9. The switching elements shall be snap acting, shock and vibration proof. All switches shall have two electrically independent SPDT change over contacts. Electrical contact rating shall be 5 amps at 240 V, 50 Hz or 0.25 amps at 220 V dc.
10. Electrical connection for the switch devices shall be suitable for plug and socket type connection.
11. All switch devices shall be provided with ¾ inch NPT conduit connection / compression type cable glands.
12. All switch devices shall be furnished in NEMA - 4 / IP – 55 weather – proof housing of cast aluminum material in safe area. Instrument in hazardous area shall have explosion proof enclosure as per NEMA – 7 / NEMA – 9.
13. Process connection shall be ½ inch NPT. Process piping connections shall include necessary union, nut, nipple, tail pipe, and isolation valve and test connection to permit servicing, testing, calibration and removal of the instrument device.
14. Instrument for steam & hot water service, shall be connected through siphon, of stainless steel or suitable material. Pulsation dampeners shall be provided for all pulsating fluids.
15. Pressure switches shall be tested as per BS – 6134.
16. The inspection / testing of the instrument shall be carried out as per following as a minimum:

    i) Switches shall be checked for operating differential, set point accuracy and repeatability.
    ii) Electrical part of switch shall be subjected to 2 kV for 1 min. and IR value shall be measured.
    iii) Type test for degree of protection of switch enclosures.

I.3 Temperature Gauge

1. Temperature gauges shall be dial thermometers (liquid spring / steam pressure spring / metal expansion thermometer), either rigid stem or capacity tube depending upon application; if this is not possible for design reasons, industry type liquid – in – glass thermometers shall be used.
2. Case shall have back or bottom connection with adjustable gland to permit adjustment of thermometer into the thermowell.
3. Thermometer stem adjustable gland with union connection and bushing shall be suitable for ½ inch NPT connection.
4. Bi-metallic type dial thermometer, if used shall be hermetically sealed, back or bottom connection type, with 150 mm dial.

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5. The gauges shall be provided with automatic ambient temperature compensation.
6. Scale ranges shall be selected so those normal process temperature in middle two – third of full-scale range. The gauges shall be provided with an over range protection of 130 % of full-scale range.
7. All gauges shall be provided with thermowell.
8. Gauges furnished under these specifications shall be in general, in accordance with the following criteria:

Dial size	: App. 150 mm diameter
Dial	: White dial with black Numerals over an arc of 270 degree
Sensing element	: Liquid spring / steam pressure spring / metal expansion / liquid-in-glass Casing Stainless steel / die – cast aluminum with polished chromium plated Screwed bezel and clear plastic crystal non-glare glass front
Bulb	: Bulb shall be SS 316; Capillary tube stainless steel, armored; Length of the capillary shall be as required for installation
End connection	: ½ NPT (M)
Pointer	: Externally adjustable
Scale for	: Black lettering on white background with coloured by Green normal range and Red for Alarm as per Process application.
Accuracy	: ± 1.0 % of full scale or Better
Thermowell	: Materials for construction of thermowell shall be SS 316 / SS 304 / SS 310 depending upon the application. Thermowell shall be designed and manufactured as per ASME PTC 19..3 – 1947, based on operating and maximum values of process conditions. Thermowell shall be drilled from solid bar stock. Connection size and test pressure shall as per Owner / Consultant's approval.
Protection class	: IP 55 / NEMA 4
Over range	: To be provided Pointer Stopper
Painting	: Stoved enamel and anti – corrosive black color.
Identification	: Engraved with service legend on phenolic laminated tag plate.

9. The inspection / testing of the instrument shall be carried out as per following as minimum:

   i) Calibration of minimum of 5 points for checking accuracy.
   ii) Degree of protection of gauge enclose shall be type tested.
   iii) Material certificates for thermowell shall be furnished.
   iv) Thermowell shall be subjected to pressure test.
   v) Over – range protected at 130 % of full scale range

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I.4 Pressure, Differential Pressure, Level (DP Type) and Flow (DP Type) Transmitters (PT, DPT, LT & FT)

Smart Transmitters of the electronic type shall be furnished.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures (LIE).

Type/Construction		Sealed capacitance / piezo-resistive based SMART type
Material		
- Body		Die cast Aluminum or Aluminium alloy with epoxy coating
- Diaphragm		316 SS
- Measurement element		316 SSL
Output signal		4 to 20 m Amp. DC (Two wires) With HART protocol
Local Indicator		LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy		± 0.065% or better of FSR ± 0.2% for remote seal type transmitter.
Turn down ratio		10:1 for vacuum / very low pressure / very high pressure applications 100:1 or better for other services
Stability		± 0.2% for 10 years
Power supply		24V DC nominal
Drive capability		600 Ohms nominal
Enclosure Class		IP-67 min. in general Explosion proof for NEC Class-1, Division 1 area
Span Adjustment		Remote or Locally adjustable
Zero Adjustment		Externally adjustable
Zero suppression / elevation		At least 100% of Span
Overpressure		150% of max. operating pressure.
Adjustment/ calibration/ maintenance		Port/provision for Centralised HMI based system maintenance
Ambient Temperature		60 Deg. C
Connection		
- Process		1. Half (1/2) inch NPT (F)
		2. Quarter (1/4) inch NPT With /without oval flanges
- Electrical		½" NPT(F), two electrical connections and blind plug
Accessories		

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Manifolds		
Type		Non-Integral type
Material of Construction		SS
- For Absolute Pressure Transmitters		Two (2) valve SS316 manifold
- For Gauge & Vacuum pressure Transmitters		Three (3) valve SS316 manifold
For DP, level & flow transmitter		Five (5) valve SS316 manifold
Protective Diaphragm Seal		
- Application		For oil, corrosive, viscous, solid bearing or slurry type medium
- Type		Flush Type
- Process Connection		½" NPT / Flanged SS316 Class 150
- Material		SS316L
Capillary Length		Minimum 10 m
Mounting bracket		For all transmitters
Drain & vent points		As per requirement

1 No. of universal type hand held /portable HART calibrators shall be supplied for each project (BTPP & BTPSE) for calibration / configuration of Transmitters & other HART based instruments. **Also 1 No.** of hand held/portable mV / RTD source generators shall be supplied for each project (BTPP & BTPSE) for calibration / configuration of temperature transmitters

Other Features

1. Pressure transmitter shall have easily accessible span, zero and time constant adjustments. A range suppression / elevation device shall be provided wherever required.
2. For pressure / differential pressure transmitter, proof pressure shall be 200% of maximum static process pressure.
3. All transmitter cases shall be dust – tight and rugged. Weather – proof and explosion – proof cases shall be used in outdoor and hazardous areas respectively. Protection class shall be of IP 65 or better.
4. Transmitters for pressure / DP measurements of liquid and steam shall always be installed below the sampling point, preferably with the connection at the top.
5. Transmitters for pressure / DP measurements for gases and air shall always be installed above the sampling point, preferably with the connection at the bottom.
6. Transmitters with diaphragm seal system shall be considered when

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a. The process temperature is outside of the normal operating ranges of the transmitter and cannot be brought into those limits with impulse piping or

b. The process is corrosive and would require frequent transmitter replacement or unusual materials of construction or

c. The process contains suspended solids or is viscous and may plug the impulse piping or

d. There is a need to make density or interface measurements or

e. The process medium may freeze or solidify in transmitter or impulse piping.

7. Diaphragm seal shall be either capillary type or direct mounted type depending upon the application. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

8. Differential pressure type level transmitters shall be used for range above 1219 mm

9. Differential pressure type level transmitters for use on corrosive service shall generally be diaphragm wafer with extended filled capillary type. Flush or extended diaphragm type DP transmitter shall be considered for special application. Diaphragm material shall normally be stainless steel or any other special alloy.

10. Differential pressure type flow transmitters shall have in-built square-root extractors

I.5 Temperature transmitter

1. Temperature transmitter shall be of true SMART type and shall be used for receiver instrument or control loop requiring signal conversion. They shall have either resistance or thermocouple type measuring system.

2. The transmitter output shall be compatible with major instrumentation selected. Adjustable spans and suppressed ranges shall be provided where required by process consideration. Thermocouple burnout or RTD wire-break protection for “failsafe” condition shall be provided.

3. Transmitters shall have easily accessible span and zero adjustment facilities and shall meet the following minimum requirements.

Accuracy	:	± 0.1 % of span or better
Stability	:	± 0.1 % of reading or 0.1^0c, whichever is greater, for 24 months for thermocouples.

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Input RTD	:	mV signal from thermocouples / Ohm input from Pt-100
Output	:	4-20 mA DC, liner
Output load	:	min 600 ohms at 24 v DC
I/O Isolation	:	should be isolated from power circuit
Output indicator	:	Built-in, digital. LCD
Power supply	:	24 v DC
Housing material	:	Low-copper aluminum
Mounting	:	Field mounting

4. Transmitters shall be provided with following features
   - Sensor drift alarm for sensor failure protection
   - Differential & average temperature measurement if required.
   - Automatic switch – over to back – up sensor on primary sensor failure.
   - Accepts any combination of two sensor types (RTDs, TCs, mV or ohms)
   - Ambient temperature compensation
   - Fault detection for electronic & sensors with fail-safe alarming.
5. Transmitters to be used for RTD sensors shall be provided with RTD EMF correction features so that it shall detect and eliminate EMF errors, which are the result of small voltage, product by RTD sensing elements.
6. The product and make shall be selected so that with one make of transmitter all application with respect to measuring ranges of temperature sensor (resistance thermometer / thermocouple) and connection type (2/3/4 wire connection of resistance thermometers) shall be covered.
7. Transmitters shall be capable of communication with HART (Highway Addressable Remote Transducer) communicator. HART communicator shall be provided with transmitters for tuning / configuring / diagnosing / maintenance of the transmitters. It shall meet the intrinsic safety requirement if required depending upon the application.
8. All transmitters cases shall be dust-tight and rugged weather-proof explosion – proof cases shall be used in outer and hazardous areas respectively. Degree of protection shall be ≥ IP55. IP65 is required for outside installation or installation in spray-water affected areas.
9. Temperature transmitters shall be separate, single channel, independent unit and shall not be thermocouple / RTD head mounted.

I.6 Thermocouple with Thermowell

1. The following types of sensors shall be used for the different temperature ranges:

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- For measurement of temperatures of up to max.1100^0 C, rapid-response sheathed thermocouples with insulated tip dia 6 mm, as Chromel-Alumel (NiCr-NiAl, ISA type K) measurement element, with admissible deviation of thermo voltage of half the values stated in IS-2054, 1974-or DIN 43710.

  All thermocouples shall be duplex type with tips grounded. Thermoelectric properties and accuracy shall be as per ANSI MC 961/ IS-2054/2055: 1974.

2. The design of the thermocouple assemblies shall be such that replacement on line is possible.
3. Gas-tight ceramic sheaths partially reinforced with steel sheath shall be used as protective tube for Pt Rh – Pt thermocouples. For other type of thermocouple stainless steel tubes shall be used as protective sheaths. For measuring temperature of high-pressure process fluid, tapered protection sheath made from solid bar stock shall be used.
4. The time-constant of thermocouples shall suit the process requirement and shall be subject to approval of consultant/Owner.
5. The thermocouples shall be supplied with factory tested and calibrated assemblies. The assemblies shall be complete with thermowell, sensing element, connection lead, duplex terminal block, extension nipple, compression fittings/unions/flanges etc. to meet all functional requirements as per Consultant/Owner's approved drawings. The thermocouples equipped with thermo well shall be spring-loaded for positive contact with the well.
6. The thermocouple assemblies shall be complete with weatherproof connection heads and nipples. The terminal head shall be of die-cast aluminum or better material painted with black enamel paint as approved by Consultant/Owner.
7. The duplex terminal block shall be constructed with high temperature ceramic base with brass screw type terminals.
8. Thermocouple shall be suitable for steam, water or any other liquid application. For air & flue gas service, suitable protection tubes shall be provided for the thermocouples.
9. All thermocouple shall be terminated to the nearest junction boxes shall be provided with constant temperature unit for cold junction compensation. The necessary arrangements to make the junction boxes functionally complete shall be provided by the Supplier.
10. The thermocouples shall be provided with following characteristics as a minimum:

Wire Gauge	16 AWG (for K type

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	24 AWG (for S & R type)
Protective sheath	As per requirement Material SS 316 seamless Filling – Magnesium Oxide (Purity above 99.47)
No. of Element	Duplex, Ungrounded
Response time	< 10sec. without thermowell & < 40 sec. with thermowell
Protective tube	As per requirement or min 8mm Material SS 316 seamless or better Filling – Magnesium Oxide (Purity above 99.47)
Loading	Shall be spring loaded to ensure positive contact with the well. Preventation of rotation of the insert with respect to head and resultant twisting of leads shall be ensured.
Accuracy	As per ANSI MC 96.1 / IEC 751 / IS-2054/2055,1974. or +/- 1%
Characteristic	Linear with respect to temperature within +/-1/2 percent of top range value.
Reference	For temperature vs. mV characteristics, following IS shall be applicable: Type K IS – 2054, 1974 Type S&R IS-2055, 1974
Head Material	Die-cast aluminum or better painted with black enamel paint.
Terminal Block	Brass screw type/silver plated on ceramic head.
Cable Connection	With cable gland and Neoprene/Teflon grommet ¾ inch. Terminal head shall have suitable gasket and SS chain. NEMA-4 screwed or equivalent.
Accessories	* Extension nipples with thermowell connection / plug-in connectors.
Compensation	All Thermocouple shall be interconnected with PLC through single-pair,multipair compensating cable. Temperature compensation shall be done at PLC Panel/end
	* Compression fittings/unions.

11. The design of the thermowell shall take into consideration the temperature, pressure, medium and fluid specified in the process in accordance with ASME Standard PTC 19.3, 1974.
12. Thermowells shall, in general, be of SS 316 and shall be drilled from bar stock.
13. Welded type thermowells with 38 mm O.D. for welding & ½ " NPT material threads shall be used for pressure above 100 kg/cm2. Socket weld type thermowell with 34 mm O.D. for welding & ½ " NPT internal thread, shall be used for pressure between 40-100 kg/cm2 and temperature up to 4000C. For pipes

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having probability of prolonged vibration, seal welding may be done all around after tightening the thermowell within the base.

14. Thermo well manufacturing drawing covering material specification, dimensional details, details of special treatment, finish etc, as well as test procedure shall be subject to Consultant's/Owner's approval. Material certificate shall have to be furnished for each thermowell.

15. Wherever any approval is necessary from any recognized body/authority during manufacturing of high-pressure wells, the same shall have to be arranged by the Supplier.

16. The thermowell immersion depth (U) shall be sufficient to eliminate conduction error. A general rule which may be followed is to use an immersion length equaling a minimum of 10 times the diameter of the protective tube or well. In general, immersion length of thermowells for different line sizes shall be as follows:

Line Size	Insertion Length (U)
From 4" to 6"	280 mm
From 6" & onwards	320 mm
Vessels	400 mm

Immersion length is based on 200 mm length between flanges face and inner wall of pipe. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. Any pipeline less than 4" nominal bore shall be blown to 4" size.

I.7 Resistance Temperature Detector (RTD) with Thermowell

1. RTDs shall be duplex, platinum three (3) wire a nominal resistance of pt100 ohms at 0 Deg C and conform to DIN 43760 / BS 1904.

2. Stability of RTD over full range shall be better than 0.05 ohms and the repeatability figure shall be better than 0.02 ohms. Accuracy shall be of the order 0.15% or better and response time shall be less than 20 seconds with thermowell.

3. The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540^0C shall not be less than 5 mega-ohms.

4. The time constant of the RTD shall suit the process requirements and shall be subject to approval of Consultant/Owner.

5. RTDs to be supplied shall have the following characteristics as a minimum:

Type of RTD	3 wire – Pt RTD 100 ohm (as per DIN 43760)

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No. of Element	Duplex
Housing/Head	IP55/Die cast Aluminum
Sheathing of RTD	SS 316 sheathed, compact MgO packed
Accuracy	+/- 0.15% of span/0.60^{0}C
Stability	Zero & span drift within 0.1% of span for 6 month period.
Accessories	• Extension nipples with thermowell connection/plug-in connectors. • Compression fittings/unions • Thermowell as per requirement.

6. Thermowells shall be of SS 316 and shall be drilled from bar stock except for air and flue gas services.
7. Welded type thermowells with 38 mm O.D for welding & ½" NPT material threads shall be used for pressure above-100 kg/cm2. Socket weld type thermowell with 34 mm O.D for welding & ½" NPT internal thread, shall be used for pressure between 40-100 kg/cm2 and temperature up to 4000C. Screwed type thermowells with ½" NPT internal threads shall be used for pressure below 40 kg/cm2 and temperature below 4000C. For pipes having probability of prolonged vibration, seal welding may be done all around after tightening the thermowell within the base.
8. Thermo well manufacturing drawing covering material specification, dimensional details, details of special treatment, finish etc. as well as test procedure shall be subject to Consultant/Owner's approval. Material certificate shall have to be furnished for each thermowell.
9. Wherever any approval is necessary from any recognized body/authority during manufacturing of high-pressure wells, the same shall have to be arranged by the Supplier.
10. The thermowell immersion depth (U) shall be sufficient to eliminate conduction error. A general rule, which may be followed, is to use an immersion length equaling a minimum of 10 times the diameter of the protective tube or well. In general, immersion length of thermowells for different line sizes shall be as follows:

Line size	Immersion Length (U)
From 4" to 6"	280 mm
From 6" onwards	320 mm
Vessels	400 mm

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Immersion length is based on 200 mm length between flange face and inner wall of pipe. In vessels, where fouling with vessel internals is expected, the immersion length shall suitably modified. Any pipe less than 4" nominal bore shall be blown to 4" size.

I.8 Orifice Plate

Concentric orifice plates shall only be provided for other flow measurements where flanged construction and higher pressure losses are acceptable. Orifice plates shall be made of SS316. The standard primary element shall be thin plate, square-edge concentric. Orifice flanges shall be of the raised face weld neck type with dual sets of taps. The minimum pressure rating for flanges shall be ANSI 300lbs. Thickness of Orifice plate shall be 3.18 mm (minimum) for pipe diameter up to 300 mm and 6 mm (minimum) for pipe diameter above 300 mm. Orifice plates shall be supplied with carrier rings as per process requirements.

The length of straight pipe run required for metering accuracy shall be in conformity with ISO. When it is extremely difficult to comply with the standard, a minimum straight length of 10D (D = pipe inner diameter) on the upper stream and a minimum length of 5D on the down-stream shall be considered

For pipeline sizes of 50 mm and less, the orifice plates shall be an integral unit comprising of carrier ring assembly, tapping arrangement on both upstream as well down stream side. For line sizes more than 50 mm, the orifice plate shall be disc type. For disc type orifice plate, suitable corner tapping arrangement on both upstream as well as downstream side shall be provided. All tapping arrangements shall be complete with a piece of impulse pipe line and a shut – off valve suitable for specified line pressure

For steam applications, orifice plate shall be supplied with a pair of steam condensation chambers suitable for specified line pressure.

Feature		Minimum Requirement
Type		Concentric as per ASME PTC – 19.5 (Part III); ISA RP – 3.2; BS – 1042; ISO 5167
Material		SS 316
Thickness		3.18 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia. above 300 mm.
Beta ratio		0.4 to 0.75
Tapping		Flanged weld neck 2 pairs of tappings.

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Feature		Minimum Requirement
Material of Branch Pipe		SS 316
Root Valve type		Ball type in general & Globe type for steam application
Root Valve material		SS 316
Root Valve size		1" or ½ "
Accessories		Root valves, flanges (if reqd.), vent / drain hole (as required)

1. Tenderer to provide Beta ratio calculation, Assembly drawings & flow vs DP curves.
2. Each orifice plate shall be provided with a handle on which the orifice diameter, pipe diameter and pressure tap distances are stamped. This information shall be so located that it can be read without removing the orifice plate from pipe line.
3. Quadrant edge or quarter circle orifice plates shall be used for highly viscous liquids and for pipe Reynolds Number below 10,000. Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids up to Reynolds Number below 250. Vent and drain holes shall be provided wherever necessary.
4. Orifice diameter shall be selected, so that d/D ratio is between 0.40 to 0.70 for gas and steam and up to 0.75 for liquids.
5. Metering orifices shall not be installed in lines less than 1 ½" (40 mm) the lines shall be blown to the 1 ½ " (40 mm) size for the meter run, keeping the d/D ratio within limits.
6. Restriction orifices and integral orifice transmitters do not require upstream or downstream straight pipe runs.
7. The orifice plate shall be supplied and fitted in conformity with ISO. When the pipe diameter is larger than the value specified in ISO, the restriction ratio will be decided by extending the specific curve externally.

I.9 Level Gauge

1. Level gauges shall be steel armoured reflex or transparent or bi – color type, top and bottom connection as per pressure vessel standard of ASME PTC code and 15 mm NB (1/2 inch NPT) Drain and vent connection.
2. Body material and cover material shall normally be forged carbon steel, 304 stainless steel or other superior material.

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3. Reflex type gauges shall be used for clean and colorless liquids and transparent type for other liquids. For condensate services, treated water the transparent type with KEL – F shields shall be used to avoid their attack on the glands.
4. The gauge glass must have a rating equal to or more than the vessel design pressure and temperature. The test pressure for the complete design gauge assembly shall be as per Owner' / Consultant's recommendation.
5. The maximum length of a single gauge glass shall not exceed 1.4 meters. Where large range is required, multiple gauges of preferably equal lengths shall be used with 50 mm over – lapping in visibility.
6. The visibility shall cover the operating level range and the maximum and minimum ranges expected considering start – up conditions as well as alarm and shut down points. Internal heating shall be provided for viscous liquids. Integral illuminators shall be used for transparent gauges, if necessary.
7. Stand – pipes, shall be used for multi – gauge and level controller installation and on horizontal vessel or exchanger with top and bottom connections to have visibility of the complete span. The standpipe shall not be used with block valves.
8. Primary isolation valves shall be used in addition to the gauge glass valves unless otherwise specified. When the process fluid may create plugging or leakage problem, gauge valves may be omitted. For low temperature liquid having high vapour pressure at ambient temperature, isolation and gauge valves shall not be permissible. Safety valve shall be provided at the vent connection of the gauge glass where isolation is required.
9. Level gauge shall be supplied as per the following specification:

Sensing Element & Material	: Tempered toughened Borosilicate Gauge glass steel armoured Reflex or Transparent type
Body Material	: Forged carbon steel / SS 304
End Connection	: Process conn. as per ASME PTC and drain/vent 15 NB
Accuracy	: ± 2%
Scale	: Linear vertical
Range Selection	: Cover 125 % of max. of scale
Over range Test	: Test pressure for the assembly shall be 1.5 to the maximum design pressure at 38 degree C
Housing	: CS / 304 SS leak – proof
Zero / span Adjustment	: To be provided
Identification	: Engraved with service legend or laminated phenolic Name plate
Packing	: PTFE Teflon

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Illumination	: 220 V, 50 Hz, 25 / 40 Watts either with deflector or Diffuser (for transparent type level gauge) / 220V, 50 Hz
Accessories	: Gasket for all KEL – F shield for transparent type vent and drain valves of CS / SS as per process req.
Others	: Anti – Frost extension for low temperature service. Heating / cooling arrangement.

I.10 Control Valve with Actuator

A. INTRODUCTION

1. The control valves and accessories equipment furnished by the tenderer shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Compressor & Pressure Vessel code, as well as in accordance with applicable requirements of the "Federal Occupational safety and Health Standards, USA" or acceptable equal standards.

B. CONTROLVALVE DESIGN & SIZING

1. The design of all valve bodies shall meet the specification requirements and shall conform o the requirements of ANSI for dimensions, material thickness and material specification for their respective pressure classes.
2. The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA Handbook on control valves,. Tenderer shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which shall be subject to consultation's / owner's approval during detailed engineering.
3. Control valves for applications shall be designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and down stream piping.
4. Trim shall be multistage type having sufficient number of discrete pressure drop turns (stages) to ensure elimination of vibration, erosive – action, cavitations. Tenderer shall identity the number of pressure drop turns in proposed equipment

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and shall also provide calculation demonstrating compliance to the trim exit velocity.

5. To prevent flow induced vibration and to protect the valve intervals from foreign particles such as weld slag flow, direction shall be a flow to close (over the plug) configuration for liquid applications. To maximize noise attenuating benefits and to allow for constant fluid expansion, flow direction shall be under the plug for steam and gas applications.
6. Control valves as per application all control valves such as low and high range feed control valves shall have min. leakage rate as per leakage class standard code shall be finalized during detailed engineering
7. The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
8. The characteristic of the control valves shall be determined based on the application / service.
9. On supply air/Nitrogen or electrical failure for pneumatic / electrical drive, the valve shall remain full closed, open or stay – put position as per process safety requirement.

