mm perforated steel sheet. Width of trays shall be selected according to number of tubes and cables. Trays shall be laid generally as per site conditions with the approval of Engineer-in-charge.

4.8.0 **LAYING OF CABLES**

4.8.1 All cables shall be laid in accordance with installation drawings and cable schedules. Before laying, cable/multicable on drums shall be meggered and tested to ascertain the transit damages.

All cables routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of thecable to the terminals on either end. The various cable lengths cut from thecable reels shallbe carefully selected to prevent undue wastage of cables. Sufficient extra length of cable shall be kept at the terminal on points.

4.8.2 Cables shall have complete uncut lengths from one terminal to the other.

4.8.3 All cables shall be identified close to their termination point by cables number as per cable schedules/junction boxes schedules. PVC ferrule/tag plate shall beused and these identification tags shall be securely fastened to the cables.

4.8.4 All cores of electrical cables shall be identified by their wire numbers by means of the PVC ferrules. Wire numbers shall be as per schedules. All temporary ends of cables shall be protected against dirt and moisture. For this purpose, ends of all PVC insulation cables shall be taped with an approved PVC or rubber insulating



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tape. Use of function type or other fabric type is not permitted.

- 4.8.5 The cable shall be bent in a large radius. Cables installed above ground shall be run exposed on walls, ceilings, structures and shall run parallel or at right angles with beams, walls or columns.
- 4.8.6 Cables shall be rigidly supported on structural steel and masonry individually or in groups as required using galvanised clips, multiple cable supports or cable trays. If drilling of steel must be resorted to, approval must be obtained and steel must be drilled where the minimum of weakening of the structure will result. Cable shall be supported at every 500 mm.
- 4.8.7 All special cables and power supply cables will be laid directly to the field instrument without any junction boxes, unless otherwise specified.
- 4.8.8 While laying cable in trenches or burying them care shall be taken to ensure that low signal cables like alarm, analyser cables, special cables, special cables from turbine meters, compensating cable etc. are separated from other power supply cables.
- 4.8.9 Each underground cable (either in concrete trenches or buried) shall be provided with identifying tag of lead securely fastened every 30m of its underground length with atleast one tag at each end before the cable leaves/enters the ground.
- Directly buried cables shall be laid underground in excavated cable trench wherever specified in layout drawings. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced. Before cables are placed the trench bottom shall be filled with 100 mm layer of sand and leveled. Each layer of cables shall be covered with 150 mm of sand on top and sand shall be lightly pressed. A protective covering of 75 mm thick second-class red bricks shall be placed flat on the final layer of sand and cable. The remaining portion of the trench shall be then back filled with soil compacted and leveled. On complete of every group of cable laying and before sand filling, every cable shall be given insulation test in the presence of Engineer-in-charge. Any cable proved to be defective should be replaced before the next groups of cables are laid. Cable route markers indicating number of cables, depth and direction will be placed enroute, on crossovers/turnings, etc. to mark the cable route.
- 4.8.10 At each road crossings and other places, where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends after pack filling.
- 4.8.11 At the entry into concrete blocks at road crossings cable loops shall be provided at either end to prevent any damage to cables. Each cable shall have one tag at each end before the cable enters/leaves conduct pipes
- 4.8.12 After laying of all the cables and multitubings, cables, the cable entry to control room shall be suitably filled and sealed so as to achieve a positive seal against the entry of gas/water.



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4.8.13 All cables and tubes shall be laid in accordance with the layout drawings with sand and precast concrete slabs shall be placed on the trench.

4.8.14 On completion of cable laying in concrete trenches, the trenches shall be filled with sand and precast.

**4.9.0 EARTHING**

4.9.1 Earthing of junction boxes, local cabinets as per the documents and instruction from Engineer-in-charge.

**4.10.0 PAINTING**

4.10.1 This part of the specification is applicable to cable ducts, MS cable ways, angle trays, instrument supports, perforated trays, all structural supports for the above items, etc.

4.10.2 The surface to be painted shall be thoroughly cleaned with wire brush, sand paper to remove all scales. After cleaning, the surface is painted with one coat of red oxide zinc chromate primer conforming to IS- 207 and allowed to dry completely.

4.10.3 Primer coated surface is painted with one coat of paint to the colour nearest to the final paint and allowed to dry. The colour number shall be specified from IS-5.

4.10.4 Final second coating shall be with the paint of desired colours and shall be selected from IS-5.

4.10.5 It shall be noted that final second coating of external surfaces not covered by cables, copper tubes etc. shall be applied just before handling over the plant or commissioning of the plant whichever is earlier.

The name of manufacturer, colour and quality of all types of primer paint shall be subject to approval of Engineer-in-charge.

**4.11.0 TESTING**

4.11.1 Electrical cables for signal power supply alarms, and compensating cables for thermocouples; resistance thermometer cables shall be checked for megger values and continuity before proper termination and ferruling.

4.11.2 Testing shall be carried out after the installation of instrument with primary piping complete in all respects and approved by Engineer-in-charge.

4.11.3 Primary piping shall be tested hydraulically pneumatically to 1.5 times the operating pressure after isolating the instruments. Flushing of piping shall be carried out as per instructions of Engineer-in-charge. Lines shall be blown after





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hydro-testing. All external displacement /float type level instrument level gauges shall also be tested as per instructions of Engineer- in-charge.

4.11.4 Tubes and air line shall be tested with compressed air to 7 kg/cm<sup>2</sup> upto the filter regulator. The down steam side of the filter regulator shall be tested for 1.5kg/cm<sup>2</sup>. The lines shall be blown with the instrument air upto the regulator for 15 minutes to remove any traces of oil, dust & moisture. All lines shall be checked with soap solution and bubbler unit for possible leak at joints. After pressurizing, source shall be cut off and rate of fall in pressure shall be less than 1 p.s.i. for each 100 ft. of copper tubing for a test period of 2 minutes as per I.S.A.R.P.7-1 "Pneumatic control circuit pressure test".

4.11.5 All test results shall be recorded in the approved format.

**4.12.0 CALIBRATION**

4.12.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to installation. The scope of calibration includes all field and control rooms of all types namely, pneumatic, electronic, electrical etc.

4.12.2 Contractor shall use his own oil free instruments, air compressor for calibration purposes.

4.12.3 The level switches (external cage type) shall be set by filling the cage with water to the desired alarm/trip level, while setting the switches, it shall be ensured that the micro switches do not reset for full rated travel of the float.

4.12.4 Control valves and positioners shall be checked for hysteresis and linearity and calibration for rated strokes. Prior to calibration, valves shall be cleaned externally. The stem is then lubricated if required, and stroked few times to extreme positions of plug to ensure that movement is free from friction. The valve shall then be calibrated for rated stroke and linearity also. Subsequently the valves shall be checked for hysteresis to the accuracy of 1% FS with positioners and 5% FS without positioners.

Stroke speed has to be evaluated for all trip/shutdown valves.

4.12.5 All calibrations reading shall be recorded in the enclosed format and submitted to Engineer-in-Charge for approval. Where significant deviations from specifications are obtained, the matter shall be brought to the immediate notice of the Engineer-in- Charge for corrective actions.

4.12.6 Furnished hereunder is a list of recommended calibration and test equipments required as a minimum for calibration work. The contractor shall clearly state in his offers the complete list of calibration and test equipments along with the range, accuracy and quantity, which he proposes to use for this job. Contractor should also ensure that any equipment not listed below but required at the time of



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calibration shall be made available at his own cost.

- 4.12.7 All test equipments/kits shall be approved by NPL authorities.
- 4.12.7.1 Controller test stands Mft. Standard
- 4.12.7.2 Indicator/recorder test stands -do-
- 4.12.7.3 Squeeze bulb (Flow calibrator -Range: 0-770, 10,000 mm wg.
- 4.12.7.4 Dead weight testers (Budenberg or equivalent)- +/- 0.1% For ranges upto 350 kg/cm<sup>2</sup>
- 4.12.7.5 Gauge comparator for pressure gauges -Rating : upto 350 kg/cm<sup>2</sup>
- 4.12.7.6 Oil bath for temperature calibrations  
Mfr's Stdmax. Temp 350°C.
- 4.12.8.7 Standard Mercury in glass thermometers- Range : -50 to + 50°C. 0 to 100°C  
± 0.25% (NPL certified) 0-250°C, 0-350°C
- 4.12.7.8 Standard gauges for Ranges upto 350kg/cm<sup>2</sup> ±0.25%
- U-tube differential manometers/inclined tube manometer Static pr. rating : 7kg/cm<sup>2</sup>  
+\_ 1mm
- 4.12.7.9 Single leg manometers +\_ 1mm Scale: -1500 mm water and 1500 mm hg.  
Static pr. rating : 7 kg/cm<sup>2</sup>.
- 4.12.7.10 Decade resistance box MFR' std.
- 4.12.7.11 Millimeters ±0.05Mv
- 4.12.7.12 Potentiometer -  
(Cable of generating and measuring mV)
- 4.12.7.13 Meggers 500V/1000V -
- 4.12.7.14 Air hydro pump/hydraulic pump -
- 4.12.7.15 Vacuum pump -
- 4.12.7.16 Instrument air compressor with filters and  
and deoilers. -Regulators
- 4.12.7.17 Current generator (instrument checker)  
dc(YEW make or equivalent) -4-20mA



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**4.13.0 LOOP TEST**

4.13.1 Loop test shall be performed after calibration of all instruments and leak test of signal lines. Loop tests are conducted to check the functional performance of all elements comprising the loop, thereby ensuring proper connections and operations.

4.13.2 Before proceeding for loop tests the calibration results of individual elements shall be recorded on the enclosed proforma and shall get it approved by Engineer-in-Charge for correctness of installation, measurements and calibration results.

Loop testing for all control loops shall be generally by simulation of process conditions and shall fix points namely 0%, 25%, 50%, 75% and 100% of full-scale inputs. Detailed procedure shall be submitted to Engineer-in-charge for approval before proceeding with the loop testing.

In case of shutdown system field/receiver pressure switches are simulated for abnormality by disconnecting the wires at terminal and function of all associated systems are checked.

4.13.5 Performance of individual loops may be accepted for an overall accuracy of  $\pm 1.5\%$  where deviations exist, contractor shall recalibrate the instruments, which form part of loop testing wherever required, at no extra cost.

4.13.5.1 After the loop test is complete, the contractor shall connect back any terminations and connections removed for loop test.

4.13.7 A loop shall be considered as handed over only after measurements in that particular loop are complete and certified by Engineer-in-Charge, in addition to loop sheets being duly filled in all respects and approved and accepted by Engineer-in-Charge and client.

4.13.8 In case of loops in which certain instruments of the loops are calibrated by other agency, loop testing shall be performed in coordination with the agency involved. Any defect in the calibration of the instrument in contractor's scope is observed, it shall be rectified to the satisfaction of the Engineer-in-Charge. However, defect in calibration of the instruments in the scope of other agency, same shall be rectified by the agency involved. After the calibration has been rechecked by the other agency/agencies the loop checking would be performed to the satisfaction of Engineer-in-Charge, and this part covers under the scope of the contract.

4.13.9 Final certified loop sheets shall be submitted in 4 copies and one transparency.

**DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR**

5.1.1 Piping and Instrumentation diagrams.



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- 5.1.2 General layout plan for all units, showing all information like position of field instruments junction boxes indicative routes of cables, main ducts/cable trays.
- 5.1.3 Cable schedules for alarm, signal, shutdown, power supply and pneumatic cables, earthing guide lines.
- 5.1.4 Termination details/drawings for connecting at control room end.
- 5.1.5 Individual Instrument specifications
- 5.1.6 Bill of materials
- 5.1.7 Installation standards/ Hook-up
- 5.1.8 Manufacturers hand book with instructions for installation and calibration wherever necessary for reference.
- 5.1.9 The drawings for materials that are included on their supply and erection scope namely local control panel, junction boxes and local cabinets.
- 5.1.10 The detailed engineering drawing wherever such drawing is assigned.
- 5.1.11 Two sets of layout drawings, standards bill of materials cable schedules etc., duly incorporating the changes/modification carried out during the course of execution of works.
- 5.1.12 Final material appropriation statement for all free issue materials indicating shortages of any in the proforma duly approved by Engineer-in-Charge.



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## **STANDARD SPECIFICATIONS FOR CABLING**



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## **1.0 SCOPE**

This is to define the requirements for supply, wherever applicable, the installation, testing and commissioning of the cabling system.

## **2.0 STANDARDS**

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

## **3.0 CABLE SPECIFICATIONS**

### **3.1 Power Cables**

Power cables for use on 415 V systems shall be of 1100 Volts grade, aluminium stranded conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed. Power cables for 3.3 KV 6.6 KV and 11 KV system shall be aluminium conductor, XLPL insulated, screened, PVC bedded galvanized steel flat armoured and PVC sheathed cable. All L.T. Cables conform to standards specification and relevant sections of IS: 1554 Part-I and H.T. Cables shall conform to IS: 7098 (Part II). Unarmoured cables will be used wherever specified on the cable schedule.

### **3.2 Control Cables:**

Control cables shall be 1100 Volt Grade, 2.5 mm<sup>2</sup> copper conductor PVC insulated PVC sheathed, single wire armoured with an overall PVC sheath, as per IS: 1554 Pt. Unarmoured cables shall be used wherever specified on the cable schedule.

### **3.3 Communication cables:**

Communication cables shall comprise 1 pair unarmoured, 2-pair, 5-pair and multipair armoured cables of sizes as specified in the cable schedule. Minimum conductor size shall be 0.5 mm telephone system and 0.71 for plant communication system.

## **4.0 MISCELLANEOUS MATERIALS SPECIFICATIONS**

### **4.1 Connectors:**

Cable terminations shall be made with aluminium / tinned copper crimped types or less lugs of M/s. Dowell's make or approved equivalent for all aluminium



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conductors and stud type terminals.

4.2 Cable Identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number, equipment no., etc.

4.3 Ferrules

Ferrules shall be of approved type size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected for ease in identification and maintenance.

4.4 Cable Glands:

Cable glands to be supplied shall be nickel-plated Brass double compression type of approved/ reputed make. Glands for classified hazardous areas shall be certified by CMRS.

4.5 Multi Cable transit

Multi Cable Transit shall be used for cable entry to all type of control room walls, Decks, Firewall etc. The MCT Block system should have only few components for facilitating simple, easy and quick assembly. The Multidiameter based cable transits shall be repeatedly re-openable and re-usable without the need of special tools and discarding the modules in normal operation.

Frame shall be G type galvanized or stainless steel. Block should be multidiameter blocks with center core in all the blocks / add blocks with plug / galvanized or stainless steel stay-plates / single piece compression wedge with galvanized or stainless steel bolts. Solid blocks and insert blocks should not be used. MCT should have 100% spare for each cable size / O.D. Spare blocks should be available on the frame as usable Multidiameter blocks / add blocks with center plug, so that these spare blocks in future can be used for wide range of cables also, solid blocks should not be used at all on frame. Apart from spare if there is any additional uncovered space left on frame then this uncovered space should also be filled only with usable Multidiameter blocks with center plug only.

The Multi Cable & Pipe Transit penetrations should have been tested for Gas Tightness / water tightness & fire tests.

4.6 Cable Trays:

This shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays as specified elsewhere. Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000



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mm unless design is approved for larger span. For requirements of larger than 750 mm width two trays shall be run side by side. Cable trays shall be suitable for a cable weight of 50 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively.

Cable trays fabricated from standard rolled sections shall use 50x50x6 /ISMC 100 Sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32 x 6 mm flat/25x25x6 angle for width upto 500 mm/ more than 500 mm respectively.

Vertical supports for both the above type of trays shall be fabricated out of ISMC 100 and horizontal supports with 75 x 50 x 6 angle iron/ ISMC75 as approved by Engineer-in-Charge.