C. VALVE CONSTRUCTION

1. Proper selection of valve type and material of construction to meet operating requirement.
2. All valves shall be of globe body design and straightaway pattern with single or double port unless otherwise recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure or pressure drops permit.
3. Valves with high lift cage guided plugs & quick charge trims shall be supplied.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type for easy dis – assembly. Bonnet joints of internal hreaded or union type shall not be acceptable.
6. Plug shall be of one – piece construction either cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.
7. All valves connected to vacuum on down-stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing).
8. Valve characteristic shall match with the process characteristic.

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9. Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280^0c.
10. Flanged valves shall be rated at not less than ANSI pressure class of 300 lbs.
11. Teflon shall be used for valve gland packing to suit process requirement.
12. The valve body shall be marked to show direction of flow.

D. VALVE MATERIALS

1. The control valve body material shall be

   (i) Carbon steel as per ASTM – A216 GR WCB for non – corrosive, non – flashing and non – cavitations services below 275 0C temperature and above 275 deg C ASTM-A217 GR WC 9

   (ii) Alloy steel as per ASTM – A217 GR WC 9 for severe flashing / cavitations services like low load and full load, emergency drains, vessel overflow drain etc.

   (iii) Alloy steel as per ASTM A – 217 GR WC 6 for low flashing / cavitations services like Heaters normal drain control, drain cooler normal level control, gland steam cooler minimum flow etc.

   (iv) 316 SS for condensate service below 300 deg. C normal and emergency make – up controls etc.

2. The control valve trim material shall be

   (i) 17 – 4 PH SS for severe services listed under item D1,(i) (II) & (III) above

   (ii) SS 440-C for severe services listed under item D1 (II) above

   (iii) 316 SS for services listed at D.1 (IV) above and

   (iv) 316 SS with stellite faced guide parts and bushings for remaining applications.

3. However, vender may offer valves with body and trim materials better than specified materials and in such cases vender shall furnish the comparison of properties including cavitations resistance, hardness, tensile, strength, strain, energy, corrosion resistance and erosion resistance etc of the offered material vis –

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a – vis the specified material for Consultant's / Owner's consideration and approval.

E. END PREPARATION

Valve body ends shall be either butt welded / socket welded, flanged or screwed as finalized during detailed engineering and as per Consultant's / Owner's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves sizes 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure – temperature class equal to or greater than of the control valve body.

F. VALVE ACTUATOR

1. All regulating control valves shall be furnished with pneumatic actuators. For pneumatic actuators, compressed instrument air shall be used and for this, necessary provision of Pressure Reducing Station (PRS) shall be considered. The tenderer shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60^0c continuously.
2. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 kg / cm^2 per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.
3. The travel time of the actuators shall not exceed 10 seconds.
4. For quick opening / closing services (such as fuel oil shut – off valve), the actuator shall be pilot solenoid operated pneumatic drive, the rating of solenoid shall be 24V DC or 110 V AC shall be decided during detail engineering.
5. Selection of actuator shall be such that it meets the requirements of thrust / torque, stroke length, angular movement, full scale travel time, repeatability & accurate positioning for successful operation of final control element.
6. All the actuators shall have also provision for manual operation during emergency / maintenance along with graduated local position indicator.

G. CONTROL VALVE ACCESSORIES

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All control valve accessories such as self reset type air / nitrogen lock valves with tubing, hand wheels / hand jacks, SMART positioners, solenoid valves, volume booster, air filter & regulator, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), tubing, fittings and junction boxers etc. shall be provided as per the requirements.

Specification for Smart Positioners

S.No.	Feature	Minimum Requirement
1	Input	4-20 mA DC
2	Power Supply	24 V DC Loop powered
3	Type of Electronics	Microprocessor based with self diagnostic facility & digital communication by means of HART Protocol
4	Valve position sensing	Non-Contact type with 4-20 mA DC Output
5	Enclosure Type/Material	Weather & Dust proof to IP-65/ Die cast Aluminium
6	Ambient conditions	Suitable for - 30 to +80 *C temperature & 0-95% Humidity
7	Operating Range	Suitable for Full range & Split Range operation
8	Modes of operation	Suitable for Direct & reverse valve action
9	Flow characteristics	Suitable for Linear & Equal percentage Characteristics
10	Fail safe/Freeze feature	Required
11	Air Capacity	Sufficient to handle the Valves Selected/Boosters to be supplied if required.
12	Air supply pressure	To suite the Air Supply Pressure / Quality available
13	Process Connection	1/4“ NPT
14	Characteristic Deviation	< =0.5% of span
15	Ambient Temperature effect	<=0.01%/Deg C or better
16	Configuration	Remote Calibration, Auto & Manual Calibration shall be possible
17	Cable Entry	½” NPT, Side or Bottom Entry to avoid water ingress
18	Accessories	a) Display with push buttons for configuration and Display on the positioner itself (Password Protected / Hardware Lock).

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S.No.	Feature	Minimum Requirement	
		b)	For Supply & Output Pressure, Filter Regulator and other accessories shall be provided as on required basis for making system complete
		c)	Valves Mounting Assembly For Sliding Stem / Rotary / Single Acting / Double Acting on required basis

1. SMART positioner shall preferably be of the same make as the Control Valve, to ensure repeatability in Calibration, serviceability and proper maintenance of the Control System.
2. SMART positioner shall be a Double stage positioner. The first stage of the positioner shall be typically a flapper-nozzle that serves as a high-gain pre-amplifier. This sensitivity shall be maintained over a wide range of dynamic conditions. Second stage shall be a power amplifier that provides power to drive the actuator. Preferably this shall be a pneumatic relay. Spool Driven type SMART positioners are not preferred due to Higher Dead Band and Poor responsiveness. The SMART positioner shall have pressure sensors to measure the pneumatic outputs to the actuator.
3. The control algorithm for the positioner shall use feedback signal from the motion of the pneumatic relay beam instead of pressure feedback to minimize pneumatic related effects and for stable and smooth response of the control valve. The SMART positioner shall have user adjustable tuning sets to identify the optimum tuning for the total valve assembly. SMART Positioner with HART Communication facility shall communicate all the valve diagnostics to Plant automation system.

Specification for Air Filter Regulator (AFR)

S.No.	Feature	Minimum Requirement
1	Type	Constant Bleed type
2	Inlet Pressure	10 Kg/Sq. cm (maximum)
3	Output	Adjustable from 0-2 Kg/Sq. cm or 0-7 Kg/Sq. cm (Continuous) as required
4	Filter Element	5 microns
5	Filter Element Material	Phosphor Bronze
6	Bowl Material	Metallic
7	Drain	Automatic
8	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
9	Process connection	¼ “ NPT

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S.No.	Feature	Minimum Requirement
10	Accessories	All mounting accessories. 2” dial size Pressure gauge.

Specification for Position Transmitter

S.No.	Feature	Minimum Requirement
1	Power Supply	24 V DC Loop powered
2	Type	Non-Contact LVDT type/Optical type
3	Output	4-20 mA DC/ Linear
4	Accuracy	+/- 1%
5	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
6	Cable Entry	½” NPT, Side or Bottom Entry to avoid water ingress.
7	Accessories	All mounting accessories

Specification for Limit Switch (Non Contact Type)

S.No.	Feature	Minimum Requirement
1	Type	Non-contact type inductive Proximity/Namur type
2	Sensing distance	10 mm minimum
3	Hysteresis	Maximum 10% of sensing distance
4	Indicator	LED indication
5	Protection class	IP 67
6	Integral Cable	1 mtr.
7	Power supply	24 V DC/ 8 V DC
8	Mounting	Flush mounting with check nut
9	Other Feature	Explosion proof enclosures shall be provided wherever required by the application. Shock & Vibration proof.

H. TEST & EXAMINATION

1. All valves shall be tested in accordance with the quality assurance plan agreed between the Owner / consultant and the vender which shall meet the requirement of IBR and other applicable codes.

   The tests shall complete but not limited to the following:

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i. Non-destructive test as per ANSI B – 16.34.

ii. Hydrostatic shell test in accordance with ANSI B16.34 prior to seal leakage test.

iii. Valve closure test and seal leakage test in accordance with ANSI B16.34 and as per the leakage class standard.

iv. Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

v. All control valves shall be tested with the positioners for accuracy of positioning and reproducibility over the full range of travel.

vi. CV Test : CV test shall be carried out as type test on each size, type and design of the valves as per AISA 75.02 standard and test report shall be furnished for owner's / consultant's approval.

vii. Magnetic particle inspection shall be performed on all machined surfaces of valves having ASA rating of 1500 lbs ASA or greater. All carbon steel valves 1500 lbs ASA or greater shall receive 100% radio graphic examination in accordance with ASTM – E71.

viii. Tenderer shall submit test certificates for the tests mentioned in above paragraphs in accordance with ASME and ASTM requirements. In addition tenderer shall also submit for the above equipment, certificate of manufacture and test as required by the Indian Compressor Regulations. The certificate shall be in the prescribed forms III A & III C and shall be endorsed by an Inspection Authority recognized by the Indian Compressor Regulations.

I GENERAL REQUIREMENTS

1. Tenderer shall furnish all the control valves as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements including the system
2. Following documents to be furnished by the tenderer after the award of contract.
   a. Final certificate data sheet for all control valves.
   b. Detailed dimensional and cross-sectional drawing of control valves, indicating end to end dimensions, various clearness required, weight etc.
   c. Test certificate for the following:
      i. Hydrostatic test for all control valves
      ii. Magnetic particle inspection for all control valves.

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iii. Radiographic examination of control valves.

iv. Seat tightness test for control valves

v. Materials test certificate for control valves.

General Requirements for Critical Application Control Valves

Control valves shall be furnished with standard certification wherever required.

1. **Noise:** The maximum allowable noise level shall be 85 dba or less at 1 m. distance from the downstream bare pipe surface. The specified noise level shall be attained without the use of orifices, mufflers, diffusers. No credit for thermal or acoustical insulations shall be taken.
2. **Valve Trim:** Valve shall have quick change type trim utilizing top entry. No components shall be screwed or welded into the body. The valve shall have equal pressure distribution around the plug to avoid chattering / vibration.

   Trim of severe/critical service valve shall be of multi stage & multi path design with sufficient no. of discrete pressure drop stage to eliminate the chance of erosion, cavitations, noise, vibration through out the control range of valve.
3. **Leakage Class:** The valve shall have leakage class as per applicable standard code for applications Valve, etc.
4. Seat ring and trim fitment should not have any part screwed or welded. It should be easily replacable type.
5. The valve trim should be multistage, multipath design having sufficient numbers of discrete pressure reductions (turns/stages) to ensure elimination of vibration, cavitations, erosion and noise effects.
6. Tenderer should work out number of pressure drop turns in the trim of the valve and should provide calculations of trim exit velocity.
7. Flow Vs. valve opening characteristics: the trim is to be so designed that the minimum flow indicated in the bid specifications of the valve is achieved with minimum lift of 8mm. of valve plug from ‘close’ position. Subsequent characteristics should be ‘Equal Percentage’ i.e. corresponding to the parabolic characteristics. Characterising the cam of the positioner to mimic the required flow characteristics is not acceptable.
8. Rangeability should be 50 to 1(minimum). Valve should be able to throttle even below 5% opening without trim erosion.

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9. Each pressure reducing element should have a uniform pressure distribution around the plug to avoid mechanical vibrations(pressure equalizing rings/ grooves).
10. To prevent flow induced vibrations and the line trace damage to seat, the flow direction should be over the plug for water and under the plug for steam.
11. During throttle opening of the control valve, flow should be diverted away from the body seat.
12. Leakage class as per applicable standard code for all the control
13. The seating force on the valve seats to achieve the leakage class of MSS-SP-61 better than ANSI/FCI-70.2class-V.
14. Tenderer to indicate the closing force on the seat in kgf/mm of seat circumference applied for actuator.
15. Trim exit velocity in both minimum and maximum flow conditions should be less than 30M/Sec. in case of water and 22.5M/sec in case of flashing water conditions. Calculation sheet should be attached demonstrating satisfactory compliance of this requirement.
16. Noise level at 1 meter distance from the valve should be less than 85dB without insulation, Orifices, silencers mufflers etc. Calculation sheet to be attached for each valve offered.
17. Critical cavitations index (Kc) for all control valves should be approximately 1 (> 9.9). This is specific requirement to avoid even remote possibility of cavitational damage to valve internals.
18. To avoid problems associated with the piston rings provided in valves of balanced design, unbalanced design for port size upto 25mm. is required. Tenderer to indicate the compliance clearly.
19. Material of the valve internals should be as under:

Guide	:	Inconel 718
Plug/stem	:	Inconel 718
Seat ring	:	SS 316 stellited

20. Valve actuators:
    i) Piston actuators shall be used for all valves.
    ii) Valve actuators shall be capable of operating at 70 Degree C ambient continuously.
    iii) Castings shall be of the type to suite individual area environments.
    iv) All fix connection size shall be ¼” NPT (Female)

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v) Tenderer shall guarantee that the size of the actuator is adequate to meet the operating thrust requirement for the control valve under extreme condition. Tenderer shall indicate the stroking time of the valve assemblies with positioner.

21. Accessories**:**

Control valve actuators shall be equipped with air supply filter regulator, gauges and valve positioners alongwith boosters for typical applications wherever required, local poison indicator with scale and pointer, position transmitter, limit switch and hand wheel, air look relay, solenoid valve etc.

22. Performance**:**

All control valves shall conform to standard applicable leakage class.

I.11 INSTRUMENTATION, CONTROL and SPECIAL CABLES

[A]. SPECIFICATION AND STANDARDS

Except, where specified otherwise, all materials, cables and construction shall conform to the Indian Electricity Act and Rules and the Indian and other international standards with latest revisions and amendments issued up to date.

[B]. MATERIAL SPECIFICATIONS

General

All materials shall be new and of tested quality conforming to applicable National and Manufacturer's Standards and Indian Electricity Rules.

All materials shall be transportable to and suitable for installation at site with ease and without any damage. It shall give continuous reliable operation over long period under worst specified site conditions.

All materials shall be designed to withstand extremes of all magnetic, electrical, mechanical and thermal stresses which may be encountered during normal and abnormal operating conditions.

[C]. Cables – Design Criteria

Cables shall be so designed and manufactured that damage does not occur in handling, during transit, storage, installation and operation under any or all the climatic and operating conditions which they may be subjected to. Outer sheath of cables shall have rodent and termite repulsion property.

Cables shall be suitable for laying in conduits, ducts, trenches, trays or for direct burial in ground in both and wet locations.

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Cables shall be capable of operating satisfactorily under the power supply voltage and frequency variations as specified in the specification. Current ratings and ratings factors of cables shall not be worse than the ones specified in IS: 3961.

Performance characteristics of cables shall be based on the following conditions of laying:

1. All cables shall be laid in single layer on tray and multi-layer in case of buried in ground.

2. Cables shall be suitable for laying in duct or burying in ground up to a depth of 1.5 meters with uncontrolled back fill and chances of flooding by water.

All instrumentation cables shall be Flame Retardant Low Smoke (FRLS) type (Both for inner sheath and outer sheath).

Fillers in multiple conductor cables shall be flame retardant.

All cables shall be provided with marking including manufacturer's name, insulation material, conductor sizes, no of pairs, voltage ratings, type of cable, etc, progressive markings to read marking of the length of the cable at each meter interval and "FRLS".

All cables shall be suitable for continuous operation at 70 deg C except for high temperature resistant Teflon insulated cables, which shall be suitable for continuous operation at 205 deg C.

The Cables, if any, in hot/high temperature zone shall be decided by purchaser during detailed engineering. All the cables in the Hot/high temp. Zone (Combustor region) shall be fire survival cable conforming to IEC 331 standard. The instrumentation cables in other area shall be FRLS conforming to IEC 332 standards.

All external field signals for BOP shall be terminated in separate marshalling/termination cabinets. Under no circumstances, Field cabling shall be directly terminated to modules / cards in system cabinets.

All cables shall be provided with anti-termite and Anti Rodent properties.

All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Purchaser's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure.

i. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the transmitters (i.e for Analog) to local JBs.

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ii. Core Cables (Overall Shielded) shall be provided for terminating the switches (i.e for Binary signals) to local JBs.

Type of Cable, tentative Size and their applications are as followings:

Sl.no.	Type of Cable	Minimum Size of Cable	Application
1	Pair Cables (Overall and Individual shielded)	1.0 sq.mm	Transmitters (i.e for Analog signals)
2	Core Cables (Overall Shielded)	1.0 sq.mm	Switches, etc (i.e. for Binary)
3	Core Cables (Overall Shielded)	1.5 Sq.mm	For Solenoid Valves
4	Core Cables (Overall Shielded)	2.5 sq. mm and above	From ACDB to load points
5	Triad Cables	1.0 sq.mm	For RTDs
6	KX - type Extension Cables	1.0 Sq.mm/16AWG	For K-Type Thermocouples
7	SX - type Compensating Cables	1.0 Sq.mm /16AWG	For S type / R type Thermocouples

10% spare pairs or min 1 pair cable (which ever is more) shall be provided with all type of cables. When the number of pairs of cables are more than four (4) pairs, except for pre-fabricated cables which shall be as per manufacturer's standard. 10% spare cores or minimum one core (whichever is more) shall be provided for core cables when the number of cores is more than three.

Suitable distance shall be maintained in routing and laying instrumentation cables so that the interferences from electrical HT & LT cables are minimized. Cables carrying redundant instrument signals shall be alternately routed. In hazardous areas cables of suitable R / L ratio shall be provided for intrinsic safety.

Tenderer shall supply all cable erection and laying hardware like cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. including hardware required for main trunk route on as required basis for all the systems covered under this specification. Technical requirement of main trunk route is specified in the electrical section.

The cables shall be provided in non returnable wooden drums. The drum length shall be 1000 m + 5% up to & including 12 pair cables and 500 m+ 5 % for above 12 paired cables. The drum length shall be 1000 m + 5%for optical fiber cables.

[D] **Cable Specification**

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General

The Instrumentation cables shall function without breakdown for surges experienced in the control system. Voltage class and insulation levels shall be compatible with the signals they convey.

Cable Designation (KX - Extension Cables)

Voltage Grade & Type		1.1 kV graded Single / Multipair twisted Extension cable as per ANSI MC96.1
Conductor type and Size		Nominal 1.0 sq.mm. area concentric lay high conductivity solid conductor
Insulation type and size		HR, extruded PVC Type - C as per IS: 5831. The Thickness of Insulation shall be min. 0.3mm.
Lay		Twisted pair with 50mm max lay
Screening and Shielding		Individual and overall shielding with 0.055 mm (0.075 mm) thick combination aluminium Mylar tape with 100% coverage and min 25% overlap.
Drain Wire		7 strands x 0.3 mm minimum size Annealed tinned copper drain wire, nominal size 0.5 mm, laid under the contact with aluminium side of the tape.
Inner Sheath		FRLS extruded PVC type ST1 confirming to IS: 5831. The thickness shall be min. 0.3mm.
Outer Sheath		FRLS extruded PVC type ST2 confirming to IS: 5831. Thickness shall be min. 1.8 mm.
Armour		Galvanised steel wire/strip to IS: 3975 (BS:5608 Part-II)
Colour Coding		Base colours of the pairs in a unit shall be as follows:
		ANSI Type: Nickel/Chromium - Nickel/Aluminium (KX (NICR/NIAI) (Nichr/NiAl))
		Positive / Negative / Overall (Outer Sheath)
		Yellow / Red / Yellow
Marking		Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.
Electrical Properties at 20 Deg.C:		
i. Maximum Conductor loop resistance not greater than		As per ANSI MC96.1 at 20 Deg.C

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ii. Insulation resistance not less than		100 M ohm / Km
iii. Mutual capacitance at 0.8 Khz not greater than		200nF/Km
iv. Cross talk attenuation at 0.8 KHz greater than		60 db

Cable Designation SX - Compensating Cables

Voltage Grade & Type		1.1 kV graded Single / Multipair twisted Compensating cable as per ANSI MC96.1
Conductor type and Size		Nominal 1.0 sq.mm. area concentric lay annealed tinned high conductivity solid conductor
Insulation type and size		HR, extruded PVC Type - C as per IS:5831. The Thickness of Insulation shall be min. 0.3 mm
Lay		Twisted pair with 50 mm max lay
Screening and Shielding		Individual and overall shielding with 0.055 mm (0.075 mm) thick combination aluminium Mylar tape with 100% coverage and min 25% overlap.
Drain Wire		7 strands x 0.3 mm minimum size Annealed tinned copper drain wire, nominal size 0.5 mm, laid under the contact with aluminium side of the tape.
Inner Sheath		FRLS extruded PVC type ST1 confirming to IS: 5831. The thickness shall be min. 0.3mm.
Outer Sheath		FRLS extruded PVC type ST2 confirming to IS: 5831. Thickness shall be min. 1.8 mm.
Armour		Galvanised steel wire/strip to IS: 3975 (BS:5608 Part-II)
Colour Coding		Base colours of the pairs in a unit shall be as follows:
		ANSI Type: SX (Pt 13/10Rh – Pt); E-Cu/CuNiMn
		Positive / Negative / Overall (Outer Sheath)
		Black / Red / Green
Marking		Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.
Electrical Properties at 20 Deg.C:		
i. Maximum Conductor loop resistance not greater than		As per ANSI MC96.1 at 20 Deg.C
ii. Insulation resistance not		100M ohm / Km

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less than		
iii. Mutual capacitance at 0.8 Khz not greater than		200nF/Km
iv. Cross talk attenuation at 0.8 KHz greater than		60 db

Cable Designation: Pair Cables (Individual and over all screening)

Application		For Analog Signals
Voltage Grade & Type		650V grade, single and multiple pair, individual pair instrumentation cable.
Conductor type and Size		Nominal 1.0 sq.mm. area concentric lay annealed tinned high conductivity 7 x 0.43 mm. dia. electrolytic grade copper conductor as per IS: 8130.
Insulation type and size		Extruded HR PVC type – C to IS: 5831 Colour coded. Nominal Insulation thickness shall be 0.3 mm.
Lay		Twisted pair with 50mm max lay
Screening and Shielding		Individual and over all screening Through aluminium mylar tape Min 0.055 mm (0.075 mm) with min 25% overlap.
Drain Wire		7 x 0.3 mm dia stranded tin coated copper drain wire laid under the contact with aluminium side of the tape.
Inner Sheath		FRLS PVC type ST1 confirming to IS: 5831 Thickness shall be min. 0.3mm.
Outer Sheath		FRLS PVC type ST2 confirming to IS: 5831 Thickness shall be min. 1.8mm.
Armouring		Galvanised steel wire/strip to IS: 3975 (BS:5608 Part-II)

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<table>
<tr><td>Colour Coding</td><td></td><td>The wires of pairs shall be coded by base Colours on insulation, which shall repeated in every unit. Base colours of the pairs in a unit shall be as follows:

<table>
<tr><td>Pair</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>wire</td><td>Blue</td><td>Grey</td><td>Green</td><td>White</td></tr>
<tr><td>wire</td><td>Red</td><td>Yellow</td><td>Brown</td><td>Black</td></tr>
</table>

The units shall be coded by colours of rings on the insulation cores as tabulated below in order to distinguish between wires of various units in cables:

<table>
<tr><th>Unit</th><th>Ring Colour</th><th>Ring Group</th></tr>
<tr><td>1.</td><td>PINK</td><td>l</td></tr>
<tr><td>2.</td><td>PINK</td><td>ll</td></tr>
<tr><td>3.</td><td>PINK</td><td>lll</td></tr>
<tr><td>4.</td><td>PINK</td><td>llll</td></tr>
<tr><td>5.</td><td>ORANGE</td><td>lllll</td></tr>
<tr><td>6.</td><td>ORANGE</td><td>llllll</td></tr>
<tr><td>7.</td><td>ORANGE</td><td>lllllll</td></tr>
</table>
</td></tr>
<tr><td>Marking</td><td></td><td>Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.</td></tr>
<tr><td>Electrical Properties at 20 Deg.C:</td><td></td><td></td></tr>
<tr><td>Maximum Conductor resistance not greater than</td><td></td><td>19.5 Ohms/Km for 1.0 sq mm. Conductor</td></tr>
<tr><td>Insulation resistance not less than</td><td></td><td>100 M Ohms / Km</td></tr>
<tr><td>Mutual capacitance at 0.8 Khz not greater than</td><td></td><td>120 nF/Km</td></tr>
<tr><td>Test Voltage: Conductor / conductor and conductor / shield</td><td></td><td>2000 Vrms for 1 minute</td></tr>
<tr><td>Characteristic impedance at 0.8 KHz</td><td></td><td>370 Ohms</td></tr>
<tr><td>Image attenuation at 0.8 KHz</td><td></td><td>0.11 dB/100 m</td></tr>
<tr><td>Image attenuation at 10 KHz</td><td></td><td>0.29 dB/100 m</td></tr>
</table>

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Cross talk attenuation at 0.8 KHz greater than		70 dB/Km
Coupling capacitance at 0.8 Khz not greater than		200 pF/100 m
High Voltage Test		Duration
Conductor to Conductor		2000 Vrms, 50 Hz for 1 min
Conductor to Shield		2000 Vrms, 50 Hz for 1 min

Cable Designation - Core Cables

Application		i. 1.0 sq.mm shall be used for Binary signals i. 1.0 sq.mm shall be used for solenoid valves ii. 2.5 sq.mm shall be used as power cables between UPS ACDB to various loads
Voltage Grade & Type		650V grade, multi-core cable
Conductor type and Size		i. Nominal 1.0 sq.mm. area concentric lay annealed tinned high conductivity 7 x 0.43 mm. Dia electrolytic grade copper conductor as per IS: 8130. ii. Nominal **1.5** sq.mm. area concentric lay annealed tinned high conductivity 7 x 0.53 mm. Dia copper conductor as per IS: 8130. iii. Nominal **2.5** sq.mm. area concentric lay annealed tinned high conductivity 7 x 0.675 mm. Dia copper conductor as per IS: 8130.
Insulation type and size		Extruded HR PVC type C to IS: 5831, Colour coded. Nominal Insulation thickness shall be 0.3 mm.
Screening and Shielding		Over all screening Through aluminium mylar tape Min 0.055 mm (0.075 mm) with min 25% overlap.
Drain Wire		7 strands x 0.3 mm minimum size Annealed tinned copper drain wire, nominal size 0.5 sqmm, laid under the contact with aluminium side of the tape.
Inner Sheath		FRLS PVC type ST1 confirming to IS: 5831 Thickness shall be min. 0.3mm.
Outer Sheath		FRLS PVC type ST2 confirming to IS: 5831

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		Thickness shall be min. 1.8mm.
Armouring		Galvanised steel wire/strip to IS: 3975 (BS:5608 Part-II)
Marking		Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.

Cable Designation Teflon Insulated cable (For High Temperature zone)

Voltage Grade & Type		650V grade, single and multiple pair instrumentation cable.
Conductor type and Size		Nominal 0.5 sq.mm. area concentric lay high conductivity 7 x 0.307 mm. Dia nickel plated copper conductor.
Insulation type and size		High temperature resistant Teflon (PTFE) insulated cables, which shall be suitable for continuous operation not less than 205 Deg.C with Nominal Insulation thickness shall be between 0.28 and 0.35mm.
Lay		Twisted pair with 25 – 40 lay / mt
Screening and Shielding		Sheath of impregnated glass fibre braiding
Sheath		As per VDE 0207 (Part-4), Nominal Insulation thickness shall be between 0.28 and 0.35mm.
Armour Sheath		Outer Protective braiding with Galvanised steel wire
Colour Coding		The wires of pairs shall be coded by base Colours on insulation, which shall repeated in every unit. Base colours of the pairs in a unit shall be as follows:

Pair	1	2	3	4
wire	Blue	Grey	Green	White
wire	Red	Yellow	Brown	Black

The units shall be coded by colours of rings on the insulation cores as tabulated below in order to distinguish between wires of various units in cables:

Unit	Ring Colour	Ring Group

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		1. PINK l 2. PINK ll 3. PINK lll 4. PINK llll 5. ORANGE lllll 6. ORANGE llllll 7. ORANGE lllllll
Marking		Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.
Electrical Properties at 20 Deg.C:		
Test Voltage : Conductor / conductor and conductor / shield		1500 V for 1 minute

Cable Designation: Triad Cables

Voltage Grade & Type		650V grade, single and multiple TRAID, instrumentation cable.
Conductor type and Size		Nominal 1.0 sq.mm. area concentric lay high conductivity 7 x 0.43 mm. dia. electrolytic grade copper conductor.
Insulation type and size		PVC type C to IS: 5831, Colour coded. Nominal Insulation thickness shall be 0.6mm.
Lay		Twisted pair with 25 – 40 lay / mt. Twisted pair with 50mm distance per lay
Screening and Shielding		Individual and over all screening Through aluminium mylar tape Min 0.055 mm (0.075 mm) with min 25% overlap.
Drain Wire		7 x 0.3 mm dia stranded tin coated copper drain wire laid under the contact with aluminium side of the tape.
Inner Sheath		FRLS PVC type ST1 confirming to IS: 5831 Thickness shall be min. 0.3mm.
Outer Sheath		FRLS PVC type ST2 confirming to IS: 5831 Thickness shall be min. 1.8mm.
Armour		Galvanised steel wire/strip to IS: 3975 (BS:5608

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		Part-II)
Marking		Marking of length and pair no of the cable shall be at every meter interval on the outermost sheath of cables.
Electrical Properties at 20 Deg. C:		
Maximum Conductor resistance not greater than		19.5 Ohms/Km
Insulation resistance not less than		100 M Ohms / Km
Mutual capacitance at 0.8 Khz not greater than		100 nF/Km
Test Voltage Conductor / conductor and conductor / shield		2000 Vrms for 1 minute
Characteristic impedance at 0.8 KHz		370 Ohms
Image attenuation at 0.8 KHz		0.11 dB/100 m
Image attenuation at 10 KHz		0.29 dB/100 m
Cross talk attenuation at 0.8 KHz greater than		70 dB/Km
Coupling capacitance at 0.8 Khz not greater than		200 pF/100 m
High Voltage Test		Duration
Conductor to Conductor		2000 Vrms, 50 Hz for 1 min
Conductor to Shield		2000 Vrms, 50 Hz for 1 min

Specification for Co-axial Cables Cable-C

Co-axial cables are used for high frequency equipment and systems for transmission and reception purposes and computers. Co-axial cable should have minimum following characteristics:-

Construction	:	Solid silica coated, annealed copper conductor.
Di-electric	:	Low loss solid polyethylene foam, semi and spaced construction.
Outer conductor	:	Braided or longitudinal tube of copper or Aluminum giving 100% coverage with slight overlap.
Outer sheath	:	FRLS PVC

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Diameter over Di-electric	:	7.24 sq.mm.
Outer diameter	:	10.29 sq.mm.
Nominal impedance	:	75 ohms
Nominal capacitance	:	20.5 pF/ft.
Nominal attenuation	:	8 dB at 1000 MHz Per 100 ft.

Fiber Optic Cable

1.1 This specification describes the minimum general requirements for the design, manufacture, supply, inspection, installation, testing & commissioning of optical fibre cable & accessories.

1.2. Tenderer shall consider all related activities such as cable stripping, Cable entry in boxes & panels, cable fibre splicing/fusion, cable performance testing & other services, to achieve properly documented & operational cable network.

1.3. OFC shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. In all cases cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS-4984, IS-12235 & TEC.G/CDS-08/01 of suitable size @ 53% fill factor**.**

1.4. Fiber Optic cables shall be suitable for installation on cable tray, duct bank, cable trench, racks and direct burial as necessary. Spliced / repaired cables are not acceptable.

1.5. Tenderer to ensure that minimum 100% cores are kept as spares in all types of fiber optic cables.

1.6 Fibre Optic Cables shall be separate for each service, Package, etc. and two (2) or more services shall not be clubbed i.e. F O Cables for DCS signals, Video signals, any other signals of CCTV shall not be through the same cable.

2.0	**Fiber & Core**			
2.1	Fiber	The optical fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80 Deg C continuously		
2.2	Type	Fiber optic cables for outdoor applications shall be single mode fiber type. However, for cable lengths less than or equal to 1km, multimode fiber cable is also acceptable subject to Purchaser's approval.		
2.3	Mode	**Multimode Fiber cable**	**Multimode Fiber cable**	**Single mode Fiber cable**
2.4	Core Diameter	62.5 ± 2	50 ± 2 microns	9 ± 1 microns

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		microns (depending upon distance between source & destination)		
2.5	Cladding Diameter	125 ± 2 microns	125 ± 1 micron	
2.6	Cladding non-circularity	1 % max.		
2.7	Core / cladding concentricity error	3 microns max.	3 microns max.	0.5 microns max.
2.8	Bandwidth @ 850 nm	160 MHz-Km min	500 MHz-Km min	-
2.9	Bandwidth @ 1300 nm	500 MHz-Km min	500 MHz-Km min	-
2.10	Attenuation @ 850 nm	3.0 dB/Km max	3.0 dB/Km max	-
2.11	Attenuation@ 1300 nm	0.8 dB/Km max	0.8 dB/Km max	-
2.12	Attenuation@ 1310 nm	-	-	0.37 dB/Km max (outside plant) 1 dB/Km max (inside plant)
2.13	Attenuation@ 1550 nm	-	-	0.22 dB/Km max (outside plant) 1 dB/Km max (inside plant)
2.14	Numerical Aperture	0.275 ± 0.015	0.200 ± 0.015	
2.15	Number of Fibers per core / tube	4 (minimum)		
2.16	Fibre coloring	Shall conform to EIA/TIA-598		
2.17	Fiber Proof test	As per IEC/EIA & other international standard.		
2.18	Coating Diameter Test	As per IEC/EIA & other international standard.		
2.19	Strength member	Aramid Yarn to reinforce the integrity of data transmission		
2.20	Buffer Tube filling	Thixotropic jelly or better material		
2.21	Core wrapping / Moisture barrier	Water Swellable Tape / Suitable Water Blocking Gel		
2.22	Loose tube	Polyamide/PBTP or other acceptable Thermoplastic material		
3.0	**Cable Construction**			
3.1	Design	Loose Tube design		

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3.2	Type	Dual jacket Armoured with Poly Ethylene sheathing (for outdoor applications)
3.3	Buffer Tubes	Shall be stranded around the central member utilizing reverse oscillating lay (ROL)
3.4	Interstices / cable filling	Thixotropic jelly or better material
3.5	Blank fillers	Shall be used as necessary to maintain circular cable structure. Fillers shall be flame retardant and moisture resistant.
3.6	Inner Sheath	Flame retardant & UV resistant Polyethylene
3.7	Outer Jacket	High density Polyethylene (HDPE) minimum 1.5 mm thick, Flame retardant & UV resistant
3.8	Outer Colour	Orange
3.9	Armour	Co-polymer coated steel tape, corrugated and wrapped around the inner jacket to provide additional compression strength and termite & rodent protection
3.10	Ripcord	Two highly visible ripcords shall be placed under the jacket / armour for easy outer jacket / sheath removal.
3.11	Central Strength member	Shall be provided for outdoor/indoor application so as to prevent any physical damage. Consists of a dielectric Fiber Glass reinforced plastic (GRP) and Buckle resistant material to provide both tensile and anti-buckling strength to the cable
3.12	Spare Cores	Minimum 100%
4.0	**Cable Specifications**	
4.1	Details marked at every meter on outer sheath.	Manufacturer's Name, Month and Year of Manufacturer, Coded description of the cable based on telcodia's (bellcore) SR-2014 suggested optical cable code (SOCC), Sheath identification Number, Sequential Length marking in meter, A telephone Handset symbol to distinguish communication from power cable as per NESC section-35G.
4.2	Life Expectancy	Fiber Optic cable shall provide a long life expectancy of minimum 25 years under continuous operation without degradation to optical or mechanical performance.
4.3	Stripping Ability	All layers easily removed with Commercially available tools
4.4	Storage Temperature	- 20 ^{0} C to 60 ^{0} C

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4.5	Operating Temperature	- 20 ^{0} C to 70 ^{0} C
4.6	Data Speed performance	1 Gbps minimum
4.7	Drum	The cables shall be supplied in non-returnable strong wooden (or alternatively steel) drums provided with lagging of adequate strength, constructed to protect the cable against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field.
5.0	**Installation / Mechanical characteristics:**	
5.1	Minimum bending radius (IEC 60794-1-2-E11A)	20 X D (D=core Diameter) - During Installation, Short Term, loaded 15 X D (D=core Diameter) – Installed, Long Term, No load
5.2	Maximum Tensile Load/Strength (IEC 60794-1-2-E1)	During Installation: 2000 N at 0.25 % strain Installed: 1000N
5.3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
5.4	Pulling	Ordinary cable grips
6.0	**Test Specification (EIA/TIA – STD455 or Equivalent):**	
6.1	Impact Resistance	2000 Impacts minimum
6.2	Crush Resistance	4000 N/10cm minimum
6.3	Compressive Strength	3000 N minimum
6.4	Moisture/Water Resistance	Water blocking layer, Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
7.0	Tests	Following minimum test as per any approved standard shall be carried out on the cables: a. Attenuation and Dispersion characteristics tests b. Proof Tests c. Macro-Bend resistance Test d. Mechanical Test e. Low and High Temperature cable Bend Test f. Impact resistance Test

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		g. Compressive strength Test h. Tensile strength Test i. Cable Twist test j. Cable cyclic flexing test k. Environmental characteristics Test l. Temperature cycling test m. Colour permanence Test n. Cable Aging test o. Water penetration test p. Lightning Test q. Kink Test r. Crush Test
8.0	Standards	Optical cable shall conform to i) IEC 60794/IEC 60793 & EIA/TIA 455. ii) Low smoke (IEC 1034 –light transmittance of 80%) iii) Halogen free (IEC 754: 1&2 - maximum acid gas generation shall be 2% by weight and PH >4.3) iv) Fire & flame retarded (IEC 331, IEEE 383) v) Rodent resistant vi) Crush Resistant (EIA -455-41) vii) Impact Resistant (EIA -455-25) Tenderer shall submit Type test report for review, conform to IEC 60794, IEC 60793, IEEE 383, IEC 754: 1 & 2, IEC 331, IEEE 1034 and EIA/TIA standard. Colour codes shall be as per EIA/TIA 598-A.

Fiber Optic splicer, terminator and tool kit box

Tenderer shall provide 1 no. new unused Fiber optic splicer terminator tool kit with box comprising of splicer and fusion jointer and tool kit shall comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc as required for maintenance and commissioning.

Twisted Pair Cable:

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		Cat - 5e cable	Cat - 6 cable
Conductor			
No of Pairs	:	4 Pairs	4 Pairs
Material	:	Annealed Bare Copper	Annealed Bare Copper
Size	:	24 AWG	23 AWG
Insulation	:		
Thickness	:	0.254 mm	-
Material	:	PO – Polyolefin / FRPE (PVC)	PO – Polyolefin / FRPE (PVC)
Outer Shield	:	Binder Tape	Unshielded
Binder Tape	:		
Thickness	:		
Material	:	Aluminum Foil-Polyester Tape	Aluminum Foil-Polyester Tape
Coverage	:	100%	100%
Drain Wire		Yes	NO
Thickness	:	Stranded (7/32) , 24 AWG	
Material	:	Tinned Copper	
Outer Jacket			
Material	:	Industrial Graded PVC	Industrial Graded PVC
Outer Jacket Nominal wall thickness	:	0.762 mm	0.24 mm
Outer Jacket Ripcord	:	No	Yes
Mechanical Characteristics (Overall)			
Installation Temperature Range:	:	-25 to +75 Deg.C	-25 to +75 Deg.C
Operating Temperature Range:	:	-40 to +75 Deg.C	-40 to +75 Deg.C
Tensile strength	:		
Max. Recommended Pulling Tension	:	177.928 N	200.169 N
Min. Bend Radius/Minor Axis	:	12.700 mm	63.500 mm
Min. Bend/Installation	:		
NEC/(UL) Specification	:	CMR	CMR

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		Cat - 5e cable	Cat - 6 cable
Electrical Characteristics			
Nominal Mutual Capacitance	:	49.215 pF/m	50.8555 pF/m
Nominal Velocity of Propagation (VP)	:	70%	67%
Max. Delay	:	538 ns/100 m	538 ns/100m
Max Delay Skew	:	45 ns/100 m	38 ns/100m
Max. Conductor DC Resistance @ 20deg. C	:	9.38 Ohm/100m	8.2 Ohm/100m
Impedance	:		
Attenuation min. At 100m	:	22 dB at 100 Mhz	18.9 dB at 100 Mhz
Applicable standards	:	EU Directive 2011/65/EU(RoHSII), MII Order # 39 (China RoHS)	EU Directive 2011/65/EU(RoHSII), MII Order # 39 (China RoHS)
Test			
Flame Test	:	UL 1666 Vertical Riser, CSA FT4, IEEE 1202	UL 1666 Vertical Riser, CSA FT4, IEEE 1202
Pair Colour Code			
1st Pair		White / Blue Strip & Blue	White / Blue Strip & Blue
2nd Pair		White / Orange Strip & Orange	White / Orange Strip & Orange
3rd Pair		White / Green Strip & Green	White / Green Strip & Green
4th Pair		White / Brown Strip & Brown	White / Brown Strip & Brown

NOTE: All cables near high temperature zone shall be high temp cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e. Teflon) as per VDE 0207 Part 6 and ASTMD 2116. The thickness of insulation shall be 0.5 mm nominal (i.e. 0.4 mm minimum). These cables shall be single / Multipair twisted & shielded.

[E] TYPE AND ACCEPTANCE TESTS FOR INSTRUMENTATION CABLES

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After completion of manufacture, type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

The Purchaser may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s) manufactured by the Tenderer in India in last 5 years are furnished.

General

During manufacture, the Purchaser's representative(s) shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the tenderer's and his Sub-tenderer's materials and may reject defective materials considered unsuitable for the intended purpose or which do not comply with the intent of the tender specification. The Tenderer, upon any such rejection by the Purchaser or his representative(s), shall replace the defective or unsuitable materials. The tenderer shall provide every reasonable inspection facility to the Purchaser's Inspector(s) or representative at his own and his Sub-Tenderer's works.

The Tenderer shall give two weeks notice (to be reckoned from the date of receipt of the Purchaser) of readiness for inspection of items and /or before final assembly and tests, so that the Purchaser's representative may inspect materials and witness such tests before shipment. The Purchaser's representative may, at any time inspect and request copies of any or all test data of raw materials or finished components, which shall be immediately furnished.

Materials being furnished shall only be shipped when factory inspection satisfactory to the Purchase and/or his representative has been conducted. Such inspection and acceptance for shipment shall not, however relieve the tenderer from entire responsibility for furnishing cables conforming to the requirement of this Specification nor shall it prejudice any claim, right or privilege which the Purchaser may have, because of the use of supply of defective or unsatisfactory materials or cables. Should the Purchaser waive the inspection, such waivel shall not relieve the Tenderer in any way from his entire obligations under the Contract.

The material shall, at the factory, or after installation be demonstrated capable of performing satisfactorily upto the Tenderer's guaranteed performance. All tests required by the tender specification, including re-tests and inspection, that may be necessary owing to the failure to meet any tests specified, shall be made at the Tenderer’s expenses. Additional tests, as necessary, shall be made to locate such failure(s) and after determining the causes of failure(s) and rectifying it, specified tests shall be repeated to establish that the rebuilt material meets the tender

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specification requirements in every respect. Should the material ultimately fail to pass the specified tests, the Purchaser will have the option to reject the material.

I. **TYPE TESTS:**

Cables shall be of type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, shall be submitted. In case the tenderer is not able to submit report of the type test(s) conducted or in the case of type test report(s) are not found to be meeting the specification requirements, the tenderer shall conduct all such tests on one drum out of every 10 drums or less for each size of cable in each lot in the presence of the Purchaser without cost implication and submit the reports for approval.

Sr. No.	**Name of Test**	**Governing standard**	**Special requirements as per Purchaser's specification.**
1.	Annealing test (for copper)	IS : 8130/84	As per IS: 8130/84
2.	Conductor resistance test		As per Specification
3.	Per sulphate test (for tinned copper wire)	IS : 8130/84	As per IS: 8130/84
4.	Test for armours wires / strips	IS : 3975	As per IS:3975
5.	Test for measurement of DC resistance of armour	IS: 1554 (I)	As per Specification
6.	Test for measurement of thickness of insulation & sheath & other dimensions.	IS : 1554 (I)	As per Specification
7.	Measurement of volume resistivity of HRPVC insulation	IS : 5831-1984	i. 3.5×10^{14} Ohm-cm at 27^0C / room temp.(Min). ii. 3.5×10^{11}Ohm-cm at 85^0C (Min.)
8.	Tensile strength and elongation test for insulation & sheath.	IS:5831/1984	As per IS:5831/84
9.	Ageing test for insulation & sheath. Loss of mass test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
10.	Shrinkage test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84

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Sr. No.	Name of Test	Governing standard	Special requirements as per Purchaser's specification.
11.	Hot deformation test for PVC insulation & sheath	IS:5831/1984	As per IS:5831/84
12.	Cold bend test for PVC insulation.	IS:5831/1984	As per IS:5831/84
13.	Cold impact test for PVC sheath.	IS:5831/1984	As per IS:5831/84
14.	Heat shock test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
15.	Thermal stability test for PVC insulation and sheath.	IS:5831/1984	As per IS:5831/84
16.	Test for bleeding and blooming of pigments for PVC insulation of sheath.	IS:5831/1984	As per IS:5831/84
17.	Colour fastness to water.	IS:5831/1984	As per IS:5831/84
18.	Colour fastness to day light.	IS:5831/1984	As per IS:5831/84
19.	Water immersion test	IS:1554(I)	IS:1554(I)
20.	Test for rodent & termite repulsion property of sheath.	-	Presence of lead shall be detected.
21.	Oxygen index test on inner & outer sheath material.	ASTM:D-2863/77	Min.29
22.	Temp. index test on inner & outer sheath material	ASTM:D-2863/77	Min.250°C
23	Acid gas emission test on inner & outer sheath material.	IEC-754-1	Acid gas generation shall be less than 20% by weight.
24	Smoke Density test on inner & outer sheath material	ASTM-D-2843/77	Min. 40% light transmission during test.
25.	Flammability test on finished cable samples as per following methods: i. Swedish chimney test ii Vertical tray flame propagation test. iii. Single vertical cable fire resistance test.	 SS-424-14-75 Cl. F-3 IEEE-383 IEC-332-1	 SS-424-14-75 Cl. F-3 IEEE-383 IEC-332-1
26.	Tests for all electrical properties at 20°C &	As per	As per specification

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Sr. No.	Name of Test	Governing standard	Special requirements as per Purchaser's specification.
	maximum operating temp. as per specification.	specification	

ll **Routine Test:**

Routine test shall be carried in presence of purchaser's representative for all types of cables.

1.	High voltage test	IS:1554 (I)	2 KV (RMS) for one minute
2.	Conductor Resistance Test	IS:8130/84	As per Specification

lll **Acceptance Tests:**

Following tests shall be carried out on 1 drum out of every 10 drums or less for each size of cables in each lot, in presence of purchaser's representative.

1.	High voltage test	IS:1554 (I)	2 KV (RMS) for one minute
2.	Conductor Resistance Test	IS:8130/84	As per Specification
3.	Volume Resistivity	IS:5831-1984	(i) $3.5x10^{14}$-cm at 27 deg C/room temp (Min) (ii) $3.5x10^{11}$ohm-cm at 850C Min.
4.	Measurement of Mutual	-	100 NF/Km (max)
5.	Calculation & Verification of Characteristic impedance on the basis of value obtain for mutual capacitance at 0.8 KHZ with the help of following formula $Z = \frac{R}{2fc}$ where Z = characteristic impedance in ohm R = Loop resistance of cable		320 Ohms(nominal)

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	per km in ohms at 20 ^{0}C F = Frequency of test in Hz (800) C = mutual capacitance per km.		
6.	Measurement of thickness of insulation and sheath & other dimensions	IS:1554 (I)	As per NIT
7.	Tensile strength and elongation at break of insulation & sheath	IS:5831/84	IS:5831/84
8.	Oxygen index test on inner & outer sheath at room temp.	ASTM-D-2863	Min.29
*9.	Temp. index test on inner & outer sheath	ASTM-D-2863	Min.250^{0}C
*10.	Acid gas emission test on inner sheath & outer sheath.	TEC-754-1	Max.20% by weight
11.	Smoke density test on inner sheath & outer sheath	ASTM-D-2843	Min.40% light transmission during test.
12.	Flammability test	SS-424-14-75 Class F-3	SS-424-14-75 Class F-3

* (If no. of drums selected for acceptance test for a particular cable size are more than one, the tests marked with * i.e. 5 no. 9&10 under acceptance tests shall be carried out on one drum only).

IV SHOP TESTS

i) General Requirements:-

a) The equipment as per this section shall be subject to shop tests.

b) The Conductor shall furnish all materials, equipment, tools, instruments, bulkheads, blanking plates and all personnel required for completing these tests.

c) Personnel performing the tests shall be qualified and experienced. Tests shall be performed as many times as necessary to assure Proper quality of materials and workmanship. If any test reveals Unsatisfactory materials or workmanship, such materials shall be Repaired or replaced to the satisfaction of the Purchaser.