If unit rate is not included in schedule of rates, then cable trays if required, shall be fabricated and installed at site as per tone rate for electrical structural supports etc.

## **5.0 CABLE LAYING**

5.1 Cable network shall include power, control, lighting and communication cables, which shall be laid in trenches, cable trays or conduits as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary without any extra cost.

5.2 High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cable trays, as applicable.

All communication cables (telephones, P.A.S.) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench with a minimum clearance of 300 mm away from electrical trench as per the direction of Engineer-in-Charge and Communication cables shall cross power cables at right angles.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient lengths for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reel shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule; shall be prepared by electrician contractor and get that approved by Engineer-in-Charge to





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minimize/avoid straight through joints required. Contractor shall work out the actual number of straight through joints required.

- 5.4 Cables as far as possible shall be laid in complete, uncut lengths from one termination to the other.
- 5.5 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor. Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. In case of larger dia cables, i.e., 50 mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Engineer-in-Charge.
- 5.6 All cables will be identified close to their termination point by cable numbers as per cable schedule. Cable numbers will be punched on aluminium straps (2 mm thick) securely fastened to the cable and wrapped around it. Alternatively cable tags shall be circular in construction to which cable numbers can be conveniently punched.
- Each underground cable shall be provided with identity tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas, cable trenches shall be identified by means of markers as per standard drawing. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M and at cable joint locations.
- 5.7 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- 5.8 RCC cable trenches shall be with removable covers. Cables shall be laid in 3 or 4 tiers in these trenches as indicated on the sectional drawings. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases, RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. The electrical Contractor at no extra cost shall do removal of concrete covers for purpose of cable laying and reinstating them in their proper positions after the cables are laid.

Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment is connected.



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5.9 Directly buried cables shall be laid underground in excavated cable trenches where specified in layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

Minimum depth of buried cable trench shall be 750 mm for low voltage and 1200mm for H.V. Cables, the depth and the width of the trench shall vary Depending upon the number of layers of cables.

Cables shall be laid in trenches at depth as shown in the drawing. Before cables are placed, the trenches bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150mm of sand on top of the largest diameter cable and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall then be laid flat. The remainder of the trench shall then be back-filled with soil, rammed and levelled.

5.10 As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-Charge / Owner. Any cable, which proves defective, shall be replaced before the next group of cables is laid.

All wall openings / pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/-lined trench.

Where cables rise from trenches to motor, control station, lighting panel etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 300 mm above finished ground level.

Cable ends shall be carefully pulled through the conduits, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following grade of the pipe fill shall be used for sizing the pipe size:

- |    |                  |   |          |
|----|------------------|---|----------|
| a) | 1 cable in pipe  | - | 53% full |
| b) | 2 cables in pipe | - | 31% full |
| c) | 3 or more cables | - | 43% full |
| d) | Multiple cables  | - | 40% full |

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ 'PUTTI' for sealing purpose. Alternatively G.I. Lidsor PVC bushes shall be employed for



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sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. Pipe and no separate payment shall be allowed.

- 5.11 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.
- 5.12 At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.
- 5.13 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.
- 5.14 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls or columns.
- Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.
- 5.15 Individual cables or small groups which run along structures/walls etc. will be clamped by means of 10 SWG GI saddles on 25x6 mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternatively small group of cables can be taken through 100 mm slotted channel/ISMC 100.
- They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result.
- Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300 mm for cables up to 25mm diameter and maximum 450 mm for cables larger than 25 mm dia.
- 5.16 All G.I. Pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. GI Pipes with bends shall be buried in soil/concrete in such way that the bends shall be totally concealed. For G.I. Pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. Pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. Plugs after they are laid in final position. The Contractor at no extra cost shall supply G.I. Plugs.



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5.17 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddles/Clamps, whereas cable in horizontal run of cable trays shall be tied by means of nylon cords.

5.18 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

## 6.0 TERMINATION

6.1 All PVC cables up to 1.1 KV grade shall be terminated at the equipments by means of double compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

All Cable entries shall be through bottom only and top entry terminations are made only after getting approval of Engineer-in-Charge.

6.2 Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

6.3 In case of control cables all cables shall be identified at both ends by their terminal numbers by means of PVC ferrules or Self-sticking cable markers. Wire numbers shall be as per schematic/ wiring /inter- connection diagram. Bidders shall have the samples of PVC ferrules/cable markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends.

6.4 Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type, at no extra cost. All switchgear and control panels shall have undrilled gland plate.

Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables.

6.5 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit hole should be drilled in the bottom



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plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

- 6.6 Cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connector as manufactured by M/s. Dowell Electro works or approved equivalent.

Crimping shall be done by hand crimping hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surfaces shall be cleaned and shall not be left open.

**6.7 Cable accessories for H.V. Systems**

- 6.7.1 The 11, skilled and experienced jointers duly approved by the Engineer-in-Charge shall do 6.6 and 3.3 KV cables terminations joints. Termination including supplying of jointing kit shall be threaded in Contractor scope unless specified otherwise.

- 6.7.2 The termination and straight thro' joint kit. For use on high voltage system shall be suitable for the type of cables required by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumables items. An installation instruction shall be included in each sheet.

- 6.7.3 The termination kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer motor. The terminating kits shall preferably be of the following types:

- a) TAPLEX' of M-seal make using non-linear resistance material for stress grading.
- b) 'PUSH-ON' type of CCI make using factory - moulded silicone rubber insulators.
- c) 'TROPOLINK' type of CCI makes.
- d) Heat-shrinkable sleeve type of M/s. Raychem.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

- 6.7.4 The straight thro jointing kits shall be suitable for underground-buried installation



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with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a) 'TAPLEX' of M-seal make
- b) 'TROPOLINK' type of CCI make
- c) Heat-shrinkable sleeve type of M/s. Raychem.

6.7.5 Makes of kits other than those specified in 6.7.3 and 6.7.4 may be considered provided the Contractor furnishes type test certificates, along with the offer.

6.7.6 Type tests are to be carried out at manufacturer's works to prove the general qualities and design of a given type of termination/jointing system. The type tests shall include the following tests conforming to the latest IEC 502.2, 466 and VDE 0278 specifications. The Contractor along with the offer for the jointing system considered shall submit the type test certificates.

- a) A.C. Voltage withstand dry test for 1 minute
- b) Partial discharge test - Discharge magnitude shall be less than 20 p.c.
- c) Impulse voltage withstand test with 10 impulses of each polarity.
- d) A.C. high voltage test following load cycling test with conductor temperature at 95°C.
- e) Thermal short circuit test of 250°C for 1 second.
- f) DC Voltage withstand test for 30 minutes.
- g) Humidity test.
- h) Dynamic short circuit test.
- i) Salt log test
- j) Impact test

**7.0 TESTING:**

7.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.

7.2 Where splices or termination are required in circuits rated above 600 volts, measure insulation resistance of each length of cable before splicing and or terminating. Repeat measurement after splices and/or terminations are completed.



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7.3 Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back-filling.

For cables up to 1.1 KV grade, 1KV Megger and for H.V. Cables 2.5 KV/5KV, 2.4 KV/4.9 KV Megger shall be used

7.4 D.C. High Voltage Test shall be conducted after installation on the following and test results are recorded.

- a) All 1000volts grade cables in which straight through joints have been made.
- b) All cables above 1100 V grade.

For record purposes test data shall include the measure values of leakagecurrent versus time.

The D.C. High Voltage test shall be performed as detailed below in the presenceof the Engineer-in- Charge or his authorized representative only.

Cables shall be installed in final position withthe entire straight through jointscomplete.

Terminations shall be kept unfinished so that motors, switchgears, transformers etc. are not subjected to test voltage.The test voltage shallbe as under: -

- i) For cables 3.3 KV grade 5.4 KV DC
- ii) For cables 6.6 KV grade 10.8 KV DC
- iii) For cables 11 KV grade 18 KV DC

7.5 All cables shall be tested as per standard test Performa available with site engineer.

7.6 Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Site Engineer.