V QUALITY ASSURANCE CHECKS FOR INSTRUMENTATION CABLE

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Instrumentation Cables are to be tested for final test Routine and Acceptance test at shop prior to dispatch.

The final Routine test to be carried out on completed cable in line with VDE-207 shall be as follows:

i. High voltage test
ii. Conductor Resistance measurement for core and drain wire
iii. Insulation Resistance

The final Acceptance test in line with applicable standard to be carried out on cable samples taken from end with sampling plan as specified in the standard or agreed under contract shall be as follows:

i. Overall dimension, conductor size, number of stands, lay length, direction of lay, thickness of insulation, core identification, shielding coverage/ overlap, inner sheath and outer sheath thickness.
ii. In case of armoring the no of armor wire/ strip, size and coverage to be measured. Armor wire sample to be checked for tensile, Elongation, wrapping/ torsion and adhesion test. Samples to be also checked for mass of zinc coating.
iii. Conductor Resistance measurement
iv. Annealing test (for reference)
v. Insulation resistance (volume resistivity)
vi. Characteristic impedance, Attenuation, Mutual Capacitance, Cross talk

Only one sample of any size from the offered lot of insulation and Sheath to tested for:

i. Thermal stability test.
ii. Oxygen index on Outer sheath as per ASTM-D-2863
iii. Smoke density on outer sheath as per ASTM D-2843
iv. Acid gas generation test on outer sheath as per IEC-754
v. Fire resistance test as per SS 4241475
vi. One length of cable to checked for length measurement and while measurement of length visual defects if any, sequential marking, embossing are to be checked.
vii. Tensile and elongation test
viii. Volume resistivity test

One sample of any size from the complete order may be selected for:

i. Tensile and elongation of PVC insulation and outer sheath after ageing

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ii. Flammability test as per IEC 332

The cable drums are to be provided in good conditions with proper identification suitable for transportation and storage / handling till lying of cable. In case of wooden drums necessary ant termite treatment to be provided. The cables are to be sealed at both ends prior to dispatch.

The manufacturing of Cables are to be carried out as per Quality program of manufacturer which shall atleast meet the following incoming and process checks:

Conductor material, resistivity, dimension, joints and lay length shall conform to requirements of International standard or IS-8130. The annealing process shall be controlled to meet the required strength and finish.

Insulation, inner and outer sheath material properties including FRLS for inner & outer sheath shall meet the requirement of International standard specified/ as per IS-5831 and standards for FRLS specified in this specification.

Insulated core shall be checked for finish, color and to be tested for spark test preferably using on line testers with counter/ identification system. The insulation thickness to be controlled to give the required thickness and concentricity when measured under profile projector.

Shielding shall be checked for thickness, width and overlap.

Armor wire/ strip samples to be checked for size, tensile, elongation, wrapping/torsion and galvanization check as per applicable International standard / IS-3975. The coverage of armor and absence of overlap to be checked during armoring process.

The extruders used shall have temperature controllers to give smooth finish and free from defects.

The outer sheathing color, finish, diameter needs to be controlled. The sequential marking shall be legible and be indented for longer retention.

Checks on wooden shall be as per requirement of International standard / as per IS- 10419.

I.12 Rotameter

Rotameter shall be provided with following features:

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Type	:	Variable area linear scale
Fluid media	:	Water / oil
Accuracy	:	± 2 %
Material body	:	Transparent toughened glass
Indicator	:	Magnetic flow
Indicator scale	:	Flow units or percent
Accessories	:	Flange, orifice in case of bypass rotameter (for line size above 50 mm)
Material of float	:	SS 316
Housing protection class	:	IP 55 / IP 65 as per requirement
Adjustment of indicator	:	Yes

Rotameter shall be used for low flow & low viscosity applications of liquid/gas.

Limit switch along with the rotameter shall be provided if required and limit switch shall be of following specifications:

Type	:	Reed - contact with bi-stable switching
Max. switching voltage	:	230 V
Max. switching current	:	0.6 A
Max. switching capacity	:	12 VA
Temperature range	:	- 10^0C to + 70^0C
Protection	:	IP 65

Rotameters shall be as per ISA – RP 16.1,2,3,4,5 and shall be used for viscous or corrosive services or where rangeability in flow precludes the use of an orifice.

Glass tube rotameters shall be used for low-pressure utility services for local indication and where line size is 1 ½ “ (40 mm) or less.

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Glass tube shall not be used if outlet line is connected to a line or vessel containing hazardous or toxic fluid unless a check valve is installed at the downstream side of rotameter.

Metal tube rotameter shall be used for all process fluids. External devices for indicating or transmitting shall be magnetically coupled to the float or extension.

Rotameters shall be installed vertically with block and bypass valves.

Rotameter end connections shall be as per piping specifications.

A straight length of 5 diameters upstream of rotameter is desirable.

Type/Construction		a) On-line type Rotameter for 50 NB and below lines
		b) Bypass type Rotameter for above 50 NB lines.
Material		
- For On-line type		
Metering Tube		Borosilicate glass
Float		316 SS
Packing		Teflon
End fittings		304 SS
-For Bypass type		
Metering Tube		Borosilicate glass
Float		316 SS
Packing		*Teflon*
End Fittings		304 SS
Orifice Plate		316 SS
Carrier ring		304 SS
Flanges & Mating flanges		Same as pipe material, 200 lbs ANSI - RF
Impulse pipe		Same as pipe material
Fittings		2000 ANSI, SW ends to match with pipe material.
Dial Size/Scale length		250 mm
Scale Details		Direct reading type engraved on detachable Aluminum scale
Accuracy		± Two (2) percent
Reproducibility		Half (1/2) percent
Connection		SCRD NPT
Accessories		a) Isolating valves (for Bypass type

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		only)
		b) Bolts, Nuts and Gaskets as required
Tests		Shall be tested at two hundred (200) percent of the maximum process pressure

I.13 SIGHT FLOW GLASS INDICATORS

Type/Construction		Flapper type.
Materials		
Body		Carbon steel/SS316 as per process requirement
Glass		Toughened Borosilicate
Gaskets		Neoprene
Bolts & nuts		SS
Flappers / Rotating Wheel		316 SS
Flappers / Rotating Wheel holder		304 SS
Process Connection		SW (Socket Welded)
Accessories		Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests		Tested at two hundred (200) percent of the maximum process pressure.

I.14 Ultrasonic Flowmeters

Ultrasonic Flow Meters shall be used on pipe of larger dia. Ultrasonic type flow sensing system consists of the sensors and the transmitter. The system shall be capable of continuously measuring and displaying the flow of the water in the pipe line.

The sensor shall be insertion type. The sensor shall include the source and receiver. The source and receiver shall be arranged diagonally with single traverses, for better signal quality. Sensor material shall be SS. The measuring arrangement shall ensure to provide stable, linear and accurate measured value. However it is preferred to have dual path measurement with 2 sensor pairs. Full flow in the pipe shall be always ensure for correct measurement.

Transmitters shall be of the SMART type with HART Protocol. The output of the transmitter shall be 4-20mA DC, isolated. Transmitter shall be of remote type with LCD display. The transmitter shall be mounted at convenient remote location. Required cable between sensor and transmitter shall be provided. The cable entry to the transmitter shall be ½”NPT. The power supply to the transmitter shall be 24V DC and the transmitter shall power the sensor. The transmitter shall be of die-cast aluminum.

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The accuracy of the system shall be ±0.1% of FSD. System accuracy shall not be affected by changes in process medium concentration, density, or particle size distribution. The system shall be suited for outdoor installation and shall have IP65 or better enclosure.

The system shall provide at least, but not be limited to, the following features:

* Frequency optimization to suit the application.
* Non-volatile memory.
* Attenuate noise
* Output linearization to create output signal proportioned to flow.

The calibration range shall be easily changed without removal of the flow meter from the process. Straight length requirement shall be as specified by manufacturer.

Flow meters shall be completely factory tested and burnt-in. Tests shall be performed to verify that the mechanical and electrical characteristics of the equipment provided meet the stated specifications, codes, and standards.

Installation shall be as per the manufacture's recommendation. Full flow in the pipe shall be always ensured, for correct measurement. The flow meter shall be installed well clear of fitting such as valves, t-pieces, elbows, etc. Required pipe length at the up-stream and down-stream of the flow meter shall be maintained. Measurement in the following locations shall be avoided:

* Highest point of a pipeline due to risk of air accumulating.
* Directly upstream from a free pipe, outlet in a down pipe.
* Directly on the down pipe.
* Intake of the pump

Type	:	ULTRA SONIC, 2-wire
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65
Transmitter		
Mounting	:	Integral
Mounting position	:	Top mounted
Housing	:	Cast aluminum
Display	:	Head mounted LCD Display and remote

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		display
Accessories	:	As per process requirement
Process connection	:	NPT/Flanged
Electrical connection	:	1/4” NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required

I.15 VORTEX FLOW METER

Sensor		
Type	:	Vortex
Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.2% or better.
Ambient temperature	:	50 Deg.C
Mounting	:	On-Line mounting with flanges of stainless steel.
Accessories	:	Nuts, bolts, gaskets etc.
Transmitter		
Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz.
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC, 2 wire, HART Protocol Based
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-66

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Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration.
Application	:	Instrument Air, Service Air flow measurements

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I.16 CORIOLIS PRINCIPLE BASED MASS FLOW METER

Sensor		
Primary Element	:	Flow Tube of 316SS or better
Heating Arrangement	:	Integral with Flow meter.
Temperature Control	:	To be provided.
For Heating		
Process Connection	:	ANSI RF Flanged and rating as per process requirement.
Drain	:	Self-draining facility
Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
Transmitter		
Measured quantities	:	Mass flow rate, Total Mass Flow, Density, Temperature as minimum.
Input Signal Processing	:	Digital Processing.
Display	:	Digital Display (LCD).
Output	:	2 Nos. isolated output of 4-20mA DC selectable from four measured quantities.
Load	:	< 750 ohms.
Power supply	:	240V AC, 50 Hz. From UPS
Accuracy	:	0.15% of measured value for liquid 0.5% of measured value for Gas
Repeatability	:	0.5%
Housing	:	IP 65 (Explosion proof for NEC Class-1, Division 1 area)
Hazardous duty Version	:	FM Standards.
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) As required for field mounting, Handheld configurator & complete Software, External zero adjustment facility b) Mounting U-bolts, nuts, bolts, prefab cable etc.
Application	:	HFO/LDO lines.

I.17 JUNCTION BOXES (Out door/Semi outdoor application)

Type		Ex Flame proof/weather proof
Enclosure		IP--65/Explosion/Flame Proof as per area classification. (Single door) Specifically designed Z bending type to drain water, such that moisture

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		does not collect against the seal -Prevents the ingress of dust and dirt when the door is Opened -Additional protection for the high-quality PU foam seal arrangement
Material		SS 304, 1.5 mm thick with foamed-in seal for outdoor and semi-outdoor applications
Rear panel , roof plate & bottom plate		1.5mm SS sheet with foamed –in seal
Mounting plate		To be provided
Gland Plate		1.5mm flush type gland plate
Cable entry		Bottom or Side
Cable glands		Double compression type – Nickel plated brass with PVC hoods.
Mounting		Indoor/Outdoor
No. of terminals		As required with standardization with 20% spare of each size & type.
Terminals		Phoenix/Wago/Weidmuller (screw less cage clamp type spring loaded)
Grounding		Two terminals for body and shield ground
Door		Hinged, lockable type (IP type lock) with common key

JUNCTION BOXES (Indoor application)

Type		Flame proof/weather proof
Enclosure		IP--65/Explosion/Flame Proof as per area classification.
Material		**FRP/ Polycarbonate min 2mm thickness**
Mounting plate		To be provided
Cable entry		Bottom or Side
Cable glands		Double compression type – Nickel plated brass with PVC hoods.
Mounting		Indoor
No. of terminals		As required with standardization with 20% spare

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		of each size & type.
Terminals		Phoenix/Wago/Weidmuller (screw less cage clamp type spring loaded)
Grounding		Two terminals for body and shield ground
Door		Hinged, lockable type (IP type lock) with common key

Suitable mounting clamps and other accessories shall be in scope of tenderer.

The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in tenderer scope of supply. High voltage & insulation resistance test shall also be conducted.

M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)

Gasket (Normal) - Neoprene thickness 6. Mm

06.07 Programmable Logic Control System (PLC)

06.07.01 Introduction

This clause defines the technical requirement relevant to the **Programmable Logic Control System (PLC)** for the Natural Gas Compressors and their auxiliaries.

Tenderer shall be responsible for engineering, selection and connection of all components and sub-system to form a complete system whose performance is in accordance with functional, hardware, software and other requirements of the specification. The successful tenderer's activities in compliance with the present specification shall include design, analysis, issue of drawings / documents, manufacturing, inspection and testing, packing, shipping, storage and commissioning as well as furnishing of instruction and maintenance manuals.

The main purpose of the PLC shall allow the plant to be automatically managed in all the foreseen operative conditions, while guaranteeing the reliability, availability, and maintainability requirements relative to the entire plant.

Omission in the present specification do not make supplier exempt from supplying a complete and operative system, in compliance with the highest quality standards.

The system shall be positioned in air-conditioned environment. If the air conditioning system breaks down, the PLC shall be able to operate, without any problems caused to the functions, with an outside temperature between 20 to 48 deg C and a non-condensing humidity between 40% and 90%.

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06.07.02 System Requirement

The PLC shall include following main systems / sub-system (please also refer PLC system configuration diagram **DRG.NO: MEC/05/28/23UU/NGCS/TD/023, Sheet 1 of 1, Rev. 0.** The PLC shall work in full integration and conjunction with field equipment / drives like pumps, motors, valves, actuators, dampers, hydraulic control system and field instruments to be provided by the Tenderer. The PLC hardware (controller, modules / cards etc) shall be housed in cabinets located in control equipment room (CER) except for operation interfaces located in Centralized Control Room (CCR) for the Natural Gas Compressor Station.

The PLC based control system must unify the processes of one platform. This shall include but not limited to auxiliaries, Machine monitoring, Plant Electrics, Data acquisition and Historian, Sequence of event recording, Performance calculation, Man machine interface and data transfer to the other Control System and Plant Wide Network for MIS integration.

The proposed PLC shall be able to control and monitor all electrical system / equipment with auto plant start-up, auto synchronization and shutdown with controller loading $\leq$ 60%.

Control System

The control system along with its measurement system shall perform functions of closed loop control, sequence control, interlock & protection of Compressors and auxiliaries in all regimes of unit operation. The control system shall consist of the following basic system:

i. Natural Gas Compressor Control & Protection System
Ii. Open Loop Control System (OLCS)
i. Closed Loop Control System (CLCS)

The measurement and control system shall perform the functions of signal acquisition, conditioning and signal distribution of various types of inputs / outputs like analog (4-20 mA DC, thermocouple, RTD), binary, pulse etc. Separate & dedicated measurement system shall be provided for each of the system indicated above.

Human Machine Interface System (HMI)

The HMI System shall perform control, monitoring and operation of TB and auxiliaries in all regimes of unit operation, interacting with the control system. For this, HMI system shall primarily perform following functions.

i. Operator interface for control system.

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ii. Plant supervisory functions like displays, alarm monitoring & reporting (reports & logs, calculations, trend recording, historical and long term data storage & retrieval, etc.).

System Programming & Documentation Facility

The engineering / programmer stations shall be provided for

i. On-line configuration and tuning of control system
ii. On-line program development / modification in HMI system.

In addition, latest state-of-the-art workstation based system documentation facility shall be provided to retrieve, generate & document all system documentation for the complete plant.

Communication System

The data communication system shall be provided for communication between control system and HMI system as well as communication & signal exchange with each system / sub-system of PLC.

Integral Sequence of Event Recording

The sequence of event monitoring device shall be provided to guarantee the chronological recording of the events relative to the plant. The time resolution for this function must be 1 mille second or better. The Sequence of Event Recording System shall provided the operators with a time-tagged log of all conditions which can directly trip Compressors and its auxiliaries as well as other conditions which require better time resolution than the standard alarm printer offers.

System Diagnostic Station

Proper system diagnostic facility shall be provided for automatic display and recording of any system disturbances and enhancing the system availability. All types of faults and disturbances in all modules used in the system shall be automatically displayed and printed.

Interfacing with PLC Station & Corporate Network

Necessary interface shall be provided to transfer information from the Control System of compressors to the Gas compressor PLC & Corporate network in an efficient manner. Each interface shall be redundant.

Synchronization System (Master Clock)

The PLC shall be equipped with a master clock system for the synchronization of modules through a satellite signal (GPS). The system shall also foresee an

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adequate number of interfaces for the connection and synchronization of the other plant control system and sub-system.

06.07.03 PLC System Hardware

System Panel Hardware configuration Design

i) Separate Interposing Relay Cabinet with relays of 24V coil and contacts (2NO+2NC) with LED indication.

ii) Power supply for SOV shall be 24V DC or 230V AC as per application and shall be finalized during detailed engineering.

iii) All DO output signal shall be pulsed type from PLC end and at MCC end holding contact will be considered i.e no laching signal shall be considered at PLC end for all drives.

iv) For LT, HT, MOV drive min. Two nos. DO signals shall be considered i.e for i) start and ii) stop for detail drive DI signal refer the drawing and Drive philosophy in Electrical volume-IV.

v) For SOV, 1 number DO signal output shall be considered (i.e latching contact). All DO signal shall be terminated through fuse TB.

vi) Marshaling or Field wire shall be terminated through Field Termination Units (FTU) for DI, DO, AI and AO shall be supplied separately. Alternatively, if it is the standard practice of the DCS vendor to provide FTUs in the PLC cabinet, the same shall be finalized during detail engineering.

vii) Mounting of cards on sides of PLC cabinet shall not be accepted.

viii) From base plate minimum 200-250 mm gap shall be provided in PLC cabinets.

ix) 24V DC, 230V AC UPS and 230V AC non UPS supply shall be provided separately in Panel.

x) A dedicated Panel (DB) for Power supply distribution shall be provided with proper rating of MCB and shall be finalized during detailed engineering stage.

xi) Dedicated Network panel shall be provided for switches and networking and network switches.

xii) For critical I/O consideration all Inputs shall not be located in same card and shall be distributed in other cards.

xiii) No field wire shall be directly terminated to the I/O card (Like DI, DO, AI, AO) without isolators/barriers/FTU (Field terminal units)

xiv) All panels shall be opened with double door (for panel width > 600 mm) from front and rear sides.

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xv) All Panel dimensions, colour shall be uniform throughout the Control Equipment Room (Preferably size 2000mm x 1200mm x 800mm with 100mm black Base channel and 15mm anti vibration pad. Front & Rear colour RAL 9002 (Grey white), End Panel side RAL5012 (Light Blue) internal colour shall be brilliant white.

xvi) Panel thickness shall be Side & Top minimum 1.5 mm, front and rear door thickness shall be 2mm, bottom 1.5 and gland plate removable type thickness 3mm.

xvii) Multiple window facilities/face plate shall be provided in all the operating stations.

xviii) Separate modules shall be provided for RTD and Thermocouple.

xix) Software details shall be submitted along with Part no. and with latest version etc.

xx) Integral SOE in PLC (min.32 points) with 1msec time stamping at card level shall be provided.

xxi) SOE/Report/Long Term data archival package/self documentation/test function/standard builder function/Alarms shall be provided for all operating station as well as Engineering Station.

xxii) Online Auto/manual tuning of PID controller with plant performance monitoring package shall also be facilitated.

xxiii) SOE can be viewed from all the workstations and shall be time synchronized over GPS master Clock.

xxiv) Logic chart, control loop display / Trending / Graphics / electronic documentation History / Alarms software shall be provided for all operating stations as well as ES cum operating stations.

xxv) History for 4 months shall be available in all OS as well as ES.

xxvi) Desks / Boards / Panels / Cabinets / enclosures wiring and piping shall be arranged to enable the removal of instruments/devices without unduly disturbing them.

xxvii) All panels/desk/enclosures interiors shall be illuminated with 2nos. front and 2nos. rear with LED Lamp fixtures with door-actuated switches. Door switch terminals shall be shrouded. All illuminated lights shall be provided with individual switch with door interlock switch.

xxviii) Sufficient number of power receptacles with disconnect switches shall be installed within panels/desk/enclosure & racks.

06.07.03.01 Controller Subsystem

The control function of the system shall be executed by the latest, industrially proven controllers (minimum 32 bit microprocessor based controller) consisting of power supply modules, processor modules,

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communication modules and I/O modules and a set of algorithms which are easily field configurable using user-friendly software.

Controller shall be provided with redundant power supply, processor and communication modules.

Controller processor memory shall be non-volatile. However in case volatile memory is provided, battery back up shall be provided with a minimum of 48 hours to keep program storage intact. A battery drain indication shall be provided when the charge in the battery dips below 50%.

The hardware capability of the controller shall be exploited for regulatory control, sequencing and interlocking functions.

Controllers shall be capable of accepting process signals from various process sensors, switches and electrical transducers preferably without requiring external or auxiliary signal conditioning devices. The system inputs shall include 4-20 ma dc, thermocouple, resistance temperature detector and discrete inputs as minimum. The controller shall be capable of processing linear and non-linear analog inputs, providing square root extraction for flow signals, linearization and compensation for thermocouple. The controller shall be able to generate 4-20 mA dc current signals for analog outputs and potential free contacts for the discrete outputs as minimum.

Controller operating system shall be Real Time Operating System.

Loop integrity shall be maintained in controller sub-system architecture by providing one-to-one controller back up. In case failure is detected in the active controller, all the loops of the failed controller shall be transferred to the back-up controller. The controller sub-system shall have automatic control transfer switching, which shall transfer the entire configuration and data base of failed controller to the back-up controller. The transfer should be bump less. Design must ensure that data integrity is maintained during switch over and no portion of data to be transferred is corrupted before and during switch over to the back – up controller. The same shall be done during normal operation. The indication of the failed controller shall be displayed at local level as well as on the central level.

Loop integrity shall also be applicable to I/O modules, power supply modulus and any other device associated with the controller sub-system.

The controller shall be able to operate either in manual or auto and cascade mode. In cascade loops, the primary controller shall be able track the steeping of the secondary controller when not operating in cascade mode. All controllers shall have facility for slow and fast ramping of steeping output.

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06.07.03.02 Data Acquisition sub-system

Data acquisition subsystem shall interface and multiplex analog and discrete inputs from open loops. The inputs shall include 4-20 mA dc, thermocouple, resistance temperature detector and discrete contacts. The system shall be capable of processing linear and non-linear analog inputs, linearization and compensation for thermocouple, linearization of RTD inputs and square root extraction for flow inputs. Depending on applications following functions may be provided in the analog or binary input modules.

a. Power supply to transmitters
b. Signal validation error checking and limit monitoring for unacceptable levels.
c. Filtering of signals.
d. Time tagging
e. Cold junction compensation and linearization of T/C input.
f. Limit value monitoring to provide output for controls, alarms etc.
g. One out of two, two out of three selection.
h. Computation e.g. function generation, square root extraction, compensation for mass, flow, density, etc.
i. Signal distribution

06.07.03.03 I/O Module Subsystem

All DIs / DOs shall be wired to the I/O cards with external interfacing relays.

All I / O modules shall be Hot Swappable type.

Each analog input / output channel shall be isolated from external control circuit by optical / galvanic isolation.

Each digital input / output shall be galvanically / optically isolated from external control circuit. The minimum isolation level between I/O and logic circuit shall be as per OEM standards-volt dc.

Each I/O shall be protected from short circuit and reverse polarity of power voltage. Each I/O channel have an indication to indicate the status. Each input shall be provided with filters to filter out any noise in the input line and contact bouncing noise.

All digital inputs shall be provided with dry contacts. All the digital inputs shall be double ended i.e. two wires per input and not with common return for all inputs. The interrogation voltage to the digital input contacts shall be powered from separate power supply. Interrogation voltage shall be 24V dc. The digital

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output from the system shall be potential free dry contact with rating 240V AC & 5.0 Amps. Each output shall be short circuit proof and protected by fuse. Visual indication of fuse blow must be provided for each module. All digital input / digital output channel shall have a facility to force the input or output.

10 % I/O channels of actual used shall be provided as spare. The spare channels shall be distributed equally through out all the I/O modules ,10% I/O channels of actual used shall be provided as a spare card a part from equally distributed and shall be wired up to the terminal blocks.

- *10% spare installed I/O modules*
- *.20 % spare module space shall be provided in all the panels.*
- *30% spare TBs space for wiring in future*

06.07.03.04 PLC Redundancies

- Controllers (CPU)
- Communication card,
- networks switches,
- N/w cables
- 24V power packs
- Critical I/O modules

The redundant communication buses between the process stations and the operator stations shall follow different parts.

The redundant processor shall be connected to the same I/O of the processor that it is associated to and shall be able to carry out all the operations assigned to this processor. In case of a processor failure the redundant processor shall become operative within the cycle time, without causing any loss of data or the interruption of the process control. The switch between the processor being utilized and the reserve processor shall be bump less and shall not cause any interruptions / stopping of the station functions. Further more, this switching shall be signaled by a high priority alarm.

The operator station electronic units shall be in dual configuration and independently connected to the system buses. In case of an operator station failure, the other station shall remain operative without the operator having to carry out any type of action. Each operator electronic unit and each process station shall be powered by redundant power packs that are able to power the entire load. In case of a failure, the switch between the power packs shall not cause stops or interruptions in carrying out of the station functions. The switching between the power packs shall be signaled by a high priority alarm.

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06.07.04 System Description

i. **Open Loop Control System (OLCS)**

The system shall have following features as a minimum.

a. The OLCS system shall include sequence control, interlock & protection for various plant auxiliaries / valves / dampers / drives etc. the sequence control shall provide automatic start-up and shut down of plant and of plant items associated with a plant group. The interlock and protection system shall ensure safe operation of plant / plant items at all times and shall automatically shut down plant / plant items when unsafe conditions arise. The sequence control system shall ensure safety oriented sequential start-up and shut down of plant auxiliaries / equipment.

b. The OLCS shall be arranged in the hierarchical control structure consisting of unit level, subgroup level & drive level. It shall be possible to perform automatic unit start-up & shut down by issuing a single command from the OWS. Thus, the unit level shall control all the control system blocks and issue appropriate start-up & shut down commands to various blocks of control system. The group level shall control a set of functional subgroups of drives. Appropriate startup and shut down commands shall be received from subgroups of drives. Each subgroup shall execute the sequential startup and shut down programmes of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that subgroup. The drive level shall accept commands from the subgroups, pushbuttons (wherever provided) etc, and transmit them to the respective drive, after taking into account interlocks and protections and the safety of that particular drive.

c. Sequence Control

- Unit, group and subgroup shall be set up by means of sequence progressing. A sequence shall be used to move a set of groups, subgroups from an initial steady state to a final steady state. The sequence initiating command for the unit & group level shall be sequence from TFT / keyboard.

- A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria. For each step there shall be a provision for ‘waiting time’ and “monitoring time”.

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- Desired number of criteria shall act as preconditions before the sequence control can take off to execute its defined programme. The programme shall comprise of different number of steps and for each step there shall be desired numbers of criteria required to be fulfilled. “Waiting time” implies that the subsequent step would not be executed unless the specified time elapses. If no value is specified as waiting time, the next step gets services as soon as check criteria are fulfilled for the previous step.

- The time required in executing the commands of any step and the time required for appearance of check back signals of the steps is indicating as “monitoring time”.

- Under normal condition of the equipment each step shall be completed within the specified time, otherwise a message shall be displayed on TFT indicating that specified monitoring time is getting exceeded and programme is not proceeding further.

- All the necessary interlocking and protection requirements of the process and equipment involved shall act as starting / stopping criteria in all modes of operations. All inputs required for protection system shall be on high priority basis.

- Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the programme on return to automatic control.

- Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands. Open or close priority shall be selectable for each drive.

ii. Close Loop Control System

The CLCS shall continuously act on valves; dampers or other mechanical drives such as hydraulic coupling etc., which alter the plant operation conditions. The system shall have the following minimum features.

a. The controller capability shall as a minimum, include

A. P, PI, PD and PID control function and their variations.
B. Cascade control
C. Feed forward control
D. On-off control

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E. Ratio and bias control
F. Logical operation etc.

b. The loop reaction / response time (from change of output of the sensor of the transmitter / temperature element to the corresponding control command output) shall be 100 to 250 ms for OLCS and 50 ms for CLCS. However, for faster loops the same shall be based on actual process requirement. For very fast acting loops like Compressor Governing Control etc., loop time shall be designed to match the fast actuation time of hydraulic control system.

c. The control system shall be bumplessly transferred to manual on the following conditions as a minimum

A. Control power as a minimum.
B. Failure of redundant controllers.
C. Field input signal not a available
D. Analog input exceeding preset limit

d. Any switch over from auto to manual, manual to auto and vice versa shall be bump less and without resulting in any change in the plant regulations and the same shall be reported to the operator.

e. Where the equipment are controlled by a group of regulators acting in parallel, the relative position of individual actuator associated with them shall be capable of being adjusted with respect to one another and to the common automatic signal.

f. The drift in the output command to the actuator (both in manual and auto modes) shall be within permissible limits to meet the close loop performance requirements.

g. Time supervision facility shall be provided to monitor the final control element.

h. It shall be possible to block the controller output on a pre-programmed basis or on operator demand.

i. All controllers shall be freely configurable with respect to requisite control algorithms and controllers with Real Time Operating System shall be provided.

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j. Controllers on PLC bus shall be able to communicate peer to peer within the update of 100 ms.

k. Whenever alternate measurement is available for a control input the alternate measurement value shall be automatically substituted in the control loop in case of loss of control input. All necessary software for switching and reconfiguration shall be provided. In addition, such substitution shall be balance less and bump less and shall be reported to the operator.

iii DRIVE CONTROL PHILOLOSOPHY

The philosophy for controlling drives from PLC

Bidirectional Drives

(a) The bidirectional drives shall be operated from the Control Room. The Local/Remote selection will be accomplished in the PLC .In local mode, the drive can be operated from the Local Push Button Station. The local mode is envisaged only for trial run of the equipment. Operation in the local mode is not envisaged during normal running of the plant.

In Remote mode, the drive can only be operated from the Control console. Drive can however, be stopped from local (through emergency stop push button) Irrespective of the position of selector switch.

(b) Local Push Button Station shall consist of open, stop and close push buttons. The stop push button will be provided with a lock. Under locked position, the drive operation is inhibit from both local and remote control stations.

(c) The LPBS/MCC commands shall be wired to the MCC to facilitate initial commissioning and trial run of drives . MCC can be tested only in test position locally from the MCC. No remote testing is envisaged in interlocked mode.

(d) Remote control commands i.e. Open/Close/Stop shall be generated from PLC and shall be wired to MCC through interposing relays.

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(e) Remote command are generated from TFT monitor function keyboard using Video process control function or from automatic operation of the drive on Interlock conditions that are realized in PLC. Intermediate Stop PB shall be available in Process Control Function block in TFT for "ON/OFF" duty bidirectional drive.

(f) Necessary electrical protections and valve position limit switch/torque switch interlock shall be realized in MCC for local operation. For remote operation, process interlocks shall be realized in PLC.
However, Limit Switches and Position Transmitters shall also be connected to PLC for status feedback. Thus drive can be operated from remote provided all process and electrical interlocks conditions are fulfilled. The operation from LPBS is envisaged to facilitate trial run commissioning only, Hence, process permissive are not provided at MCC during trial mode of operation for bidirectional drives.

(g) While for ON-OFF duty Bidirectional Drives, 'Open', 'Close' positions will be decided by Limit Switches and for inching duty drives additionally a Position transmitter contact less or (LVDT , 2 Wire type) shall be provided with each drive for position feedback Information throughout the travel.

(h) Following potential free signal exchange shall take place between MCC & PLC.

- Valve Open and Close Command (2 DO)
- MCC Disturbance (Thermal overload/local/MCC not in service /switch fuse off)
- MCC selected for local operation (S/S in Trial).
- MCC Run/ON feedback

(i) Following potential free signal exchange shall take place from valve actuator to PLC.

- Limit switch open
- Limit switch Close
- Torque switch open
- Torque Switch close
- Valve Position

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- Process Interlock signal (if any)
- Electrical signal from MCC

Lock Under locked position, the drive start operation is inhibited from both local and remote control stations. Drive can however be stopped from local irrespective of the position of Selector Switch.

(j) The LPBS/SWGR commands shall be wired directly to the SWGR to facilitate initial commissioning and trial run of drives. Safety start permissive signal & protection trip (wherever applicable) will be made available from PLC to SWGR. SWGR can be tested in test position locally from the SWGR.

(k) Remote control commands i.e. Start and Stop shall be generated from PLC and shall be wired to MCC/ SWGR

(l) Remote control commands are generated from TFT function keyboard using Video process control function or from automatic operation of the drive on interlock conditions that are realized in PLC. Drive "Electrical fault " display will also be available in Process. Control Function in TFT in addition to "Start-Stop" buttons and indication.

(m) Necessary electrical protections shall be realized in MCC/ SWGR whereas process interlocks and protections are realized in PLC. Thus drive can be operated from remote provided all process and electrical interlock conditions are fulfilled. To check drive operation from LPBS, protection trips, safety permissive (wherever required) shall be wired directly to SWGR.

(o) Following potential free signal exchange shall take place. Between SWGR&PLC.

- SWGR Disturbance.
- RUN/ON Feedback
- OFF feed back
- SWGR selected for local operation (S/S in SWGR or Trial)
- Safety Start Permissive (wherever required)
- Elec. Trip (wherever required)
- Start Command
- Stop Command

(p) All field contact shall be considered "NO" contact except for Drive fault and Lube oil system their "NC" contact shall be

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considered

Further, In this connection, please also refer Electrical portion of TS considering the electrical signals for various system.

06.07.04.01 II. Measuring System

A. All the signals coming into / going out of the control system shall be routed through marshalling cabinets. The input / output modules employed in the control system shall be separate from controller hardware.

B. The conditioning and processing functions to be performed as a minimum for the analog inputs coming for control and information purposes are :

- Galvanic isolation of input and output signals wherever required.
- Transmitter power supplies with per point fuse protection or current limiting and power supply monitoring.
- Monitor sensor break conditions.
- Transmitter / transducer signal output limit check.
- Implementation of multiple measurement schemes.
- Square root extraction.
- Pressure & temperature compensation.
- Online ADC gain and drift monitoring and correction at periodic intervals.
- Linearization of thermocouple signals.
- Reasonability check for all analog inputs.

All analog signals for control purpose shall be acquired, validated; processed and their respective data base updated as per process requirement. For signals required for information only, the above functions shall be performed at an interval of 1 – 5 seconds, selectable and as decided during detailed engineering. The validated analog inputs shall be converted into engineering units on a per point basis. Analog input processing (scanning to alarm checking) shall be performed once every scan cycle. It shall be possible to delete any analog input from scan or to return it to scan on demand by the operator.

C. The conditioning and processing functions to be performed as a minimum for the binary inputs coming for control and information purposes are:

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- 24 V dc power supply for contact interrogation for all potential free contacts with per point fuse protection or suitable current limit feature.
- Contact bounce filtering delay time of 15 millisecond
- Facility for pegging the binary signal to logic one / zero or last correct value in case of failure of binary input module
- Binary signal distribution to different user shall be in such a way so as to ensure that a short / ground fault on one user is not reflected to the other user.
- Implementation of multiple measurement schemes for signals for control purpose.
- All binary signals shall be acquired, validated, processed, alarm checked and their database updated within one second.
- Checking for excessive number of status changes for all binary / contact inputs.
- Facility to delete any binary input from scan on operator demand

D. Triple measurement scheme for analog inputs employing three independent transmitters connected to separate tapping points shall be employed fails or shows excessive deviation with respect to others, it shall be removed from computation of medium / average value & the average of the other two transmitter outputs shall be used for controls. The control loop shall trip to manual when any two of the three transmitter signals fail. The operator shall be able to select any of the transmitter or the median / average value from the OWS. The outputs of the transmitter shall be continuously monitored for excessive deviation, which shall be displayed, logged & alarmed.

E. Dual measurement scheme for analog inputs employing two independent transmitters, connected to separate tapping points shall be employed for the remaining measurements used in CLCS and TCS. The output of the redundant transmitters shall be continuously monitored for excessive deviation. In case the deviation is within limits, the mean value shall be used for the control loop. If the deviation becomes high, the loop shall be automatically transferred to manual. However, if one transmitter fails and the other transmitter remains healthy, then the output of the healthy transmitter shall be used of the control. If the other transmitter also fails, loop shall trip to manual. The output of the transmitters shall be continuously monitored for extensive operation, which shall be displayed and logged and alarmed.

F. For binary and analog inputs required in FPS and TPS, triple sensing devices shall be provided. For critical binary and analog inputs required

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in OLCS / CLCS / TCS which are required for equipment protection of more than one equipment (e.g. flame failure, Deaerator level very low etc), triple sensing devices shall be provided. For other critical binary and analog inputs required in OLCS / CLCS / TCS for protection and interlock purpose also (e.g. those interlocks which may result in loss of generation, non-availability of a major equipment etc.), dual sensors shall be provided.

G. The signal conditioning functions like, multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value monitor / computation can be performed either in the redundant controller or in redundant signal conditioning and processing hardware outside controllers.

H. The maximum number of inputs / outputs to be connected to each type of module shall be follows:

Analog input module	:	04/08
Analog output module	:	04/08
Binary input Module	:	16/32
Binary output module	:	16/32

I. The following requirements shall be met:

- Input filters to attenuate noise shall be provided.
- All analog / binary inputs and outputs shall be capable of withstanding 500 v dc common mode and 500 v ac peak. All analog outputs shall be short circuit proof.
- Common mode noise rejection of analog inputs shall be minimum 120 dB at 50 Hz.
- Normal mode noise rejection for analog inputs shall be 60 dB at 50 Hz.

J. Any single / transducer / transmitter failure alarm shall be provided on Engineer (programmer) Station monitor for all sensors / transducers / transmitters. Similarly sensor break alarm for thermocouple etc. shall be displayed on the monitors.

06.07.04.02 Human Machine Interface System

Human machine Interface (HMI) System shall be designed and engineered for safe, efficient, reliable and convenient operation. HMI system shall employ high performance, non-proprietary open system architecture to ensure fast

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access and response time and compatibility with other system. HMI shall be used primarily for the following functions.

- As operator interface for control operation of the plant or accepting data from and issuing commands to TB Control & Protection System, OLCS, CLCS.

- To perform plant supervisory, monitoring and information functions.

The operator interface of the HMI shall consist of Colour TFTs / keyboards of operator work station (OWS), Colour inkjet printers & laser printer, large video screen etc. The TFT operation shall employ powerful menu – driven and window supported input facilities for operational ease and comfort.

All OWS of the HMI shall be fully interchangeable i.e. all operator functions including (for quick access to displays & other operator functions) control, monitoring and operation any plant area or drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files. Each OWS shall be able to access all control / information related data under all operating conditions including a single processor / computer failure in the HMI. Further, simultaneous operation from a single display without calling additional displays for multiple drive operation shall be possible.

No single operation in HMI shall lead to non- availability of more than one OWS and two printers. In such an event i.e. sniggle failure leading to non-availability of any OWS, it shall be possible to operate the entire plant in all regimes of operation including emergency conditions from each of the other available OWS.

The HMI shall be designed as on-line system that shall process, display and store information to provide the operator, either automatically or on demand, the relevant information.

Operation work Station shall perform operation control, plant information and monitoring function with the help of TFTs and associated keyboards, its own computers and communication controllers. These stations shall be connected to the system bus. Operator console shall be the main operator interface between the process operator and the instrumentation system. This shall employ TFT monitor, console electronics, operator’s keyboard. Operator’s console electronics shall be the interface between the operator’s console and the dual bus system. This shall be in dual configuration and both the electronics units shall be independently connected to both the buses. This shall accept all the

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data received from the bus system and store the same in the memory unit of the control. Similarly it shall pass on all the instructions through the bus system to the corresponding I/O unit on addressing the same. This shall also have the necessary capacity to drive printers, hard disk etc. The operating system shall be WINDOW based.

The HMI system shall be based on latest state-of-the-art workstation and technology suitable for industrial application & power plant environment.

The workstations shall be configured in such a way that loss of one workstation does not result in loss of any function. The actual size of the memory shall be sufficient to meet the functional and parametric requirements as specified with 25% additional working memory and 50% additional bulk memory over and above the memory capacity required for system implementation. The exact system configuration and sizing shall be as approved by the owner / consultant.

The workstation / servers employed for HMI implementation shall be based on the open architecture with industry standard hardware and software which shall ensure easy connectivity with other system and portability of owner developed and third party software. These shall be 64 bit machines.

Redundant sets of communication controllers shall be provided to handle all the communication between HMI and redundant system bus and to ensure specified system response time and parametric requirements. Each communication controller shall have message checking facility. Power fail auto restart facility with automatic time update shall be provided.

All the peripherals shall conform to the following minimum requirement but the exact make & model shall be as approved by the owner / consultant during detailed engineering. All the Monitors shall be proven 24” color TFTs and suitable for mounting in table-top arrangement. The printers shall be heavy-duty color inkjet printers (minimum printing speed 16 pages / minute for B & W and 8 pages / minute for color print out). Logging printers shall be dot matrix type that shall be suitable for A3 size paper also. Dot matrix printers shall be provided for connection to the console for logging purposes whose printing speed shall not be less than 180 characters / second. The noise level of printing at 1 meter distance shall be less than 65 dBA. Colour laser printer shall be provided to the console for printing the current TFT display on demand. Keyboard shall be self explanatory, easy to operate and shall meet all the functions to configure, operate and maintain the system. Membrane type keyboard may be offered with dust and drip proof. Commercial, continuous duty PCs shall be used with sufficient memory and DVD R-W drive.

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06.07.04.03 Large Video Screen (LVS)/Large Video Wall

SCOPE OF SUPPLY AND SER ICES:

The scope of work includes engineering, procurement, Supply and installation & commissioning of seamless video wall with each dimension of 4000 mm X 1012 mm +/-5% based on direct lit 1.575mm or lower pixel pitch fine pitch LED/LASER/LASER/Laser technology including following components/accessories as minimum:

a. 600 – 800 mm depth mounting panel for above video wall.
b. LED/LASER/LASER/Laser Mounting frame/structure combined with mounting panel and shall be decided during detail engineering.
c. Special tools & tackles to install commission & maintain the video wall.
d. Video wall, Video wall Controller/Processor, Software and Mounting Structure shall be from same OEM to avoid any compatibility issue.
e. The Bidder and OEM should have ISO Certifications: “ISO 9001, ISO 45001, ISO 14001”.
f. The Mounting Structure shall be Supplied Form Same OEM/ OEM Approved Authorized Partner(Bidder).

In addition to above, any items which are required for proper functioning of the video wall have also to be supplied.

FUNCTIONAL RE UIREMENTS OF IDEO WALL:

Video Wall will be used as a display wall (through video wall controller) to display multiple sources (Workstations) on user selected area of the wall. In addition, multiple user configurable layouts on the entire video wall through video wall controller shall be possible. Video wall shall have suitable input ports to enable direct connection over HDMI/DVI and connection through video wall display controllers on suitable connections e.g. HDMI.

Video wall should be Front accessible and shall be based on LED/LASER/LASER display modules/tiles with 1.575 mm fine pixel pitch, Non-reflecting, flicker free & shall be suitable for Control room, for continuous viewing (24 hours in a day) under normal room ambient lighting without any need to darken the room. There shall be no burn-in due to prolonged display of the same picture at the same display area on the wall.

The Video wall shall include projection of multiple Web Pages, spreadsheets, PDF files, presentation files & other various kinds of data files.
Back side of Video wall shall be supported by Brick wall keeping approx. 3- 4 feet distance. Video wall shall be covered by perforated sheets with climbing arrangement. Maintenance work on the video wall shall be confined to easy replacement of the LED/LASER/LASER display modules/tiles. Vendor shall provide necessary training to Buyer’s staff for maintenance of video wall.

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TECHNICAL SPECIFICATION FOR FINE PITCH LED/LASER IDEO WALL

SL.NO	FEATURE	DESCRIPTION
1	Make	Approved make
2	Video wall Size:	4000 mm X 1020 mm +/- 5%
3	Pixel Pitch	1.57 mm or lesser
4	Pixel Density	403124/Sq m or better
5	Bezel width	Zero (seamless)
6	LED/LASER type	Commercial grade 3-in-1 Black SMD
7	Brightness	≥ 600 Nits
8	Brightness & Color uniformity	≥ 97%
9	Color Temperature	3200 - 9300 K
10	Life Time	100000 Hrs.
11	Contrast Ratio	≥ 5000:1
12	Horizontal Viewing angle	≥ ±80°
13	Vertical Viewing angle	≥ ±70°
14	Installation and service	Front only
15	LED/LASER display cabinet adjustment	all axis integrated
16	Line voltage	100-240 Volts AC, 50/60Hz auto switching
17	Power Consumption per cabinet, Max	110 Watt
18	Power Consumption per cabinet, Min	40 Watt
19	Operating Temperature	-10 to 40°C
20	Operating Humidity	10-80% RH non-condensing
21	Storage Temperature & Humidity	-20 to 60°C
22	Storage Humidity	10-85% RH non-condensing
MOUNTING SYSTEM:		
23	Mounting System	LED/LASER display cabinet must come standard with its own mounting system, designed exclusively for wall mounting for the video wall product from OEM only.
26	Curved Walls	The LED/LASER display cabinet mounting structure must be capable of supporting concave curved walls
31	2-Year Warranty	The video wall may be covered by warranty for up to 2 years min.

IDEO WALL CONTROLLER AND SOFTWARE:

The Controller for the management of video wall systems, single displays and control accessories capable of projecting displays over a part of screen to multiple screens in PIP/POP/resize/zoom windowing offers a big combined desktop for network applications.

SL.NO	FEATURE	DESCRIPTION
Technical Data		
1	Make	Approved make
2	Architecture	PC based Architecture
3	Processor:	Intel Core i7/Xeon or (Latest)
4	Memory:	16GB RAM

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5	Data Storage:	1 TB
6	Ethernet:	2x 10/100/1000 Mbps RJ45 connectors
7	Onboard Audio	YES
8	PCI slots:	3 x PCI express
9	Power supply:	400W, redundant, Hot Swap
10	Operating System:	Microsoft Windows 10 64-Bit
11	Power Supply	Redundant Power supply required
12	Output Ports	2 * HDMI ports
13	Input Ports	> 2 * HDMI > Scaling & Display : Display multiple sources of any size, anywhere on the video wall.
14	Environment conditions:	Voltage: 100-240V 50/60Hz Operating temperature: 0 - 40°C / 32 - 104°F Humidity: 10 - 90% (non-condensing) Altitude: up to 3.048m / 10,000ft

Firewall:

Firewall appliance should facilitate multi-vendor, multi-application environment and should support third-party products on open alliance. It should support Active-Active configuration.

- The firewall should contain following features:

(a) State ful inspection of packets.
(b) NAT functionality, including dynamic and static NAT translations
(c) Latest version of SNMP

The firewall must send log information to a separate log server via an encrypted connection. Firewall logging must not impact firewall performance.

Remote network access to the firewall should only be possible through the administration interface.

Firewall should also meet the following requirements.

- The firewall must not support any unencrypted means of access to the firewall.
- It should Monitor ALL network traffic-traffic at Firewalls (Internet and external networks), in the DMZ and detect known threat through deep packet inspection.

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- Detect unknown threats via anomaly scanning.
- Detect unknown threats via behavior pattern to protect from zero day attacks.
- Keep up-to-date on new threats and vulnerabilities.

06.07.04.04 System Programming and Documentation Facility

The Tenderer shall provide redundant Engineering Work Station (EWS) with programming facilities for the following systems as a minimum.

- Control System
- HMI system

The system shall have in-built safely features which shall protect the system against inadvertent and unauthorized use of these tools. Necessary hard key lock and software locks etc shall be provided for this.

The system shall also have facility to permit the engineer to add test information at the beginning and end of each program, wherein Engineer shall list out his name, time, date the change which has been made, name of the person who has authorized the change etc.

The EWS with plant supervision and management capabilities equal to those of the OWS shall be provided. EWS shall be located in the Control room. It shall be able to access the system database and modify the elements.

The EWS shall allow for the management of process variables, of the input and output signal address, of the control loop and control logic structure, of the modalities in which information is presented to the operator, of the synoptic graphics, of the printing and archiving protocols and of all those characteristics which are needed to carry out the tasks assigned to the control system. The engineer shall be able to manage the system's memory devices through the EWS in order to save the configuration files.

The SMART type electronic transmitters connected to the control system and possible field devices (instruments, valves, etc) that can be managed with HART protocol technology shall be able to be managed from the EWS. The system shall provide remote configuration, calibration, test and monitoring of SMART transmitters using HART protocol.

The configuration of the control system's application software shall be above to be modified with regards to the process controllers (logic, adjustments, interlocks, alarm pages, etc). The use of the modified configuration however

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shall not require the suspending of control and supervision function of the node or nodes involved in the modifications.

I. Control System Structuring / Configuration / Tuning Facilities

Structuring / configuration and tuning facilities shall be provided for structuring / modification, storing / loading, testing, tuning, monitoring etc. of all the microprocessor based controllers of the control system. It shall be possible to configure the system with ease without any special knowledge of programming or high level languages. Control strategy shall be implemented using familiar and conventional automation function blocks (software implemented). Whichever any changes in configuration is done, it shall be recorded and modified. Configuration shall be available for printing and documentation and shall be stored in non-volatile memory. The entire system configuration, tuning / fixed parameters shall be documented and printing in form of function diagrams and lists respectively.