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## **TECHNICAL SPECIFICATION FOR ODORIZING SYSTEM**



## **1.0 ODORIZING SYSTEM DESCRIPTION**

### **1.1 General**

The Odorising System is required to mix the odorant in the natural gas for identifying the leakage in the associated equipment or during transportation of piped gas in the city area.

The intent of this Technical Specification is to outline minimum requirement for Design, Engineering, Manufacturing, Supply, Erection & Commissioning of equipment along with Supply and Erection of associated electrical and mechanical works for Odorising System complete with all auxiliaries & features required for efficient & safe operation.

## **2.0 PROCESS PARAMETER AND SPECIFICATION:**

### **2.1 Gas Composition & Gas Pressure and Temperature condition:**

The expected gas composition is given in the Job specification enclosed with the Tender. The Odorizing System should be designed to meet the changes in the gas compositions from gas fields, India. The inlet gas pressure & temperature to the Odorizing System also define in the MR/Job specification

### **2.3 Operations & Control Philosophy**

The Odorizing System should be designed with minimum operator intervention. Any system requirement at site for proper operation shall be consider in the Scope of supply and design. The maintenance frequency of the system shall be 18 month or better.

### **2.4 Design Philosophy**

It is anticipated that the natural gas feed composition, flow rate and pressure will be fluctuating. Hence, Supplier should design the Odorizing System with optimum degree of flexibility, reliability, and operatability to accommodate the varying composition of feed, other unexpected contaminants, flow rate and pressure.

The Odorizing System facilities should consist of standardised modules, which are assembled into a complete system. Each system should be designed in packaged frame, housing, etc. The design life of the Odorizing System should be minimum 30 years.

### **2.5 Design Basis**

The Supplier should prepare the design basis required to meet the demands mentioned in the Data sheet and Scope of work and liaise with Client or Consultant to obtain necessary confirmation and approval.

### **2.6 Applicable Standards and Codes**

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

The Vendor without any additional cost and delivery implications should carry out any modification suggested by the statutory bodies either during drawing approval or during inspection, if any.



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

1. IS 5572 Classification of hazardous areas (other than mines) for electrical Installations.
2. IS 5571 Guide for selection of electrical equipments for hazardous area
3. OISD 113 Classification of areas for electrical installations at hydrocarbon processing and handling facilities
4. OISD-STD-220 (DRAFT III): For restricted circulation.
5. ASME & PNGRB Technical standards
6. ANSI, ASTM, NEC, NEMA, Indian Electricity Rules, Indian Explosives Act.

### **3.0 ODORIZING SYSTEM SPECIFICATIONS (Main Odorizing Units)**

The brief requirements specified are applicable for main big odorizing system as well as Mini odorizing system (except power & field control unit pneumatic / electronic; refer Particular Job specifications for more details related to scope of work).

#### **3.1 ELECTRONIC CONTROL UNIT (Main Odorizing Units)**

The Supply of Electronic Control Unit of the Odorizing System will be by an external power source. Powers supply Single Phase AC, 230V $\pm$ 10%, 50Hz $\pm$ 3% through UPS and to be provided by Client.

Bidder has to provide Surge protection device of Make MTL/ Pheoenix in 230 V AC UPS Supply provided by the client. This should be installed at the JB where incoming power supply will be terminated). Any problem in the input supply, the equipment should be protected. The surge protection device shall be pluggable and testable with thermal disconnection and indication facility. It should be for input power supply as per IEC standard IEC-61643-12

**Note:** Vendor to confirm that the supplied Electronic Control Unit are suitable with the above power supply and indicate the maximum and minimum tolerable values of voltage for safe operation of Odorizing System. **Vendors must include suitable voltage conditioning system (Voltage Stabiliser) in their scope to prevent failure from voltage fluctuations if supplied equipments need the same.**

Electronic Control Unit should have the following specifications as minimum:

- 3.1.1. Electronic Control Unit should be provided with a Liquid Crystal Display (LCD) / L E D for ongoing Flow Monitoring, Operation Modes etc. It should be easy to read lighted display. Displays must remain active for at least 15 minutes after power failure. Necessary battery backup shall be provided in the system. Electronic unit shall have the external keypad for entering the data and provide password protection for unauthorised use.
- 3.1.2. Client will provide dedicated UPS supply for Odoriser Control Unit in Control room. The Power Supply cable has to be provided by the client however the terminations of power supply cable at Odoriser control Unit is in the Vendor's scope.
- 3.1.3. For the Odorizer auto Mode operation flow signal shall be provided in the form of analogue 4-



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20 mA / serial communication data inputs / pulse from Flow Computers/ metering device. The offered Electronic Control Unit is able to accept two nos. of 4-20 mA signal/ serial inputs corresponding to instantaneous standard flow rates from each flow computer of dual steam metering system. Refer the respective job specifications for specific provisions considered for signals. For serial communication the protocol will be Modbus and all the necessary register addressing has to be done by the vendor.

3.1.4. Physical design should be of steel body with doors/panels with suitable paint to minimize corrosion and on-going wear and tear. The Electronic Control Unit should have locking arrangement. The panel/cabinet should be suitably designed to accommodate all required electronic equipment.

3.1.5. Mounting of Electronic Control Unit shall be wall mounted. Necessary provision for proper mounting shall be provided. Cable entry shall be from bottom, therefore necessary removable Gland plate with matching hole as per supplied Cable glands shall be provided.

3.1.6. The Protection Class of Electronic Control Unit shall be weatherproof to IP55 / NEMA4.

3.1.7. Odorizing System should not be shut off in case of:

- i) Power failure
- ii) Failure of throttling valve/regulator
- iii) Low flow
- iv) Failure of any field instruments (Transmitters, temp. element, etc.)

3.1.8. The Electronic Control Unit should be capable of storing odorizing data and such data should be downloaded frequently into another portable computer to store the data. In order to meet the above requirement, 2 Nos. of RS232 Serial Communication ports shall be included in the Electronic Control Unit. One Port will be utilized for Portable Computer and another port will be utilized for future SCADA application. For this application, Vendor shall include in the scope all relevant software, together with the license, compatible to Microsoft Windows XP/2000 software.

The data of odorising unit shall be hook-up by the client in future by providing SCADA system and RTU. **The odoriser electronics shall have facility to read & write the data remotely through SCADA.** The electronics should have provision and dedicated communication card & port for connection to RTU for monitoring and control the transaction parameter. The detail requirements of SCADA will be communicated to the successful vendor during detail engineering. For selection of equipments compatibility for SCADA system vendor shall consider the **MODBUS** RTU protocols, FCC-68, RJ 45 connection type, RS 232 D communication standard, Baud rate upto 19.2K, with configurable software.

3.1.9. All the cabling (Signal, Control, Power, Communication), Ex. proof JB, termination and mounting accessories from field to Control unit, Cable gland (Double Compression Type) shall be provided. All the cable and tubing shall be mounted and dressed on the cable tray.

3.1.10. All the cabling (Signal, Control, Power) shall be armored FRLS type.

### **3.2 STORAGE CONTAINER**



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The capacity of each storage containers for Odorant shall be as specified in the MR specification.. The quantity of container will be indicated in respective Particular Job specification / MR. If more then one storage containers are used then the entire storage containers shall be interconnected. The containers should have positive pressure of Inert Gas if required. Vent should be only for Inert gas. No odorant shall be vented in any case. Vent should have neutraliser container in case if there is a possibility of odorant to be vented out.

The odorant tank shall be constructed as per ASME section VIII specifications and other relevant section requirement. The tank shall have all valves necessary for proper filling, as well as volume indication, pressure relief, and pressure gauges.

The Container shall be made of Stainless steel (min SS 304) and suitable & certified for the Odorant handling. The Container shall have Inlet, Outlet, Drain Valve, Level Indication, Low level alarm switch with hooters, Y type strainer at outlet, pressure regulating valves with safety alarm, pressure relief valve with manual gas vent valve. Warning & Safety Instruction stickers shall be provided for each container.