On-line tuning of the control loops shall be possible without causing any disturbance in the execution of the control loops. Provision to store and retrieve on immediate and long term basis the system configuration, data base etc. on some device such as CD shall be included. Facility shall be provided to reload / down – load the system or controller module from the already stored data, on-line.

II. HMI Program Development / Modification

The EWS shall be able to provide programme development / modification to achieve various functions including development modification and testing of software of HMI; generation and modification of graphics, Logics, Historical Storage & Retrieval system functions in an interactive manner; HMI data base from the console and other features necessary for system maintenance.

III System Documentation Facility

The system shall have the facility to generate the associated documentation for both the control system & HMI system. The document, to be generated by the system shall include P & I drawings, control loops drawings, signal distribution list / drawings, system interconnection drawings, cabinet general arrangement drawings, measurement list, drive schedule, alarm schedule, system hardware and functional configuration drawings for displays, logs, trends, graphics etc. The system shall also include all required software and hardware tools for creating, modifying and printing CAD drawings to achieve paperless documentation for PLC.

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06.07.04.05 Historical Storage Unit (HSU)

The Historical storage unit (HSU) shall augment the global memory in the system and will archive data and parameters for logs and historical records including trends, alarms and events. These will be used for analysis, data presentation and performance calculation. The historical storage unit shall be a stand-alone unit on the data highway performing as file server.

Redundant facility has been envisaged for historical storage unit by dual disc imaging or other such technique so that any signal failure will not lead to any loss of historical data.

Assignment between globally distributed memory and the historical storage shall be judiciously determined during system engineering stage. While the historical data storage function shall be exclusively performed in HSU, some invariant application programs / data link mimic diagram (the fixed part) may be resident in selected fixed sectors of the HSU provided the display latency to its appearance on screen shall be less then 3 seconds. The latency for historical trend display shall be less then 10 seconds. If these latency criteria cannot be met, the relatively invariant application programs shall also be globally distributed for faster response.

The memory capacity of the HSU shall be determined based on the monitoring requirements for the plant data indicated in the logs; the average, minimum and maximum values are to be indicated.

Parameter can be archived / configured at Historian with selectable sample time. Module shall also have the capability of storing both snapshots and average value.

Facility for archiving the historical data in DVD shall be provided. Historian node shall have DVD read write (for CD, VCD & DVD-with read and write) device with blank DVDs for such archiving.

Provision shall be kept at the module for adding new tags. Sizing of the historian shall be carried out such a way that at least additional 25% over the already configured tags can be added in future.

Historical storage should permit trending of all analogue inputs with time scale (X-axis) selectable as 1sec, 10 sec, 30 sec, 1min, 4 min, 20 min, 2 hours, 8 hours and 24 hours on TFT screen. Vertical scale (parameter range) shall be freely programmable. It shall be possible to map the real time and history trend

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on the same trend display. History data storage shall be minimum 8 (eight) days / 192 hours and after expiry data will automatically / manually transferred to the external storage device such as DVD writer.

06.07.04.06 Communication system

The communication system shall be digital communication bus that provides a high speed data transfer rapidly and reliably between the operator consoles, process I/O devices, process controller and devices connected to it. The data communication system shall include a redundant system bus with hot back up and other applicable bus system like cubicle bus, local bus, I/O bus etc.

Communication system shall be dual redundant, consisting of two separate communication buses and two separate communication system interfaces for each device. In case of system having traffic directors, redundant traffic directors shall also be provided.

Communication speed on the communication bus shall be sufficient to update the operator console data base once in every second. The overall system performance shall not be degraded whether communication system is 10% loaded of 100% loaded. Degradation of communication bus is defined as a change in the system performance from the specified one while loading the communication system from 10 through 100%.

In case of main bus failure or any communication device failure, the transfer to the backup device or bus shall be automatic without interrupting the system operation and without any operator's intervention. Information about the failed device / bus shall be displayed on the operator console.

It shall be possible to switch over the communication from main bus to the redundant bus manually without disturbing the system operation.

In general the transmitting message shall identify the receiving device. The transmitting device shall receive a reply from the receiving device on the receipt of correct message, lack of response shall be considered as a receiver failure.

The mechanism used by the communication system for error checks and control shall be transparent to the application information. Error checking on all data transfer shall be done by cyclic redundancy check and other advanced codes.

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The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause on more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure / physical removal of any station / module connected to the system bus shall not result in loss of any communication function to and from any other station module.

Data transmitting speed shall be sufficient to meet the response of the system in terms of displays, control etc. plus 25% spare capacity shall be available. The data transmission rate on all buses shall be very high (minimum 100 MBPS or better) to commensurate with system response requirement.

Passing co-axial cables or fiber optic cables shall be employed for system bus. The redundant buses shall be physical separate and shall be routed separately.

The Tenderer shall furnish details regarding the communication system like communication protocol, bus utilization calculation etc.

06.07.04.07 Sequence-of-Event Recording System

A Integral sequence of event recording (SER) system shall be provided. SER system shall accept sequence of events (SOE) inputs in the form of potential free contacts. The member of SOE inputs shall be on as required basis but not less than 32 points.

The SER system shall be synchronized with master clock every one minute. The accuracy of the clock on the processor / controllers or inputs modules as well as the internal synchronization rate shall be adequate to meet the resolution requirement.

The system shall monitor SOE inputs with a resolution of one (01) millisecond at all times for all inputs including spare inputs. That is, all SOE points' status change shall be reported and time tagged within one (01) millisecond of their occurrence.

The SER system shall be based on redundant processor / controllers and it shall be ensured that not more than 32 channels are used per input card / module. Redundant power supply packs / modules shall be provided for contract interrogation supply and power supply to the processors / controllers and inputs modules.

Input card shall be equipped with digital filters with filter delay of minimum 4 millisecond (identical for all points) to eliminate contact bounce such that field

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contact which is changing state must remain in the new state for successful 4 millisecond to be reported as one event.

The start of data collection for SOE report shall be reported to OWS within 1 second of SOE data collection initiation.

Facility shall be provided to identify bad inputs (like chattering) and make them off scan. It shall also be possible to modify data base, change point's identification description, and get SOE reports print out from dedicated SER VDU / Keyboard.

The system shall also include provision for historical storage and retrieval of SOE report for one (01) month period.

The SOE report collection shall being on occurrence of change of status of any SOE point and shall be printed after an operator selectable interval of 1 to 3 minute or 100 status changes have taken place after the first event. Adequate memory to accommodate two SOE reports i.e. two buffers of 100 status changes each shall be provided. Third SOE report shall overlap the first SOE report memory and so on.

It shall be preferred to have a SER system from the same family of PLC using SOE input cards of same PLC family.

06.07.04.08 System Diagnostic Station

Diagnostic facilities for automatic display and recording of any system disturbances shall be provided to enhance the system availability. For these all processors, modules, cards, operator console, transmitters etc shall have on line self-diagnostic features which shall be displayed at equipment / module level and inform to the central diagnostic station to display the fault with equipment / module identification in clear text. All types of faults and disturbances in all modules used in the system shall be automatically displayed and printed.

A graphic system that supports the system's self-diagnosing system shall be proposed and realized by the successful Tenderer. These pages shall allow for the unequivocal identification of any system component that is not functioning perfectly. The graphics pages of the self-diagnosing system shall be retrieved from both the system's engineering station and the diagnostic display station.

The diagnostic pages of the system shall be arranged according to a hierarchical structure. This self-diagnosis level in the PLC shall run continuously and automatically without requesting any type of action to be

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taken by the operator. The self-diagnosis functions are used to identify and report any type of malfunctioning of each module, processor, operator console, transmitter in order to assure system integrity. After a serious problem is pointed out in a redundant component, the passage to the back-up component shall be made within the cycle time and shall be bump less.

06.07.04.09 Interfacing with compressor SIL-3PLC, PLCand & IGGL central Network

Necessary interface (OPC / MODBUS connectivity as per requirement) shall be provided to transfer information from the Control System of NGC to the Common PLC ,Plant wide Network &IGGL central network in an efficient manner. Each interface shall be redundant. Wherever PLC, micro PLC,SCADA based automation systems are to be used for any application like as nitrogen plant, metering unit, DG set, Air compressor, etc. these shall be interfaced through OPC/Modbus protocol or hardwire as per applicability on a common PLC network under Level-1automation for smooth and integrated operation of the plant with hardwire like as OFC, cables , electronic modules,converter etc under scope of tenderer

The purpose for transferring information to the main PLC is as follows:

- Permit the transfer of control graphics.
- Provide consolidated alarm sequencing,permissive,interlocks and handling capability for the NGC and auxiliary equipment
- Permit historical data storage and retrieval for the NGC and auxiliary equipment
- Permit MIS functions through Plant wide Network for monitoring & supervisory functions.

Interface hardware and software shall be suitable to match the foreign device communication requirement, like hardware interface, communication protocol etc. While writing software or mapping the input / output in the interface device it must be ensured that integrity of the data to be transferred like resolution, correctness etc shall be under scope of tenderer.

06.07.04.10 Synchronization System (Master Clock)

The PLC shall be equipped with a master clock system for the synchronization of modules through a satellite signal (GPS). The Tenderer shall provide a master & slave clock system for uniform timing throughout the various plant facilities. The system shall be complete with receiving antennae (for receiving

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time from satellite & radio signal), receivers and associated electronics, redundant master clocks, slave clocks, interconnecting cables, cubicles, power supplies and any other accessories. However, a provision shall be kept for synchronization of the master clock with other source. The master clock shall drive the slave display units. It shall be ensured that loss of any other slave display unit does not affect the display of any other slave unit. The HMI system shall be synchronized with the master clock once in every minute. The master clock shall be located in the Control Room and shall have facility for automatic synchronizing with external radio / satellite signals.

Adequate number of slave clocks shall be provided at various plant facilities.

06.07.05 System Software

The Tenderer shall provide all license software required by the system for meeting the intent and functional / parametric requirements of the specification. Software to be supplied shall include but not limited to the following to perform all the functions specified under this specifications. All software shall be in English. Software for microprocessor based distributed control system shall include the following.

- Real time operating system
- Input scanning, processing and alarm monitoring.
- Open and closed loop control software.
- Graphic utility
- Communication between process modules through data bus
- On line diagnostic
- Human machine communication
- Input data base generation and maintenance
- Log generation.
- Utility for the software development
- Background executive for software development in time-sharing mode.
- Visual C or equipment compiler.
- Screen editor for software engineering.
- File handling utility
- Library facility for object modules
- On line debugging facility for the purpose of software development.
- Utility of data transformer from magnetic tape to disk and vice versa
- Software for communication with system supplied by others.

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- Full scale steam / water property routines conforming to ASME 1967 steam tables.
- Any other software as required meeting all the specification requirements.

The Tenderer shall have the total responsibility for the design, development and implementation of software for the control & instrumentation system. The Tenderer shall include in his scope of work the following.

The application software for implementing control algorithms, interlocks, generation of mimics shall be using a graphics editor and graphic tool kit and shall not use a programming language approach. Graphic blocks, engineering blocks etc. shall be used to configure the software.

The Tenderer shall provide software locks and passwords to Owner at site for all operating and application software so that Owner can take backup of software and are able to do modifications at site.

The requisite licenses for the system software and application software shall be included. Software Licenses as far as possible shall be taken on group basis rather than individual PC based. Alternatively, the software license shall be taken as project specific instead of hardware / machine specific. All licenses shall be valid for the continuous service life of the plant. Source code for all application software shall be handed over to the Owner. The Tenderer shall include and indicate any other software e.g. Anti-virus, communication, MS office etc required for realization of functions and completeness of system. All software upgrades / new releases, which take place after commissioning of the system, should be reported to the Owner for subsequent procurement and installation at site, if desired. The Operating System (OS), Standard Software (like MS Office, Antivirus etc.), Application Software etc shall be supplied in suitable media (CD) and as preloaded with the system.

06.07.06 Plant Information Functions

I. Process Display

The PLC shall provide the real-time process parameters and equipment status information to the operators which shall be needed to supervise automatic control functions, provide process feedback during manual intervention, allow monitoring of performance trends, and simplify post mortem analysis of equipment of unit trips. It shall provide the centralized information to the plant operator / engineer in the following fields.

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a) Indication of all analog and digital process variables of control loops, open loops and all loop related parameters.

b) Manipulation of control loops including changing set point, mode, output, configuration, tuning and computational constants.

c) Alarm displays and annunciation.

d) Graphic displays and status indication.

e) Logging and trending including historical trend recording.

f) Self-diagnostic message.

Information shall be provided to the operator in several formats as follows.

I.1 Overview display

Overview display shall incorporate a minimum of 64 analog or discrete inputs that can be monitored simultaneously on the TFT screen (referred as page). Each page shall be organized into a suitable number of groups. Each group shall be identified separately. Each group shall further incorporate suitable number of inputs (Referred as tags). Suitable identification and description shall be shown for each group on the overview display to relate it to a group or loop display.

All analog points in the overview shall be represented as variable lengths indicating deviation above or below the normal operating value or set point.

Alarms shall be displayed in change of colour against each variable if the variable crosses a set value. Control loops operating in manual mode shall be indicated. An input in alarm condition shall be identified by flashing.

I.2 Group Display

A. Group display shall be limited to the group of inputs as displayed in the overview display. Each group shall preferably include eight (8) numbers of inputs.

B. Each input in the group shall be identified by the tag number, unit of measurement and process description that shall be displayed on the TFT screen.

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C. Display, as a minimum, shall show following degree of details.

a) Process variable in analog form shall show, as a percentage of the transmitter span on a linear scale bar graph of 0 – 100% and / or engineering units.

b) Set point value in analog form as percentage of the transmitter span on linear scale bar graph of 0 – 100% and in digital form as alphanumeric display in engineering units.

c) Output value in analog form as a percentage on linear scale bar graph of 0 – 100% and in digital form as percentage.

d) Controller mode i.e. auto, manual, cascade, computer.

e) Process alarm on process variable, deviation or velocity.

f) Selected loop within the group shall be identified by cursor making or similar identification.

g) Control valve failure position.

h) The contact input / output shall be represented by simulated graphic lamps and configurable alphanumeric status description.

D. It shall be possible to control the process from group views. Following control actions shall be possible.

a) Increase / decrease of set point value either slow or fast.

b) Change of controller mode i.e. Auto / manual.

c) Changing output to the final control element.

d) For digital points, start / stop or open / close command.

e) It shall be possible to repeat any tag number in more than one group / console. However, it shall be possible to control or change configuration from only pre assigned group.

I.3 Loop Display

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A. Loop display shall provide a separate detailed display for each of the process inputs. The graphic representation of analog and digital points shall be similar to group display. However, in addition following information shall also be presented in alphanumeric form as a minimum.

a) Controller tuning constants.
b) Process variable zero and span values
c) Alarm set point on various parameters
d) Limits on set point, output, velocity etc.
e) Controller action (direction / reverse)
f) Failure position of final control element
g) Computational constants like ratio or bias
h) Integrated value
i) Output to the final control element
j) Engineering units

B. It shall be possible to change the following through the keyboard of operator console.

a) Changing tuning constants
b) Changing scale, zero and span
c) Changing limits on set points, output, velocity etc.
d) Changing configuration of any loop
e) Changing alarm set points
Loop control parameters changes as specified above [point (a) to (e)] shall be restricted by a key lock control
f) Changing control mode
g) Changing output to the final control element
h) For digital points, it shall be possible to issue start / stop or open / close command.

C. The loop display shall also contain a trend displaying process variable, set point and output with a sample interval time of maximum 1 second and full-scale time base of minimum 60 seconds for tuning the process control loops.

I.4 Graphic Display

A. It shall be possible to display dynamic of different sections of plant on the operator console TFT, Graphic displays shall be field configurable only through engineering key-board with standard / user defined graphic symbols. Different plant sections dynamics shall be displayed different pages.

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B. The system shall have the capability of having and developing graphic symbol library as per ISA – 5.1 and 5.3. In addition standard industrial symbols like distillation columns heat exchangers, pumps, compressors, tanks etc. shall also be provided as a standard.

C. Graphic displays shall be interactive type through which it shall be possible to control the process. It shall also be possible to send motor start / stop and shutdown valves open / close command from these displays.

D. It shall be possible to view the process variable and alarm points and view and change set point value, manipulated variable, controller mode etc. from the graphic display. Also compressor / pump status and valve status shall be displayed on the graphic display with different colours.

E. Various colours used in the generation of graphics like colours of the process lines, utility lines, instrument signal lines and event modifier conditions shall be finalized during detailed engineering.

F. It shall be possible to go grow any graphic page to related graphic pages or any group view summary in single key stroke using soft key function.

I.5 Trend Display

A. The system shall be capable of displaying the following trends:

a) Real time trends of the parameters displaying current data. It shall be possible to assign any parameter for real time trend.

b) Historical trends for any parameters. Historical data trend shall be displayed for a period of minimum up to 25 hours.

B. Historical data shall be stored on the nonvolatile memory device in such a way that such historical data can be utilized for archival storage and subsequent recall. Trend display shall provide the capability to scroll backward in time (viewing historical data) to view performance or process trends thereby assisting in trouble shooting and post-mortem analysis.

C. Real time and historical trend shall be possible on any parameter or variable like measured variable, set point, output, calculated variable etc.

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D. It shall be possible to sample and store data of instantaneous and average value at the intervals mentioned below. However, it shall be possible to display by scrolling or expanding the time base for all the trends.

a) At intervals 10 seconds and below for the real time trend.
b) At minute, 10 minutes & 1 hours interval for historical trend.

E. Selection of the tag number and sampling time for real time and historical trending shall be possible from operator keyboard.

F. The system shall also have a multi-trend capability in such a way that it shall be able to display set points, marked variable and output on the same trend of either the same process variable / any other process variable.

G. Trend display shall be single line type with additional information like loop tag no. engineering units, present value of the trended point, alarm status etc.

I.6 Faceplate display

Multiple open minimum 6nos at a time not in group formation also Faceplate displays consist of an intelligent grouping of manual / auto station of control switch “faceplates” associated with given piece of equipment or process. Operator control action shall be first selecting the appropriate faceplate then initiating the desired control station.

I.7 X-Y Plot

X-Y plots provide the capability to plot one process variable versus another.

I.8 Permissive Display & Step Indicator

Permissive display and step indicator shall group, into single display, the conditions that must be met for a designated piece of equipment to be started or continue operating. The permissive display and step indicator shall be dynamic to rapidly indicate to the operator sequential start/stop or open/close and the reason for a piece of equipment tripped or failed to start. A similar type of display shall be used to serve as a checklist when operating in the semi-automatic or manual start-up modes.

I.9 Operator Guidance Message

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Guidance message shall consist of a single line of text designed to prompt the operator when specific actions are required based on logic decisions within the PLC.

I.10 Alarm Monitoring & Display

A. Alarm Summary Display

a) It shall be possible to display summary of all in the sequence of their occurrence and shall disappear from display only when they are acknowledged and cleared. The alarm display shall list the following for each alarm as a minimum:
   i. The date and time of occurrence
   ii. Point identification (i.e. tag number)
   iii. Point Description
   iv. Type of alarm (absolute value of deviation)]

b) The system shall be able to display on alarm summary a minimum of 250 alarms.

c) Alarm shall be listed in the form list like current, list I, list II etc. The minimum number of alarms per list shall be 25.

B. Alarm History

a. The history of alarm conditions shall be maintained in the database for alarm history display and printed on shift basis for the parameters to be specified during detail engineering. The alarm display and print out shall list the following for each alarm as a minimum.
   i. The data & time of occurrence
   ii. Point identification (i.e. tag number)
   iii. Point description
   iv. Type of alarm (absolute value of deviation)
   v. Time of acknowledgement
   vi. Time of return to normal
   vii. Serial number of alarm in the sequence of occurrence.

b. The system shall be able to display and print out alarm history of minimum 500 alarms.

c. Alarms shall be listed in the form of alarm lists I, list III etc. The minimum number of alarm points per list shall be 25.

d. Historical system shall have automatic off loading of history data after certain defined period to DVD/suitable storage media.

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C. System Area

a. System shall have capacity of on-line diagnostics.
b. Any abnormal conditions in any sub-system or in any other function device shall be displayed as system alarm message on the operator console irrespective of the display selected.

I.11 Configuration Display

Configuration display shall provide a separate detailed display for each loop indicating the configuration of that loop. When control requires more than one loop, all interrelated loops shall also be displayed. Following information is required to be available for configuration display.

a. Loop configuration-giving designation of each block.
b. Control block interconnection showing software or hardwiring.
c. Value of each block parameter like PID, ratio, bias, dead time, lead-time etc.

It shall be possible to configure & reconfigure the loops from this view using user-friendly software.

II Logging Function

It shall be possible to log all measured and computed parameters, operator actions, alarms etc. from operator consoles. The system should two basic types of report (i) time activated, (ii) on operator demand. Event log is foreseen and shall be provided with the software update as soon as it is available. Logs shall include alarm report, post trip review logs, start up logs, compressor recall logs compressor shut down analysis logs. The time activated logs shall include hourly, shift, daily logs and summary logs. The operator demand logs shall include single point digital trend, group / point digital trend, scan summary, alarms, group summary of compressor, turbo-compressor and auxiliaries, maintenance logs for circuit breakers, motors, transformers, pumps etc. Special logs such as logs of all vibration inputs, summary logs of all bad inputs, bearing temperature logs of all motors etc.

Programmed log formats shall include but not be limited to all required headings, subheadings and work descriptions. The exact format and printer assignment for each log shall be defined by the client during detail engineering stage.

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The logs required to be provided are indicated below. The operator shall be able to create new logs and modify existing logs and reassign them among the printers on line.

A. Run-up log

A log of minimum 100 compressor data points shall be collected and automatically printed at either 1,2,3 or 5 minutes intervals as selected by the operator. The log shall be initiated by the compressor roll-off and shall continue until stopped by the operator.

B. Diagnostic Log

The TB diagnostic log shall consist at least 100 TB data points. These shall be printed out once in every 24 hours at a time selected by the operator. This shall help in analyzing possible troubles in compressor and compressor.

C. Recall Log

The compressor log printout shall be initiated by the occurrence if any one of several alarms and shall consist of all data defined for the compressor diagnostic log. The system shall store information wherever the compressor and compressor are on line. The data shall be stored in the memory at 1-minute interval. A total 30 minutes of data shall be stored in the memory. Following the initial 30 minutes of operation, the oldest data in the memory shall be discarded and replaced by now data. The log print out shall be initiated by pre-selected alarm conditions and shall continue at 1 minute's intervals after initiation until the alarm condition has disappeared or stopped by the operator.

D. Unit Shutdown Analysis Log

The post trip analysis facility shall be provided to record operating data during the period immediately before and after a unit trip.

Up to minimum 100 data points for compressor and compressor analog variables shall be stored once in each second. After the initial 30 minutes of operation, process shall continue with the oldest reading being replaced by new reading. In the event of unit trips the post trip analysis for preceding 20 minutes shall be stored in the memory. The computer shall continue to record data and store data at 1-second interval for 15 minutes after trip. The data log shall then be printed on demand.

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E. Periodic Printout of Logs (Hourly, Shift, Daily, Review etc).

i. Hourly / shift / daily log of minimum 100 points shall be provided to furnish data for routine analysis of plant performance. These logs shall be automatically printed at specified time and on demand at any time.

ii. Summary log (on demand printout) – The system shall permit the operator to specify 5 summary logs of up to 25 points each to be printed on demand. This shall include data for the previous 24 hours, such as daily maximum, minimum hourly values etc.

iii. Operator request summary log – The data acquisition system shall have the capacity to store all the operator's request for a 24 hours period and the information shall be printed once in every 24 hours in the form of summary log and also on operator's demand.

F. Performance Log

Provision shall be made for logging up to 100 variables that can be used in unit performance calculations. The log shall be initiated and printed on demand and shall consist of average data accumulated over an adjustable period of 10-60 minutes.

G. Maintenance Log

Provision shall be made for logging operating information about certain plant equipment for the purpose of routine equipment inspection and scheduling preventive maintenance of equipment.

The log shall be capable of including all equipment for which an equipment status digital input should be provided and such other equipment as shall be designed by the Owner / Consultant.

Each item of equipment shall have the following operating limits.

- Maximum number of cycles (starts)
- Maximum number of operation

The computer shall count the number of cycle of operation or hour of operation or hour of operation since the pervious maintenance or

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inspection period. When the limit is exceeded, a log shall be provided. The printing of log shall be daily, weekly, monthly or on operator's demand.

H. Special Log

All analog and digital output not connected with hourly log shall be printed and shall appear in a daily log with automatic printout or on demand.

Capability shall be provided for printing individual groups on demand. A log of all vibration inputs shall be made on the daily summary log and on demand. A summary log of all bad inputs shall be made on demand. A lot of temperature devices including but not limited to, bearing temperature of all 6.6 kV motors, stator hot spot temperatures of 6.6 kV motors and bearing temperatures of all driven equipment equipped with temperature detectors shall be made hourly.

06.07.07 SPECIFICATION FOR CONTROL ROOM INTERIORS & PARAPHERNALIA INCLUDING VIEWING GALLERY

[A] The purpose of this specification is to define the specifications of control room interiors & consoles for

- main control room, @ EL+5.0m
- conference room, @ EL+9.0m
- viewing gallery and @ EL+9.0
- engineering room. @ EL+5.0m
- Cable cellar @ EL+3.5m

(Refer civil drg. enclosed for tender purpose and reference)

Tenderer will design a modern state-of-the-art control room. The control room layout, colour scheme selection etc. will be 3D modeled on computer at least **(03)three nos**. different layout proposals are submitted to Clint/Consultant out of which the finally selected option, taking into account Client/Consultant comments will be implemented.

As the control room is a significant place where critical operations/monitoring takes place, it is imperative that it is designed properly in terms of aesthetics, safety, ergonomics and functionality. Various aspects shall be considered while designing control room area to create ideal workplace, considering physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity as per ISO 11064.

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The scope of the project includes designing; engineering, supply & installation of 24X7 mission critical control centre interiors.

Being a project of national repute this state-of-the-art facility & all its components like

- ceiling,
- flooring,
- panelling/partition,
- glass partitions,
- control desks,
- ceiling light &
- luminaire's electrical etc.

shall look integrated and therefore it shall be treated as a part of one single solution i.e., Control room interior solution provider. Main tenderer to submit MAF (Manufacturer's Authorization Form) from professional control room interior solution provider.

To ensure an integrated solution, to qualify as per the international control room design & safety norms; main tenderer shall bring one single professional control room interior solution provider on board with an experience of at least five control rooms interiors along with control desks. Corresponding purchase orders/work orders and their appreciation/completion letters to be submitted along with the bid.

The control room interior solution provider shall have experience of supplying below products

- Modular rigid PVC metal panelling / partition – minimum 300 Sqm.
- Metal false Ceiling - minimum 300 Sqm. Factory made acoustic modular metal false ceiling of powder coated panels.
- Acoustic laminate/carpet flooring – minimum 300 Sqm.
- control desk modules with moulded polyurethane edge.
- Proposed console shall comply with the stringent/advanced version of BIFMA X7.1 standard

It is mandatory for the main tenderer that the control room interior solution provider supplies all elements & executes all the activities at site like ceiling, flooring, wooden cladding ,Laminates fabric, paint, POP/Putti, control desks, panelling, partitions & illumination to avoid interface & quality related issues.

All the certificates and reports mentioned shall be submitted along with the technical bid.

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In broad, the scope of work and supply shall consist of the following parts
Interior design, engineering of control room.
All related services for supply, installation & testing.
Ergonomic compliance report as per ISO 11064.

The control room interior shall be greenguard gold certified (Modular Metal Ceiling, Flooring & Modular Metal wall panelling) from UL/Intertek. Valid certificate to be submitted along with the technical bid.

[B] Design Criteria

The metal ceiling, removable type metal panelling and partition shall be of modular design, facilitating future equipment retrofits and full reconfigurations without requiring any major modification to the structure.
Panelling/cladding tiles shall be designed to achieve shape and design as per the design consultant. To enhance the aesthetic appeal the control room interior solution provider shall include diffused & concealed light elements in the control room wall panelling. These illumination elements shall have provision of quick & easy installation & maintenance.

[C] Quality Criteria

The critical components of the control room i.e., designer metal ceiling, carpet/laminated flooring, modular metal wall panelling/partitions shall not emit formaldehydes, TVOC beyond permissible limits i.e. 9 µg/m³, 0.22 mg/m³ respectively. This is to ensure healthier air quality for the operators. Therefore, the control room interior shall be green guard gold certified (Modular Metal Ceiling, Flooring & Modular Metal wall panelling) from UL/Intertek. Valid certificate to be submitted along with the technical bid.

[D] Modular rigid PVC metal panelling

Panel design to support proper integration of large video screen.
Gluing, screwing, ACP (Aluminium Composite Panels), Paint, Fabric, Gypsum, Wooden laminates shall be deemed unacceptable.
Structure shall allow uninterrupted flow of wires/cable/tubes of maximum diameter 25mm.
Panel shall be designed in such a manner that it takes care of undulation of walls and gives perfect flat surface finish and compile easy service & maintenance procedure.

[E] Hexagonal Composite Panelling

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Designer composite panelling with combination of perforated / non-perforated / printed / backlit hexagonal tiles. The shapes shall be installed over extruded aluminium profiles joined together to form a rigid structure.

[F] Curve/bend modular rigid PVC metal partition

The material of construction and technical specification shall remain the same as per modular rigid PVC metal panelling (Wall Finishing modular rigid PVC metal panelling) however, the shape shall be a perfect curve to provide more space for mounting of the LED. Paneling's curve shall be achieved by curved tiles only. Curvilinear arrangement using straight tiles shall be deemed unacceptable. In partition the cladding shall be done on either side of the section/grid work.

[G] Switchable glass partition material with switchable smart functionality for viewing gallery

Switchable glass is an electrical component and shall be covered in the electrical layout including the provision of fused spurs, switches, cable management and electrical connection boxes. Including full glass partitions of minimum 10 mm thick clear toughened glass, structural support system for top and bottom including holding system from RCC slab above false ceiling, including runner hung anchor fastener to fix it. Rubber interlinear & gaskets to fix bottom into SS "U" channel in floor. Silicon sealant to filled gap.

Modular glass partition with metal wire-raceway on top/bottom.

Glass partitions made of 12mm toughened glass with minimum 450mm modular metal wire-raceway on the top/bottom. The modular metal wire-raceway shall have the same material as that of metal panelling/partition. The proper structure shall be made to ensure fixing of glass from RCC slab above the false ceiling and support on partition structure below. Straight & vertical structural members shall not be visible. Glass shall be fitted on anodized extrusion with tool-less technology and having a provision for replacing the glass with perforated sheet/acoustic tile by removing the glass. NOTE: - The nature of installation should be replaceable, expandable, and flexible to cater to the future expansion/technical up-gradation.

[H] Doors

12mm thick Frameless tempered clear glass door with fittings (Single / Double Doors): - With door spring and locking arrangements and both way handle and patch fittings or automatic sensor baesd glass door which shall be decided during detailed engineering.

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[I] Lighting and Illumination

LED lights

Brief: - The lights shall be available in flat panels. These shall be designed and developed with slim shape for stylish look. The product shall have better colour rendering index for interior illumination.

The LED shall have three basic choices of colours like cool white / warm white / neutral white. The LED lights shall have uniform light distribution without any spots on surface of panel, to make it highly luminous.

Round LED Lights: - High performance LED downlighter with high system efficacy for good quality and uniform lighting. Conforms to general lighting norms for office and other indoor applications.

Colour Temperature (K)- 3000 K / 4000 K / 5700K

LED Efficacy (lm/W) – 100 to 160

CRI >70

Power Consumption 6W to 24W

LED's life >25,000 hours @ L70

LED Based Square lights

LED office General Lighting Solutions which offer excellent energy saving and maintenance free operation. The luminaire has a slim design which is suitable for recessed mounted application for office Spaces. Powered by Long lasting LED light source and high efficiency optical system the luminaire offers a uniform and uninterrupted Lighting.

Light source: LED

Light color: 3000 K / 4000 K / 5700K

Power consumption: 29 to 38 W

Input Voltage Range (V) - 150 - 270

LED's life >25000 hours @ L70

MASTER LED tube integrates in Baffle Ceiling: - It integrates a LED light source into a traditional fluorescent form factor. Its unique design creates a perfectly uniform visual appearance which cannot be distinguished from traditional fluorescent. For those that are looking for value for money within limited budget and re-lamping efforts for better light effect and lifetime.

Lumen Output - 2000 – 3000

Colour Temperature (K)- 3000 K to 6500K

LED's life >25,000 hrs @ L70

CRI >70

Input Voltage Range (V) 150 - 270

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LED Efficacy (lm/W) >150
Power Consumption (W) 20W to 32W

LED based Strip Light for Ceiling: - It will be a continuous rail of LED light, high brightness, neutral, or warm white with wall washing applications. Its slim profile and simple daisy-chain system allows high design flexibility to form long.
Light source: LED
Lumen output: 600 lm/m
Light color: 6500K
Power consumption: 3W/m to 5W/m
Operating Voltage Range (V) 100 – 300
Operating Frequency (Hz) 50 ± 3%
Colour: White
Lifetime: 15000 burning hrs. (At L70)

[J] Control Desk

Technical Specifications: - The control room console solution shall conform to high standard of engineering as mentioned in the document; meeting the specified codes, standards and designs. It shall be capable of performing 24X7 operations under the specified environmental condition in compliance to control room ergonomic norms i.e. ISO 11064.
Structure
Made of heavy duty extruded vertical and horizontal aluminium profiles of 6005 grade. The extrusions shall be duly powder coated with 40+ microns over all surfaces. All sheet metal parts shall be finished with a durable, black, electrostatic powder coating. The structure shall allow easy assembly of shutters, slat wall, gland plate, and monitor arms in extremely rigid manner.
To allow future extension and expansion, a weld free system shall be proposed. The structure shall be rigid enough to withstand BIFMA X5.5: 2014 tests. The structure shall allow easy assembly of shutters, slat wall, gland plate, and monitor arms in extremely rigid manner. Following tests shall be qualified to ensure the stability of the structure.
Tests shall be based on ANSI BIFMA X5.5 -2014 standards applied to the proposed product solution.
The EPD (Environmental product declaration) of console shall be verified in accordance with ISO 14025 (from UL/Intertek) for Impacts on environment by console.

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Table top: - The material of the working surface shall be minimum 25 mm thick MDF with High Pressure ANSI/NEMA LD3 certified scratch-resistant laminate.The proposed console's life cycle should be assessed (from approved LCA consultant) for environmental impacts associated with all the stages of a product's life for cradle to grave analysis.

[K] Colour Coordination

Tenderer shall ensure full co-ordination of the colour of various components of the control room in consultation with client/consultant for Natural Gas compressor control room viz. walls, ceiling, floor Vitrified-Highlighter), control desk & other furniture, which shall be aesthetically appealing. A comprehensive proposal for the colour coordination shall be furnished to Client/Consultant during detailed engineering for approval
The Tenderer must pay particular attention in the positioning of desk mounted TFT's and large video screens in relation to control room lighting in order to minimize reflections

06.08.00 Miscellaneous Requirement

I. Safety Requirement

All the equipment in PLC shall be located in general purpose non-hazardous area, normally in control room. However, transmitters, process switches and final control elements shall be located in the field and shall be specified as per the electrical area classifications. Intrinsically safe certified transmitters shall be used if located in hazardous area. PLC shall have either built in intrinsic safety or shall use external barriers for intrinsic barriers. All process switches and solenoid valves shall be explosion proof as per safety area classification.

The system as a whole shall be intrinsically safe based on entity concept. It may be noted that the transmitters and I/P converters bought separately can be of different make and modules certified intrinsically safe by any of the recognized statutory body like FM, BASEEFA etc. These details shall be specified during engineering. Zener barriers selection shall be done based on the type of transmitter or I/P converter and shall be certified intrinsically safe by any of the statutory body.

II. Electrical Disturbances

The control system shall be able to operate in environments presenting disturbances generated by

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- Radio transmitters-receivers
- UHF and VHF transmitters
- High power electrical motor
- Atmospheric discharges

A great deal of caution shall be used while filtering the incoming signals and in the radio shielding of serial transmission cables.

III. Earthing

Each panel, cabinet, console, and other equipment on Control Room shall be provided with an Earthing lug. All these lugs shall be properly secured to the AC mains earthing bus. All circuit grounds of electronic instruments, shields and drain wires of signal cables shall be connected to instrument ground bus, which is electrically isolated from the AC mains Earthing bus. This bus shall be typically **25mm wide and 6 mm thick copper**. The instruments ground bus is connected to independent instrument Earthing pit through insulated wire. All AC mains earth bus and instrument ground bus shall be properly connected to the separate earth pits. Preparation of earth pits shall also be in the Tenderer's scope.

All zener barriers if used shall be securely grounded. The zener barrier ground wire shall be capable of carrying a maximum fault level current of 0.5 amps at 250v rms per barrier.

06.09.00 Testing, Installation, Commissioning & Acceptance of PLC

Vendor shall submit his own testing, installation, and commissioning and acceptance procedures (For hardware the procedure, results expected and acceptance criteria. For software, it shall include details of the method, list of tests, sequence of execution, results excepted and acceptance criteria). The testing and acceptance of the system shall be carried out on the mutually agreed procedures and criteria based on this specification and vendor's standard procedures.

I. Factory testing & acceptance

I.1 Vendor shall test and demonstrate the functional integrity of the system hardware and software. No material or equipment shall be transported until all required tests are successfully completed and certified "Ready for dispatch" by the Client / Consultant

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I.2 The Client / Consultant reserve the right to be involved and satisfy him at each and every stage of inspection. The client/ consultant shall be free to request any specific test on any equipment considered necessary by him although not listed in their specification. The cost of performing all tests shall be borne by the vendor.

I.3 Vendor to note that acceptance of any equipment or the exemption of inspection or testing shall in on way absolve the vendor of the responsibility for delivering the equipment meeting all the requirements specified in this specification.

I.4 It shall be vendor's responsibility to modify and / or replace any hardware and software if the specified functions are not completely achieved satisfactorily during testing and factory acceptance.

I.5 Vendor shall not replace any system component/ module/ sub-system unless it is failed. A log of all components modules in a sub-system shall be maintained which shall given description of the failed components/module, effect of failure on the sub-system, cause of failure and number of hours of operation before it failed.

- The interconnection between power earth busbar and earth pit for power earth will be through 25 sqmm Multi stranded copper cable PVC insulated.
- The interconnection between System/Shield earth busbar and earth pit for System/Shield earth will be through 25 sqmm Multi stranded copper cable PVC insulated.
- Earth pits shall be located at field.
- The minimum distance between system/shield earth pit and power earth pit shall be 10mtrs.
- The earth resistance shall be less than 0.5ohms.

All zener barriers if used shall be securely grounded. The zener barrier ground wire shall be capable of carrying a maximum fault level current of 0.5 amps at 250v rms per barrier.

I.6 If malfunction of a component/module in a sub-system repeat, the test shall terminate and vendor shall replace the faulty component / module. There after the test shall commence all over again.

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If even after this replacement, the sub-system fails to meet the requirements, vendor shall replace the full sub-system and the system shall be tested all over again.

I.7 a) Vendor shall perform tests at his works to ensure that all components function in accordance with their respective specifications for review within two weeks of completion of each type of test giving details. All sub-system shall undergo a minimum of 30 days burn-in period.

b) As for as electronic modules are concerned, aging tests corresponding to at least 300 hours of functioning shall be carried out in the most damaging type of environmental conditions for the equipment (Room temperature 45 degree C, non-condensing humidity 80%.

I.8 The test logbook shall contain the following information about the tests:

a. Date / time
b. Loop tag number
c. Test input
d. Test results and sign off with personnel name
e. Action required (if deficiency is detected)
f. Action taken, date of completion and sign off.
g. Special test methods (including special equipment requirement, bypass used etc)

I.9 Quality Control Test

a) Quality control tests shall be carried out to assure quality of all components and modules in accordance with vendor's quality control and assurance procedures. Vendor shall forward the details of these procedures for Client/Consultant's review.

b) The sampling procedures for all purchased components or components manufactured by the vendor, for quality assurance tests shall be in accordance with relevant international standards.

c) All assemblies shall be aligned and adjusted and all test observations shall be recorded as per manufacturers published set-ups and testing methods.

I.10 System Power-up Test

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Vendor as minimum shall check the function of all the systems hardware and software including diagnostic software at sub-system level by simulating the inputs.

I.11 Factory Acceptance Test

I.11.1 This test shall systematically, fully & functionally test all the hardware and software in the presence of Owner/consultant representative. All the sub systems shall be inter-connected to simulate, as close as possible, the total integrated system. Barrier cabinets shall be used as the connecting points for test inputs and outputs.

I.11.2 The duration of the testing shall be mentioned by the vendor with reasons. System shall be shipped to site only after this testing and certified ready for dispatch by Owner/consultant.

I.11.3 Data Review

a) Client/Consultant shall perform a comparison of all current data. Any revision of changes required shall be informed to Vendor.

b) The test report/log book forwarded by Vendor after Shop Internal Testing shall be reviewed. Client / Consultant has right to witness any test performed in shop internal testing, if found necessary.

I.11.4 Testing Record

During Factory Acceptance Testing each test carried out shall be recorded. Any deficiency or problem shall be clearly brought out and shall be corrected.

Any change in the data or configuration etc. informed to the vendor shall be recorded and carried out by the vendor.

I.11.5 Visual and mechanical testing

a) Visual and mechanical testing shall be carried out in principle to assure correct, proper, good and neat workmanship by the vendor.

b) The following shall be checked:

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The solutions used for limiting the amount of dust that enters the cabinets, the degree of electrical protection of the cabinets and components (degree of dielectric strength of the wired cabinets and of the electronic components installed in the panel) and the protections used against vibrations.

c) Environmental compatibility tests on electronic equipment.

I.11.6 Functional Testing

Functional testing shall include the simulation of each input and output to verify proper system response for both analog and discrete signals. The testing, as a minimum, shall include:

I.11.6.1 Complete system configuration loading.

I.11.6.2 Demonstration of all controller functions from local as well as from central level e.g. changing of tuning consultants, loop tuning, checking of algorithm functions, changing algorithms, changing controller mode, changing controller action etc.

I.11.6.3 Checking of scan time values for controllers and data acquisition sub-system.

I.11.6.4 Checking of loop configuration for correctness with respect to ranges, limits, alarm points, engineering units etc.

I.11.6.5 Checking of all types of TFT displays including process and system displays on Operator and Engineering and other console.

I.11.6.6 Checking of correct functions of keyboard operation for Operator, Engineering and other console.

I.11.6.7 Checking of correct changeover of the back-up units in case of main units failure. This shall include:

a) Uninterrupted controller operation shall be checked. The failed controller database, point record, input and output etc. shall be transferred to back up controller without any interruption. The same shall be repeated for transfer back from back up controller to the main controller card.

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Maximum transfer time shall not exceed the specific value. The test shall be repeated foe controller cards.

b) Uninterrupted auto and manual transfer of main communication bus and interfaces to the redundant ones shall be checked. Further it shall be checked that the transfer back to main bus. This test shall be repeated for all interfaces units in the system.

c) Uninterrupted operation of system shall be checked on failure and resumption of any of the power supplies where redundant floating power suppliers are provided.

I.11.6.8 System diagnostics shall be thoroughly checked for all sub-systems on local level as well as on Operator / Engineering console. These include failure of a sub-system, module, power supply, interface unit, failure of transfer to redundant module on main module failure etc. and other detailed diagnostic displays. Diagnostic alarms for any ventilation fan failure shall also be checked.

I.11.6.9 Testing of proper functions of all printers

I.11.6.10 Testing of system features like interchangeability between TFTs of a console synchronisation of system clocks, selective tuning from Engineering Work Station, Key look functions etc.

I.11.6.11 Checking of various log formats, shutdown reports, I/O mapping and other MIS formats printing.

I.11.6.12 Checking of shut-down and interlocks configuration and proper operation thoroughly.

I.11.6.13 Proper system operation of power supply specification.

I.11.6.14 Checking of proper operation of all foreign devices interfaces with the system.

I.11.6.15 Checking of bus-degradation while loading the bus from 10% to 100%

I.11.6.16 Simulation of power failure and restarts.

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I.11.6.17 Checking of all hardwired instrumentation including all alarm cards, alarm annunciation system, switches and other indicating instruments.

I.11.7 The vendor shall notify the Client / Consultant at least three weeks prior to final system testing. In the events that representatives arrive and the system is not ready for testing, the vendor shall be liable for back charges for any extra time and expenses incurred.

II Installation, Testing & commissioning

II.1 Vendor shall offer the services of the installation team which would install the equipment in the control room lay the interconnecting cabling inside the control room, check out, test and commission the system.

All technical personnel assigned to the site by the vendor shall be fully conversant with the supplied system and software package, and have both hardware and software capability to bring the system on-line quickly and efficiently with a minimum interference with other concurrent construction and commissioning activities.

II.2 Vendor's responsibility at site shall include all activities necessary to be performed to complete the job as per TS including :

a) Receipt of hardware / software and checking for completeness of supplies.
b) Installation of the system including free supply equipment and field cable termination in the system.
c) Check-out of the equipment installation.
d) Checking of inter-connection, hardware & software configuration, overall system functioning etc.
e) Loop checking
f) Liaison with vendor's home office
g) Field tests
h) Commissioning and on-line debugging of the system
i) Performance of final acceptance test

II.3 Loop checking

II.3.1 The vendor shall carry out Loop check the interconnection, configuration and over-all system functioning.

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II.3.2 Calibration and installation of field instruments, installation of junction boxes, interconnection between instruments and junction boxes, laying of single/multi-pair cables up to control room, tagging all field cables, performing continuity/insulation test of cable, core identification of field cables etc.

II.3.3 Vendor scope of work in loop checking shall include termination of field cables in control room, checking of inter-connection between instrument/equipment, ferruling, tagging of interconnecting cables in control room, ferruling of field cables in control room and performing overall loop performance check.

II.3.4 Loop checking shall be carried out to check the functional performance of all elements comprising the loop and thereby ensuring proper configuration, functioning and interconnection.

II.3.5 Vendor shall co-ordinate with the field contractor for smooth loop checking. Any discrepancy found during checking shall be brought to the notice of Client / Consultant's representative. All loop checking shall be performed in his or his authorized representative presence. All readings shall be recorded on a suitable format and shall be submitted for approval.

II.3.6 A) All the components of the loop shall be checked for proper functioning.
All field instruments connected to control room shall be in loop checking at 0%, 25%, 50%, 75%, & 100% of full scale (for both increasing and decreasing signals) and the mode of generating signals from the field shall be as follows for different instrument types.

Sl. No.	Type of Instrument	Mode of signal generation
1.	Differential pressure/flow instruments/DP type level instruments.	By applying impulse to the primary element by squeeze bulb or regulator at field
2.	Pressure Instruments	By applying impulse to the instrument using instrument air, regulator or standard gauge or using portable hydro pump and standard gauge.

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3.	External Instruments	Gauge shall be filled type level instrument with water for different levels and specific gravity correction shall be applied.
4.	Other type of tank level instruments	By lifting the float for 0%, 100% of range.
5.	Temperature loops with T/C.	Appropriate mV signals shall be fed from thermocouple head.
6.	Temperature loops with RTD	Appropriate resistance shall be fed from RTD head.
7.	Pressure switches	Alarm and shutdown simulation by disconnecting the wires at field instruments end.
8.	Owner's supplied items	As per Client / Consultant' representative instructions
9.	Special instruments & any other type of instruments.	As per Client / Consultant' representative instructions

B) Receiver alarm cards shall be checked for different settings on both increasing and decreasing signals. Shutdown schemes shall be checked for proper functioning, configuration and actuation. Performance of individual loops may be accepted for an overall accuracy of +/- 1.0% unless otherwise specified. Where deviation exists, recalibration of instruments, based on the scope of work, shall be carried out either by Field Contractor or Vendor.

C) Signal from controllers/shutdown schemes, control valves/shut-down valves shall be checked at the respective values. The strike checking including checking of time of operation of control valves/shutdown valves also forms a part of loop checking.

D) After loop checking is completed, vendor shall connect back any terminals and connections removed for loop checking.

II.4 Field Testing

All the equipment shall be checked thoroughly after its receipt at site. The tests, as a minimum, shall include:

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a) Visual and mechanical testing
b) Complete system configuration loading
c) Demonstration of all system functions.
d) Checking of loop configuration
e) Checking of all TFT displays.
f) Checking of correct functioning of all key boards.
g) Demonstration of all system diagnostics
h) Checking of correct change-over of redundant devices
i) Checking of bus-degradation
j) Checking of proper functioning of all printers, sample printing of all types of log reports, shut-down reports and MIS reports.
k) Checking of all disc drives, historical trending points, alarm summary and alarm history.
l) Complete checking of shutdown system.
m) Complete checking of hard-wired instruments.
n) Demonstration of proper operation of system at specified power supply specifications.
o) Loading of user's program and check out of results.