### **3.3 PNEUMATIC PANEL**

All transmitters & temperature element should be intrinsic safe "exia" as per IEC 79-11 and solenoid valves; switches and related junction boxes should be flame proof "Exd" as per IEC 79-1. Other special equipment's/instruments, where intrinsic safety is not feasible or available, should be flame proof as per IEC 79-1. Flying leads from any of the instrumentation items are not acceptable.

The Odorizing System shall be shipped in fully assembled condition. Only gas supply connection and power supply connection shall be made on site.

The pneumatic panel shall have cabinet and it will be installed in the Hazardous area. The Enclosure of pneumatic panel shall be weather proof.

The field unit (pneumatic panel with container assembly) shall be located in the hazardous area and may be more then 100 Meters away from the Main Gas pipe line. The Electronic unit will be in control room and may be more then 100 meter away from the field unit. The supplier shall indicate the distance limitation if any for the installation clearly during bid stage. Client/Consultant will not entertain any dispute during detail engineering and vendor has to supply the system to meet the tender requirements.

Vendor cannot use the Gas actuated operation of Solenoid valve, as it is not recommended.

For Mini odorising system; Gas actuation / operation is permitted due to non availability of power and the space.

### **3.4 ODORANT LOADING / UNLOADING SYSTEM:**

Vendor shall provide Odorant Loading / unloading System for the filling of Odorant in to the Storage Containers. Manual pump (portable type) with proper safety features and with necessary connecting Hose & connector / coupler should be provided and shall be suitable for uses in Hazardous area. If refilling through Milkman concept then filling system shall have



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Nitrogen Blanketing System to avoid leakages of Odorant to Atmosphere during loading / Unloading. Necessary Nitrogen Cylinder shall be provided for blanketing during refilling.

Vendor shall provide detailed procedure and the arrangement for filling the Container with Odorant. It is the responsibility of the Vendor to fill the odorant (to be supplied by Owner) in Container/ tanks at site during final commissioning

Vendor shall Supply “Active Carbon Saw Dust” & “Sodium Hydrochloride” for Odorant 10 Kg each in Container for Odor and neutraliser for spillage handling of Odorant. The container shall be suitable for handling and Storing of these Chemicals for uses.

### 3.5 PIPE WORK, VALVES AND FITTINGS

Pipe work should be designed, tested and installed to ensure its safe operation at the worst conceivable conditions of flow, pressure and temperature.

All tubing work should be of SS fully annealed (Bright annealed) seamless conforming to ASTM A269- SS316. All tubing shall be minimum of ½” size shall be clamped and routed in GI tray up to pipeline. For any different end connection necessary adopter is in vendor’s scope. The piping/tubing, valves, fittings shall be of Parker, Sandvik, Swagelok. The system should be “go-no-go” gaugeable to demonstrate that fittings are properly tightened. Wherever possible; valves and control devices should be of same end connector. The number of fittings used should be minimized. The Supplier should ensure that personnel assembling the pipe work should be competent in the system employed.

The preferred valve types for isolation are ½” quarter turn ball valves. Such valves have similar material to the tube they are attached to. Ball valves must be from Swagelok, Parker and be appropriately selected frequency of use. Ball seats/ Peek seats must be suitable for natural gas operation of the gas composition indicated.

***Valves and fittings subject to corrosion must be either inherently resistant, or be coated with a corrosion inhibiting paint or surface treatment.***

End connections including fittings & Valves to be supplied with the unit. Details required if any, to be conformed at the time of detail engineering.

Any accessories required for Odoriser Control Unit and the field unit & interconnection is in the Vendor’s scope. Minimum tapping size shall be provided of ¾” only. Gas Inlet tapping will be one number of ¾”, more tapping as per the requirements of Vendor can be provided. The necessary Isolation Valves and weld –o- let in vendor’s Scope.

Injector Probe Tapping will be Two no ¾”, necessary Isolation Valves and weld –o- let suitable for the Injector probe is in vendor’s Scope. **For any different size, Vendor should considered necessary adopter.**

### 4.0 HAZARDOUS AREA

The Supplier should specify the hazardous area in accordance with the IS 5572. All electrical equipment cabling and earthing should be appropriate for the zone in which it is fitted, and all



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cables passing from the hazardous to safe area should be equipped with appropriate barriers where necessary.

All Instruments should be suitable for an area classification of "Class 1, Division 1, Group Das per NEC" OR "Zone 1, Group IIA /IIB as per IS/ IEC".

All Odorizing Unit mounted transmitters & temperature element should be intrinsic safe "exia" as per IEC 79-11 and solenoid valves, switches and related junction boxes should be flame proof "Exd" as per IEC 79-1. Other special equipment's/instruments, where intrinsic safety is not feasible or available, should be flame proof as per IEC 79-1. Flying leads from any of the instrumentation items are not acceptable. The Electronics of the Odorizing Unit shall not be open and shall be provided within a suitable enclosure

**5.0 INSPECTIONS AND TESTING: At Vendor's works:**

The following activities shall be covered under inspection:

- a. Review of Q.A documents.
- b. Review of Calibration certificates for Odorizing Unit, transmitters, gauges and all instruments.
- c. Review of all statutory certificates.
- d. Review of Area classification compatibility of all the items including bought out items. e.Review of NDT reports.
- f. Review of bought out sub-assemblies/major components, test/inspection certificates. g.Dimensional checks as per approved drawing and data sheets.
- h. All the Odorizing Units shall be tested to demonstrate the functioning of all the components and controls.

Before bringing any items of equipment to site, factory testing should be carried out to demonstrate the function of all equipment trips and control system.

The Client / Consultant should be given 2 weeks prior notice for inspection of the equipment.

**After Commissioning at Site:**

Upon delivery to the site, all the equipment should be assembled in a complete system. All the Odorizing Units shall be tested by vendor for their function & performance in presence of Client / Consultant representative. Any part or component, which is not functioning to the satisfaction of Client / Consultant, shall be repaired or replaced by the vendor without cost & time implication to purchaser and performance test again carried out.

All pipelines should be pneumatically tested to 1.5 times the design working pressure. Such pressure should be held for 8 hours and be witnessed by Client/ Consultant.

**6.0 WARRANTY**

The supplier's should provide a warranty from the date of final site acceptance of odorizing system by the Client as define in the respective Job specification or tender documents.



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## **7.0 DRAWING & DOCUMENTS**

The bidder shall furnish the drawings and Documents as specified in Job specification. In addition to this bidder shall provide following:

Along with the Technical bid the following information is to be provided:

1. Process and instrument diagram along with Bill of Material. The Bill of Material should indicate all items, quantity of all items installed per Odorizing Unit, their part nos and make.
2. General arrangement drawing of the Odorizing Unit indicating overall dimensions and erection / shipping weight.
3. Technical data sheet of all the major equipments and instruments of Odorizing Unit.
4. Literature to fully describe the details of all major components such as valves, regulator, Instruments, tube, fittings etc.
5. List of spares required for 2 years normal operation & maintenance per Odorizing Unit (itemized rate to be given in price bid). List of commissioning spares for Odorizing Unit.
6. List of special tools & tackles required for installation & maintenance per Odorizing Unit.
7. Shop test procedure.
8. Cable schedules & Complete wiring diagram.
9. A complete electrical dossier and zone drawings of the Odorizing Unit, all certification for all components used within the hazardous areas should be provided

### **Within one month from date P.O.**

1. General arrangement drawing of the Odorizing Unit giving overall dimension & shipping weight.
2. Detailed foundation drawing of the Odorizing Unit for casting foundation giving load pattern etc.
3. Details of inlet gas termination including X, Y, Z co-ordinates with respect to centre of Odorizing Unit or any reference. The minimum / maximum distance limitation for the installation of system.

### **ALONG WITH SUPPLY**

1. Operation and maintenance manuals – 3 sets all in original for each Odorizing Unit along with 1 set of soft copy in CD-ROM. The instruction manual should describe in details the construction and recommended procedure for maintaining, operating and troubleshooting of the Odorizing Unit should also include cross-sectional drawings, exploded views of all spare parts along with part nos., quantity installed per Odorizing Unit. The manual should provide detailed catalogues of all bought out items.
2. 3 sets of hard copies & 1 set of soft copy in CD-ROM for all the approved drawings and documents shall be included along with supply.



**Design, Supply, Installation, Testing, Commissioning, and 5 Years Comprehensive Operation & Maintenance of LNG Storage & Regasification station along with all necessary auxiliary units at Bikaner & Churu GA**



TENDER DOCUMENT NO:  
GSL/REPL/011/LNG

Date: 29/05/2023

3. Mechanical and electrical installation drawing including interconnection. Complete wiring diagram of Odorizing Unit
4. Test certificates and catalogues of all major components like valves, Instruments, tubing etc.
5. Calibration certificates for all measuring and protection devices (eg. pressure transducer, pressure gauges, other instruments etc.,).
6. Test records of mechanical running, performance test.
7. One set of relevant Software with licence including application program (compatible to Microsoft windows XP/2000 software) and all logic diagrams of Odorizing Units on CD-ROM with suitable communication hardware with Odorizing Unit in order to download or change Odorizing Unit parameters if required by client through Laptop. Necessary adaptor for direct downloading into laptop if required has to be supplied by the vendor.
8. Certificates from statutory authorities confirming suitability of design / construction of all electrical and electronic items for use in hazardous area classification. In case of foreign supply, the Vendor should get all certificates endorsed by the concerned statutory authorities, Govt. of India within one month of delivery of Odorizing Units at site.

Sl.	Technical	Minimum Requirement
	Process data such as Flow Rate, Operating pressure at dozing point, design pressure at dozing point Line Size & Design Pipe class Operating Temperature - As Define in the Particular Job specification	
2.	Operating Principle	Microprocessor based programmable, Pressure Injection System / Automatic dozing system with Solenoid operated pump (Electrical / pneumatic system; not to be actuated by Natural Gas)





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3.	Quantity of Odorant injection	Adjusted automatically proportional to flow rate through 4 - 20 mA or Pulse signal or serial communication (Modbus protocol) data from Metering Device/ Flow computers / EVC.
4.	Temperature	System should be suitable for installation in open atmospheric Conditions at ambient temp. of 0-50°C; Design 65 °C
5.	Odorant Injection Rate	Actual mg /Sm <sup>3</sup> – The use of odorant to be monitored using On-line dosing / monitoring system.
6.	Gas Odorant	(Ethyl Mercaptane / TBM+THT blends / THT/ TBM+IPM blends / 75-80 % TBM (Tert-Butyl Mercaptan) + 20-25 % MES (Methyl Ethyl Sulphide)
7.	Power Supply	230 VAC +10 %, 50Hz±3% UPS at one point in electrical feeder
8.	Pneumatic Panel with Cabinet	Suitable to be installed in hazardous area, WP IP 54 with safe Venting system, safety protection and Warning Instructions.
9.	Electrical components, JBs in Hazardous Area	Eexd IIC T4 Explosion Proof / Intrinsically Safe
10	No. of Injection units	2 (one working & one stand by)
11	Electronic Control Unit	Installed in safe area, with two RS 232 communication port, Printer port & provision for remote connectivity & must be lockable. Software to configure the odorizing system. Battery back up to retained configuration data due to power failure.
	Protection class	IP 54 (Min) / NEMA4
	Display	Back lit Alphanumeric LCD display / LED display
	Operating Modes	Manual / Automatic / Washing / Off
12	Storage Tank (Min SS304)	(*capacity & qty as per PJS/MR) The container with safe venting system, Level Transmitter with gauge / level Switch and SS flame arresters and Warning & safety Instructions.
13	Emergency Provision	To be provided to automatically continue odorization if main odorizing system stops due to power / control unit failure.
14	Maintenance Frequency	Yearly or better
15	System Features	In case of power /control unit failure, system to continue dozing at constant flow rate, till the power supply resumes.



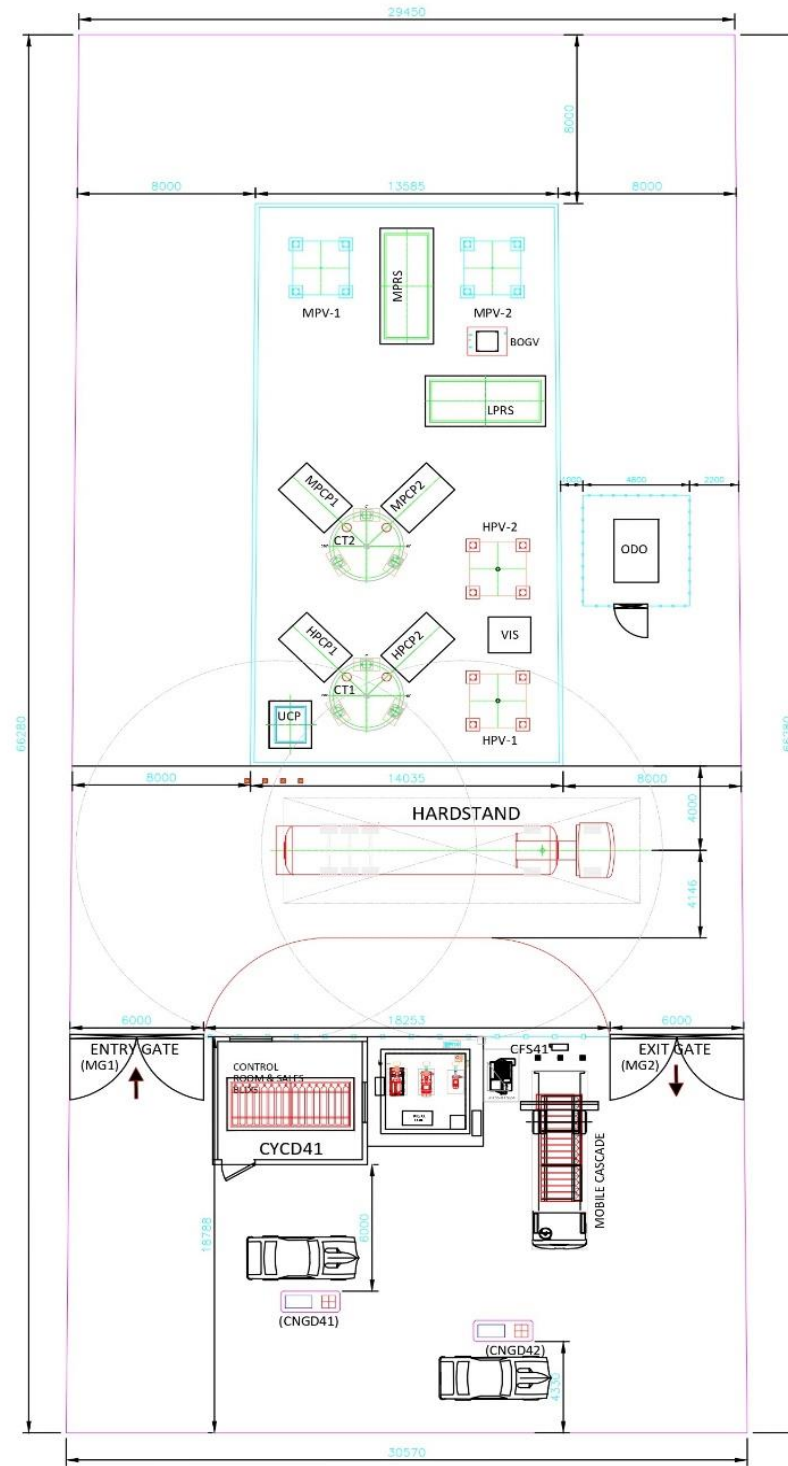
**Design, Supply, Installation, Testing, Commissioning, and 5 Years Comprehensive Operation & Maintenance of LNG Storage & Regasification station along with all necessary auxiliary units at Bikaner & Churu GA**



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## **DRAWINGS (Annexure-I)**



**NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS.
2. FOLLOW WRITTEN DIMENSIONS ONLY, DO NOT SCALE THE DRAWING.
3. THE PROPOSED CNG FACILITIES ARE DESIGNED IN ACCORDANCE WITH THE FOLLOWING CODE AND GUIDELINES:
  - 3.1. OISD - OISD 179
  - 3.2. GSR 388(E) SMPV RULE LONG
  - 3.3. GAS CYLINDER RULES - 2016, (GOVT. OF INDIA)
  - 3.4. GUIDE LINES OF CHIEF CONTROLLER OF EXPLOSIVE.
4. 75 KG, 9.0KG AND 4.5KG DCP FIRE SAFETY EQUIPMENT SHALL BE PLACED AS PER PNGRB GUIDELINES.
5. NO ELECTRIC LINE PASSING OVER THE CGS PREMISES.
6. VENT PIPE SHALL BE 3.0M HIGH FROM NEAREST PLATFORM WITH 5.0M CLEARANCE ALL ROUND.
7. SS TUBING SUPPORTING ARRANGEMENT SHALL BE PROVIDED AT EVERY ONE METER (MAX.).
8. ALL CNG EQUIPMENTS LIKE DISPENSER, STORAGE CASCADE AND COMPRESSOR IS CONNECTED BY SS TUBES.
9. FIRE SAFETY EQUIPMENT AND TRAFFIC SIGNS FOR CNG FACILITIES SHALL BE PROVIDED AND INSTALLED BY SS TURNING CONTRACTOR.
10. ALL EXISTING LIGHTING POLES SHOULD BE INSTALLED 6 MTR. AWAY FROM THE CNG EQUIPMENT LIKE COMPRESSORS, CASCADE & DISPENSER.
11. NO-SMOKING SIGN & EXPLOSIVE LICENCE NUMBER AND THE COPY OF LICENCE SHALL BE CONSPICUOUSLY DISPLAYED AT THE FUEL STATION.

**LCNG EQUIPMENT DETAILS**

S.NO	DESCRIPTION	QTY.	
1	MPRS	MEDIUM PRESSURE PRS	01
2	MPV 1 & 2	MEDIUM PRESSURE VAPOURIZERS (2500 SCMH)	02
3	BOGV :-	BOIL OF GAS VAPOURISER	01
4	LPRS	LOW PRESSURE PRS	01
5	ODS	ODOURIZER	01
6	VIS	VAPOUR INTERCONNECTING SKID	01
7	HPV1 & 2	HIGH PRESSURE VAPOURIZORS (1200SCMH)	02
8	UCP	UNLOADING CRYO PUMP	01
9	CT1 & 2	STORAGE TANK 56KL	02
10	HPCP1 & 2	HIGH PRESSURE CRYO PUMP ( 33 LPM)	02
11	MPCP1 & 2	MEDIUM PRESSURE CRYO PUMP (70 LPM)	02

**LEGEND**

- (N) - "NO SMOKING" SIGN
- (F) - "NO OPEN FLAME PERMITTED" SIGN
- (D) - "FLAMMABLE GAS" SIGN
- (V) - "STOP VEHICLE" SIGN
- (S) - "SAND BUCKET STAND"
- (E) - "EARTHING PIT"
- (M) - "NO MOBILE PHONE" SIGN
- (L) - "FLAME PROOF LIGHT"
- (O) - "SWITCH OFF THE MOBILE PHONES" SIGN
- (P) - "SIGN SHOWING DETAILED PRECAUTIONS PROCEDURE OF REFUELLING."
- CO2 - CO2 FIRE EXTINGUISHER 4.5kg
- D.C.P. - 10 Kg DRY CHEMICAL POWDER

PROPOSED FACILITIES

Rev	D	M	Y	Modifications	Drawn	Checked	Approved	Validated
A	28.11.2022				PV	NBS	AN	-

CUSTOMER: **Gasonet GASONET SERVICES (RJ) LIMITED**

SUBJECT: **PLOT PLAN LAYOUT OF LCNG STATION AT, KARNI MATA INDUSTRIAL AREA, BIKANER (RAJ.)**

CONSULTANT	Size	Scale	Sheet	No.
<b>Resonance Energy Pvt. Ltd.</b>	A1	1:200	1 of 1	A
	Drawing No.	P.20221128-GSL-KMA-MEC-DR-1001		

# RIICO

(A Rajasthan government undertaking)  
 (Bikaner Unit)  
 Bichhwal Industrial area, BIKANER  
 Phone: 0151-2250023

SITE PLAN OF PLOT NO.- F-636

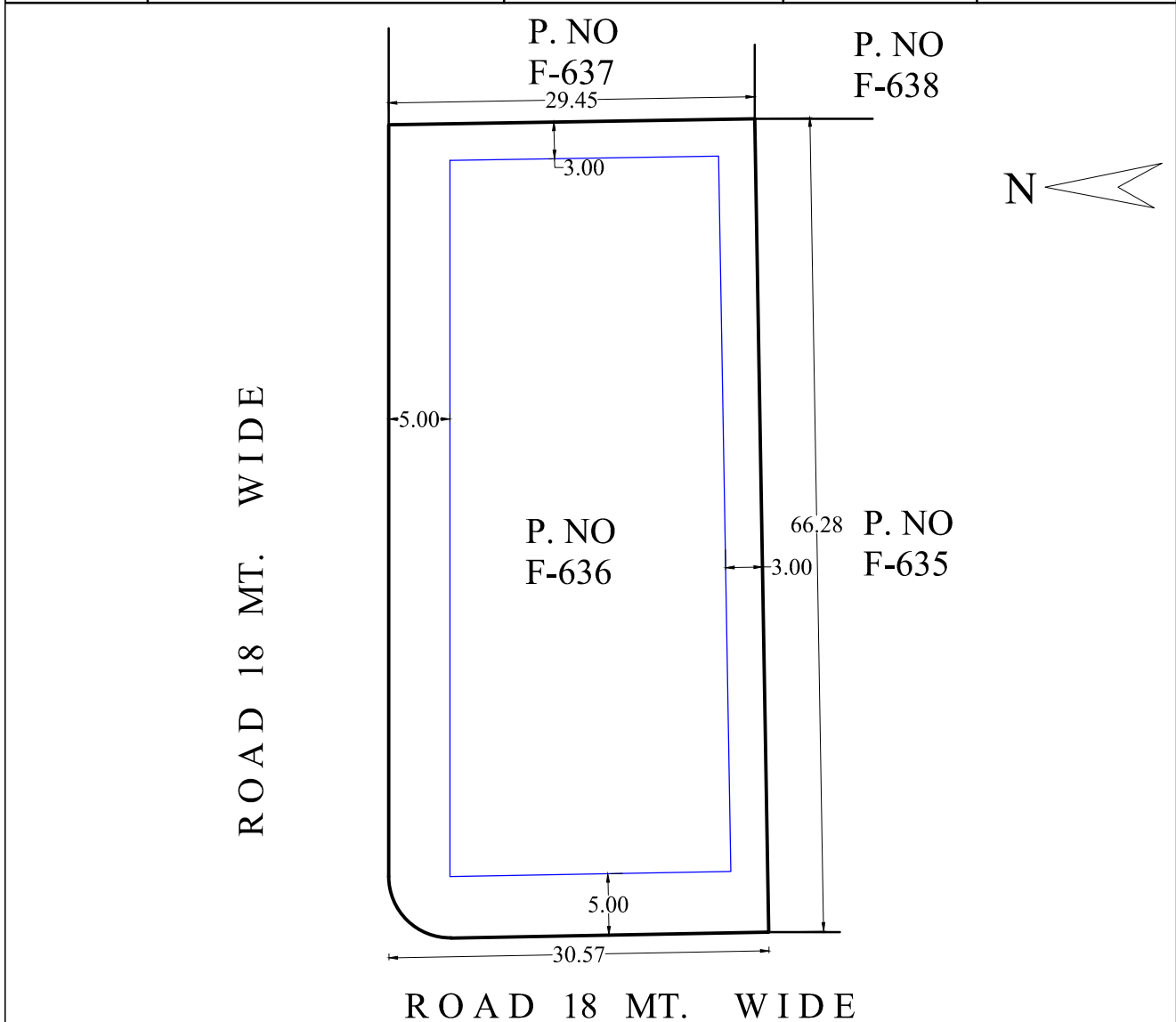
AT INDUSTRIAL AREA S.G.C. KARNI (EXTN.), BIKANER.

SCALE: 1 CM = 5.00 METER

## PERMISSIBLE FACILITIES IN SET BACKS

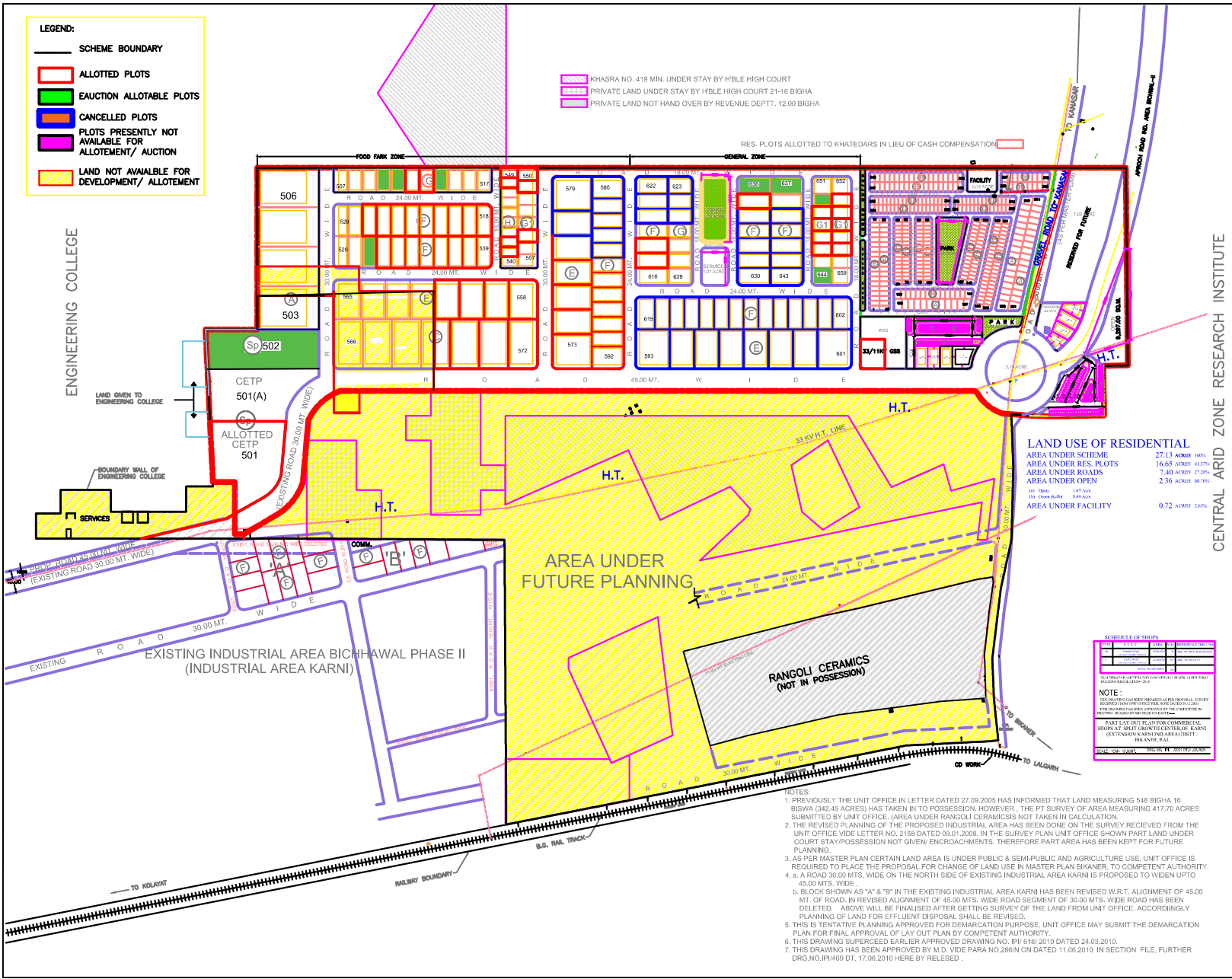
Note: ALL DIMENSIONS IN METER

Area of Plot	GUARD ROOM, METER ROOM IN FRONT / SIDE SET BACK	CYCLE, CAR SHED IN SIDE / REAR SET BACK	TOILET BLOCK IN SIDE/REAR SET BACK	CHOWKIDAR QUARTER IN REAR SET BACK
1989 sqm	3.30X 5.50	2.00 X 8.00	1.50 X 3.00	3.00 X 6.00



Sr. D. M.

A. R. M.



# RIICO

### SCHEDULE OF PLOTS

TYPE	S I Z E	AREA	NOS.	SET BACKS			
				FRONT	SIDE I	SIDE II	REAR
SP	AS PER SITE	29,000.00	02	25.00	15.00	15.00	15.00
A	80.00m x 125.00m	10,000.00	04	12.00	7.00	7.00	7.00
C	60.00m x 100.00m	6,000.00	07	10.00	5.00	5.00	5.00
E	50.00m x 80.00m	4,000.00	23	8.00	4.00	4.00	4.00
F	30.00m x 65.00m	2,000.00	69	5.00	3.00	3.00	3.00
G	30.00m x 50.00m	1,500.00	18	5.00	3.00	3.00	3.00
G.I	25.00m x 40.00m	1,000.00	24	5.00	-	3.00	2.50
H	20.00m x 35.00m	700.00	10	4.00	-	3.00	2.00
<b>TOTAL NOS. OF PLOTS</b>			<b>157</b>				

### SCHEDULE OF RESIDENTIAL PLOTS

TYPE	S I Z E	AREA	NOS.	SET BACKS			
				FRONT	SIDE I	SIDE II	REAR
A	12.50m x 24.00m	300.00	52	4.50	3.00	-	3.00
B	10.00m x 20.00m	200.00	109	4.50	1.50	-	2.50
C	8.00m x 17.00m	136.00	218	3.00	1.50	-	2.50
<b>TOTAL NOS. OF PLOTS</b>			<b>379</b>				

### LAND USE

TOTAL AREA UNDER SCHEME	417.70 ACRES	415.83 ACRES
AREA UNDER FUTURE PLANNING	201.30 ACRES	
AREA UNDER REVISE PLANNING	214.53 ACRES	100%
AREA UNDER IND. PLOTS	108.44 ACRES	50.55%
AREA UNDER ROADS	45.34 ACRES	21.14%
AREA UNDER SERVICES	10.92 ACRES	5.09%
AREA UNDER OPEN	7.44 ACRES	3.46%
AREA UNDER COMMERCIAL	8.26 ACRES	3.85%
AREA UNDER C.E.T.P.	7.00 ACRES	3.26%
AREA UNDER RESIDENTIAL	27.13 ACRES	12.65%

### TENTATIVE PLAN FOR DEMARCATION

## REVISIED PROPOSED LAYOUT PLAN SPLIT GROWTH CENTER, OF KARNI (EXTENSION KARNI IND. AREA) Dist : BIKANER, RAJASTHAN.

SCALE : 1 cm. = 40.00 mtr.	DRG. NO.	IPJ/439/2008	DT. 07.03.2008
(R.S. NIRAWAN) Sr. PLANNING ASSTT.	REV.-1	IPJ/618/2010	DT. 24.03.2010
(R.G MAHAWAR) ASSTT. TOWN PLANNER	REV.-2	IPJ/649/2010	DT. 17.06.2010
(ANIL KUMAR PATHRIA) DY. TOWN PLANNER	