III Testing/Calibration Equipments

Vendor shall make available all consumables, instruments, and equipment necessary for testing, calibration, maintenance etc. as required by the defined scope of works. All instruments and equipment used for the above purpose shall be of standard make with accuracy better than the accuracy expected from the calibrated/tested instruments, and certified by National Physical Laboratory or other equivalent agencies. These instruments/equipment are necessary only during testing/calibration/maintenance.

06.10.00 TRAINING

I. The vendor shall carry out training courses for the Owner's personnel. The courses shall be held at the vendor's premises before the plant is started up and the plant during the start-up of the plant itself. The vendor shall make available all the material needed for the courses at his own expense. The courses and the documentation used during the lessons shall be in English.

II. The vendor shall be responsible for furnishing details of course outlines, manuals of training, equipment necessary to conduct the training, exercises to evaluate trainees' progress. Vendor shall also be

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responsible for any other requirements necessary to train the engineers deputed by the purchaser within a time limit so that they acquire the necessary expertise to operate and maintain the programs and the equipment supplied. At least 30 man days shall be envisaged for training operation engineer, C & I maintenance engineer, supervisor and technicians.

III. Purchaser/Consultant shall select personnel for training on the basis of his requirements and shall review all materials furnished for adequacy of teaching aids and time tables.

IV. Training of Personnel

Each Instructor-designate shall have the following minimum qualifications for his area of instructions:

a) Complete and through technical knowledge of the equipment and system supplied under the contract an skilled experience in their programming, maintenance and operation.

b) Complete and through knowledge of the test and laboratory equipment and software, handbook and guides and their actual use as aids and tools in maintaining, diagnosing, programming, operating and trouble-shooting the hardware/software system.

V. Course Contents

The outline of each course shall give the subject matter, a short resume of the prerequisite subjects (if applicable), the position of the course in the training programme, the aim and yardsticks for evaluation and other topics, which shall add to the usefulness of the program. In order that the selected trainees shall have time to participate in the course, sufficient advance notice of minimum 8 weeks shall given by the vendor. The course outlines shall be submitted 10 weeks shall be given by the vendor. The course outlines shall be submitted 10 weeks ahead for review. The training exercise shall be designed to be objective in nature and shall include trouble-shooting exercises on similar equipment.

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VI. Training Manuals

All training manuals shall be prepared by the Vendor and submitted for review 10 weeks ahead of the commencement of the course. After course completion, these manuals shall become the property of the owners. Any change in equipment, manuals and other material shall be informed to the owners. Any change in equipment, manuals and other material shall be informed to the Owner during the guarantee period. In addition to vendor documentation, the following minimum requirements shall be adhered to for the training manuals:

a) Functional flow charts, descriptive material source listings applicable to all operating and application software and diagnostics programs.
b) Schematic drawings of each assembly of the hardware for the course on maintenance.
c) All manuals pertaining to procedures, specifications and operation for each equipment.

VII PLC hardware and software maintenance training

VII.1 Vendor shall conduct a course in hardware (module level and optional component level) maintenance. Software maintenance and diagnostic of the system for Client at Vendor's facility. The course shall be conducted prior to the factory system performance tests so that trained personnel can participate effectively in the final testing if possible.

VII.2 The hardware maintenance training course shall cover every equipment item supplied as part of the PLC. This course shall include:

a) Actual operation, detection and correction of faults in equipment.
b) Familiarization with maintenance procedures for the system offered.

VII.3 Some of the topics covered in the course shall include:

a) Fundamentals of the system
b) Equipment logic diagrams
c) Diagnostic procedures
d) Peripherals maintenance
e) Preventive maintenance procedures

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VII.4 Software maintenance training shall cover all software supplied with the system. The trained personnel shall be able to write and debug the application and system software.

06.11.00 WARRANTY & RESPONSIBILITY

I. The supplier shall guarantee that the supply complies with is indicated in the present specification, in the order and in the documents retrieved by the order itself. Vendor shall be fully responsible for the manufacturer in respect of proper design, quality workmanship and operation of all equipment, accessories etc. supplied by the vendor for the time period in the order.

II. The supplier shall be responsible for the realization of the system configuration, of the block logic, of the management of the commands relative to each single machine operating in a semi-automatic mode (command of the single machine) and automatic mode (automatic start-up and stop of a plant area).

III. If the supply dos not maintain the characteristics and performance levels indicated in the contract during the period of warranty, with the exception of wear within the normal limits, the Vendor shall be obliged to immediately make any modification needed to restore the above-mentioned characteristics and performance levels, at his own expense and care. As far as all these parts that have been replaced, repaired or in any case, directly or indirectly influenced by these operations, are concerned, the warranty period shall be extended by the same basic warranty period, starting from the date the repair, replacement or modification was finished.

IV. It shall be obligatory on the part of the supplier to modify and / or replace any hardware and modify the operating, application and diagnostic software free of costs, of any malfunction is revealed even during on-line operation after taking over with the warranty period.

V. Design, engineering, testing and commissioning shall be carried out by OEM only.

06.12.00 Installation, Calibration, Testing & Commissioning

I. Installation

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a. Instrument piping / tubing installation

i. All primary piping / tubing shall be installed in the best workman like manner and shall follow installation standard in each case where there is no installation standard, the decision of the Engineer-in-charge shall be followed. Horizontal and vertical lines shall be installed using spirit levels and plumb and shall be supported to permanent structure at every 1.5 meter.

ii. Piping / compressor shall have a slope of 10% on horizontal runs. All the welding shall be carried out as per the relevant codes with electrodes approved by the Engineer-in-charge. Only qualified welders approved by the Engineer-in-charge shall carry out the welding IBR grade of welder shall be required wherever BIR grade welding is involved. After IBR welding, radiography as per the required standard to be done by qualified welder. Pipes shall be bent using pipe benders and any hot bending shall be totally rejected. Pipe shall be cut, using pipe-cutting devices. Hot cutting shall not be allowed. All threaded joints shall be jointed using Teflon tapes and no other pipe jointing compound shall be used except on higher temperature service where graphite sealing compounds shall be used. Brand of Teflon tape, insulation tape, and graphite compound is to be approved by the Engineer-in-charge.

iii. Tubing shall be bent with correct size tubing bender wherever possible to avoid the use of fitting. Tubing cutter shall always be used to cut tubing. The use of short length of tubing in long runs shall be avoided. Wherever required coils shall be provided. All tubing shall be run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together where possible. Tubing shall be arranged so that couplings can be tightened without disturbing lines. Pipes or tubes installed but not connected, shall have the ends closed in an approved fashion to prevent the entry of foreign material. For a period up to one week, adhesive tape may be used. For longer periods caps or plugs shall be used. All reasonable precautions shall be taken to prevent foreign material entering pipelines before and during erection. All lines shall be blow through with filtered air before connection to instruments. No pipe or tube shall be left with mechanical strain on it. On tubing to pipe connections and in making up screwed pipe joints, Teflon tape shall be applied to make thread in a manner to insure tape is not over the end of the male fittings.

b. Instrument impulse pipe & fittings

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The design and testing of instrument impulse pipes and fittings shall comply with all currently applicable status, regulations and safety codes. These pipes and fittings shall also confirm to the latest applicable standards. Impulse pipes and fittings shall be designed to meet the requirements of ASME code for pressure piping ASA – B 31.1. Impulse pipes shall be used from process tap points to instrument tea-off and impulse tubing shall be used from tee-off to the instruments.

c. Piping supports

i. Piping and compressor shall be adequate supported and fixed at distances not exceeding those in the following table.

Single Tubing / pipe	listance between suppo supports
3/8 inch OD and less	Continuous
½ inch to ¾ inch nominal site	2 meters (6 ft.)
¾ inch to 1 inch nominal size	3 meters (9 ft.)

All field mounted instrument air tubing shall be supported with steel angles / channels of a minimum 1/8 inch thickness fabricated to present a neat appearance. Multi core / multi pair cables shall always be installed on trays or ducts and properly clamped. At every vertical drop to / from junction boxes, they shall be clamped at frequent intervals as per instructions of Engineer-in-charge. They shall be connected inside the junction boxes strictly according to the numbering systems mentioned in the junction box schedule. All instrument signal / control / power cable shall be run only above the ground level in cable trays / ducts. At bends, minimum radius shall be maintained as per manufacturer's standard.

ii. Thermocouple compensating cables to be laid from instrument location to control room as per required standard. Identification tags shall be provided on either end of individual cores, multicore / pair / triad cables including unused cores as per wiring diagram / cable schedule / junction box schedules PVC ferrules shall be used for identification of cores. Aluminum tag plates shall be used for identification of cores. Aluminum tag plates shall be used for identification of cable / junction boxes. All cables shall be cut, after the exact site measurements are taken between ends and the cable drums shall be so selected before

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cutting the lengths, as to avoid nay wastage. While terminating the leads at the field instruments, a 300 mm length loop shall be provided to facilitate easy removal of instruments. In the field, the cables shall be laid in the overhead ducts and trays as per layout drawings.

iii. While laying cables in cables / trenches or burying them, care shall be taken to ensure that two signal cables like alarm, analyser cables, special cables, compensating cables, etc are separate from other power supply cables. Separation of low signal cables and power supply cables in trays / ducts shall be done as shown in the tray / duct drawing. Jointing of cables are not permitted. At each road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not stack and get damaged by pipe ends after pack filling. After laying all the cables, the cable entry to control room shall be suitably filled and scaled so as to achieve a positive seal against the entry of gas / water etc. All cables shall be laid in accordance with the layout drawings and cable schedule and tubing schedule. Multicore / multipair cables shall be bent in a large redius as per manufacturer's standards.

iv. Cables shall be rigidly supported on structural steel and masonry individually or in groups as required using individual cast or malleable iron galvanised clips, multiple cable supports to cable trays. If drilling steel must be resorted to, approval must be secured and steel must be drilled where the weakening of the structure shall be minimum. Cable shall be supported at every 500 mm. In case, no such supports are available, the contractor shall provide suitable supports for the cable where required. No cable shall be terminated or left with mechanical strain on it in any conduit where cabling are run through conduit, the entry and exit shall be smooth and free from burners. The use of conduits shall be kept to a minimum, as far as possible. Cable must be pulled into ducts / conduit in a way that ensures there is no damage to the cable. All multi-cable laid in ducts shall be properly dressed and tied with nylon wire of 3 mm diameter. All cables finally entering JBs / cabinets shall run through flexible PVC conduits for approximately 500 mm.

d. Installation of Instruments

All electric instruments shall be generally installed on supports as per installation standards. Filter regulators shall be mounted on the instrument supports below the instruments or at the nearby suitable structures as per instruction of the Engineer-in-charge. No instrument

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shall be installed in such a way that it depends for support on the impulse pipes, hand-rails, floor grills, process pipes or structures in the passage. Field mounted instruments shall be mounted on brackets, sub-panels, or placed on a suitable pedestal. They shall be easily accessible from grade, ladder or platform. All local indicators shall be readable from grade or operating level, and if used for manual control, shall be visible from the related valve. Where possible, local mounted instruments shall be mounted at approximately 1.35 meters (4ft 6 inch) above the platform or floor in an accessible position. Instruments shall be mounted as close to the sensing points as possible.

e. Process Connection and Installation

i. Installation of pressure instruments at locations subject to excessive vibration shall be avoided. All measurement tapping points for pressure above 30 bar application shall be provided with a double isolating valve at the pressure source and these valves shall not be smaller than 25 mm. This shall apply to all services where flange ratings are of or in excess of ANSI 600. An additional block valve and vent valve shall be required adjacent to the transmitter. Means shall be provided for venting pressure from the live and gauge so that gauges may be removed safely. Primary injection testing shall be incorporated together in a manifold. Approved ball valves shall be used where temperature conditions permit. The valves shall be rated for not less than the line pressure on the main pipeline.

ii. When an instrument is located at a distance of 2.5 meters or more from its pressure connection, an additional block valve and a vent valve shall be provided adjacent to the instrument vent valves shall be arranged, if necessary, with drain lines to ensure the operation of these valves does not create a hazard. If the pressure piping is of such length that the isolating valve is inaccessible from the instrument location, a suitable valve shall also be fitted at the instrument itself.

iii. All pressure instruments shall be installed vertically. These for steam must be tapped directly from above, for pressure transmitters and switches, there shall also be a condensing leg. The same applies to gas and vacuum measurements, but adequate provision should be made to ensure no condensation can take place along the line, i.e. the slope shall be adequate to drain any condensate back to the main lines (slopping upwards from the sensing point). Tapping points for liquids shall made at an angle of 45^0 from the bottom of the main pipe and these are to be sloped downwards from the sensing point. An exception is made in the

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case of the tapping point for fuel oil or corrosive fluid in which the pressure instrument shall not have direct contact with the process fluid. Any suitable liquid shall be used as a medium to separate the fuel oil from the pressure instruments.

iv. Transmitters, controllers, pressure switches and the like shall be supported independent of the pressure connection. The type of support shall depend upon the make of instrument and location. When installing pressure instruments, care must be taken to avoid the possibility of imposing stresses from the pressure-piping, conduit etc. which may cause mal-function. When the pressure impulse line in liquid filled, the measuring unit shall be compensated for static head. The head correction shall be stated on the unit. All process connections, pressure impulse lines and instrument arrangements shall be fully detailed and to the approval of the Engineer-in-charge.

f. Instrument Erection Hardware

i. Main cable tray is of flat / angle construction with 3 mm thickness and fully galvanised. However, the various bends and tees have to be fabricated as per site conditions, if required. The quantum of trays shall be as per relevant drawings. The trays shall be properly supported at regular intervals. Wherever insert plates are not available, support on concrete structures of ceilings shall be fixed with a minimum of 10 mm expansion blots. Angle supports for trays shall be fabricated as required after retting approval from the Engineer-in-charge.

ii. All supports shall be cut with hacksaw only. Any work executed by gas cutting shall be totally rejected. Free ends of angle supports shall not sharp ends and shall be properly rounded off. All supports shall be painted with one coat of red oxide zinc chromate printer conforming to IS 2074 after cleaning to remove scales and then painted with 2 coats of final epoxy paint. Performed trays shall be used for branching cables and tubes from main trays. Junction boxes shall be erected by contractor.

II. Calibration & Testing

a. Calibration

i. All instruments shall be calibrated strictly as per the manufacturer's instructions prior to installation. The scope of calibration includes all field instruments of all types namely electronic, electrical etc. Contraction shall use his own oil free instruments and air compressor

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for calibration purposes. Conversion from one unit to another for the purposes of calibration is not allowed.

ii. Procedure for calibration for different items are as outlived below. However, the detailed procedure shall be submitted to Engineer-in-charge for approval before proceeding with the calibration.

- All pressure and differential pressure transmitters shall be calibrated to the settings as per instrument data / specification sheet and instruction of Engineer-in-charge. Pressure instruments shall be calibrated by applying pressure to the instrument using dead weight tester and monometer (for low pressure).

- Receiver instrument shall be calibrated and aligned using test hookup as per instruction from the manufacture / Engineer-in-charge.

- Pressure transmitters shall be calibrated at 0%, 25%, 50%, 75% and 100% and vice-versa of range using dead weight tester.

- DP transmitters shall be calibrated at 0%, 25%, 50%, 75% and 100% and vice versa of range using dead weight tester.

- Control valves and positioners shall be checked for hysterisis and linearity and calibrated for rated strokes. Prior to calibration, valves shall be cleaned externally. The steam shall then be 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 valve shall be checked for hysterisis to the accuracy of 1% FS.

All calibration readings shall be recorded in the prescribed format and submitted to the Engineer-in-charge for approval. Where significant deviations from specifications are obtained, the matter shall be brought to the immediate notice of Engineer-in-charge for corrective actions. The contractor is responsible for calibration of all instruments / items covered under the scope of works. The test reports shall be submitted to Owner on a daily basis. Calibration test facility shall be located near the work site.

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b. Loop test

i. Loop test shall be performed after calibration of all instruments and leak test of signal lives loop test in conducted to check the functional performance of all elements comprising the loop thereby ensuing proper connections and operations. Before proceeding for loop test, the calibration results of individual elements shall be recorded on the prescribed proforma and shall get it approved by Engineer-in-charge for correctness of installation, measurement 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.

ii. The field / receiver pressure switches are simulated for abnormality by disconnecting the wires of terminals and function of all associated system are checked. Performance of individual loops may be accepted for an overall accuracy of ±0.5%. where deviations exist, contractor shall recalibrate the instruments which forms part of the loop checking where required, at no extra cost. After the loop test is complete, the contractor shall connect back any terminations and connection removed for loop check. A loop shall be considered as completed, only after measurements in that particular loop are complete and certified by the Engineer-in-charge, in addition to loop sheets being duly filled in all respects and approved by the Engineer-in-charge and Owner. Final certified loop sheet shall be submitted in four copies and one transparency.

iii. Loop checking of following shall be carried out.

- All local loops
- All loops up to local panel
- All loops up to control room
- All loops to control room for non PLC / PLC instrument such as gas detectors, fire detectors and other special instruments.

c. Testing

i. Instrument impulse piping

- Flushing of impulse piping shall be carried out while the live is pressurised after the isolating valve of the instruments is closed. The connection near the instrument shall be opened so that no dirt enters the instrument. Testing of impulse piping /tubing shall be carried out after

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the installation of instrument with primary piping / tubing and flushing is complete in all respects and approved by the Engineer-in-charge. Primary piping / tubing shall be tested hydraulically to 1.5 times the maximum operating pressure.

- After through flushing, lines shall be isolated from both instrument and vessel / piping ends. After pressurisation, the source shall be cut-off and the pressure shall not drop during 15 minutes testing period. The lines shall be blow with air, after hydraulic test. 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 the scale in case of pressure instrument and maximum operating pressure in case of differential pressure instruments with equalizing valve open. In special conditions, where hydro testing is not permissible due to service requirement, the testing shall be carried out by using air / nitrogen as per instructions by the Engineer-in-charge.

iii. Instrument air lines / signal tubing

- Flushing of instrument air lines shall be carried out while the line is pressurized to 7 Kg/cm^2 after disconnecting the copper tube at each air regulator upstream end. The line shall be blow for 15 minutes to remove trace of oil and dirt. The air regulator shall be taken in line, the copper tubing at the instrument end is disconnected and blown for 3 minutes to remove trace of dirt.
- Testing of instruments air lines shall be carried out with instrument air at 7 $Kg/cm\text{-}^2$ up to the upstream of filter regulators after through flushing. All lines shall be checked with soap solution and bubbler unit for possible leak at joint. All the signal tubing shall be tested with 1.5 Kg/cm^2 air after proper flushing.

- All air tubing shall be tested and inspected by one of the methods given in ISA RP7.1 “Pneumatic Control Circuit Pressure Test” Clean & oil free instrument air shall be used for the test instrument air tubing and piping shall not be isolated from the instrument and pressurized to 7 Kg/cm^2. Then they shall be isolated from the pressure source and pressure reading on the gauge shall not fall by more than 1 PSI in ten minutes or as per the acceptance of the Engineer-in-charge.

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iii. All cables (signal, control, T/C extension, special, power supply etc.) shall be laid as per the junction box / cables shall be tested for continuity and for the insulation resistance by a certified megger and checked for proper connections and results recorded and approved by the Engineer-in-charge. The testing shall be done after disconnecting the cable at both the ends.

Cable shall be identified with aluminum tags at both ends and termination ends by PVC ferrules. Wiring shall be checked to ensure that is correctly connected and properly grounded. Correct connections of all electric switches shall be checked. Alarm operation checks shall be made by the contractor to check functionally all alarms and trip system. Wherever possible, process conditions shall be simulated to check the operation. Faults in wiring or piping shall be corrected in the presence of Engineer-in-charge.

iv. Earthing of local panels / cabinets etc shall be done as per the documents and instructions of the Engineer-in-charge. Erection procedure shall be further detailed if necessary after award of contract and shall be subject to the approval by consultant / client.

III. Commissioning

The measuring and control instruments shall be commissioned in accordance with plant start-up schedule. The contractor shall take care to complete all pre-commissioning activities and simulation tests after erection to suit the over all commissioning of respective plant equipment.

The pre-commissioning activities of instruments shall be completed at least seven (7) days in advance as per the schedule of plant pre-commissioning schedule eg. Compressor rolling etc.

The controllers shall be tuned as per the process requirement. The list of set points, alarms interlocks, settings for the controllers shall be furnished in the standard format of controller manufacturer and handed over to client / consultant.

Control loop shall be put on auto mode as per the operation requirement of differential phases.

Before taking over of the plant by the client, all the instruments, system and auto control loops shall run satisfactorily for at least one (1) month at varying

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load without disturbing any adjustment. During this period, supervision and maintenance of total instrumentation equipment shall be the scope and responsibility of the Contractor.

The performance test shall be carried out for the system offered and certificates to these effects shall be approved by the client.

06.13.00 Drawing and Documents

Drawings and Documents for Instruments

Following drawings and documents shall be submitted for conventional instrumentation. All communications/descriptions in the drgs., documents, technical literatures and manuals shall be in English language :

Along with the offer

i) Process and instrumentation (P&I) diagrams for the unit and all auxiliary equipment indicating all mounted instruments and PLC displayed measurement using ISA symbols and using suitable tag numbers against each instrumentation equipment. Alarm and interlock functions shall also be indicated in the P & I diagrams.
ii) Approximate dimension of control rooms and analyser rooms.
iii) Quality and quantity of electric power requirement for instrumentation and also instrument air requirement.
iv) List of deviations/ exclusions if any w.r.t TS

Drawings/documents to be submitted by the successful Tenderer

A. **For approval**

i) Process and instrumentation (P&I) diagrams for each TB and its auxiliaries indicating all field and panel mounted instruments using ISA symbols and using suitable tag numbers against each instrumentation equipment. Alarm and interlock functions shall also be indicated in the P & I diagram.
ii) Specification of each instrumentation equipment indicating make, model no., application, scale range, quantity, tag no. (as per P&I diagram), accuracy, power consumption etc. Data sheets for each instrument as per standard format shall be submitted with all the required details filled in along with detailed technical literature. Schedule of instruments / BOM shall be submitted by the Contractor.
iii) Analog control schemes for NGC and measurement diagram.

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iv) Specification indicating make, model no., accuracy, quantity of laboratory equipment along with detail technical literature.

v) Instrument power supply diagram and instrument air supply diagram along with bill of quantities (BOQ).

vi) Instrument panel general arrangement drawings (both local and remote panels) along with BOQ for all units.

vii) Disposition of instrument panels, desks, cabinets, consoles etc. inside control room and computer room.

viii) Disposition of sampling instruments, cabinets, racks etc. inside analyser rooms (both dry and wet).

B. **For procedural Checking and Records.**

i) Instrument panel wiring diagrams.

ii) Hook – up diagrams.

iii) Data sheet for Control Valves

iv) Erection / installation diagrams for all primary sensors and field mounted equipment.

v) Alarm annunciation scheme.

vi) Flow sensor & control valve sizing calculation sheets.

vii) Instrumentation layout drawing showing location of sensors, control valves, transmitters etc. and route of cables from these up to the instrument panel in the control room.

viii) Cable and pipe schedules with specification.

ix) Manufacture's test, calibration and guarantee certificates for all the instruments.

x) Operation and maintenance manual for each instrument.

xi) Quality assurance plan for each instrument.

[C] **Drawings and Documents for PLC**

Following drawings and documents shall be submitted for PLC System. All communications in the drgs., documentations, technical literatures and manuals shall be in English language

[D] **Along with the offer**

i) System configuration diagram along with write-up on the system

ii) Instrument power requirement

iii) Tentative integral layout sketch of cubicles, consoles, peripherals etc. inside control room including total area requirement.

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Drgs/doc to be Submitted by the successful Tenderer

A. **For Approval**

i) System configuration diagram along with write-up on the system.
ii) Bill of Material for PLC
iii) I/O listing
iv) Nest loading details.
v) Overall G.A. and general arrangement of various cabinets, panels, consoles etc. showing internal disposition of all components / units etc. with dimensional details.
vi) Single line power supply diagram.
vii) Graphic display sheets, plant mimic sheets.
viii) Quality assurance plan.
ix) System grounding scheme with bill of materials.

B. **For Reference /Information category drawings**

i) Wiring and termination diagrams for marshalling racks, cabinets and consoles
ii) Cable schedule, cable routing,
iii) Data sheet of cables
iv) Formats and work sheets for generation and display of overview, groups, loops, graphics, alarms, operator's guide messages, real time and historical trends, log and shift formats.
v) Application software formats and details in documentation and floppy disks.
vi) Hookup drawings
vii) Foundation plan drawings for various cubicles and consoles with dimensions along with opening on floor for cable entry
viii) Bus loading calculations
ix) Factory testing and acceptance procedure
x) Initialization/booting procedure and associated system software in documentation (all in English language) as well as floppies
xi) Test, calibration and guarantee certificate
xii) Operation and maintenance manual (in English language)
xiii) Warranty / guarantee certificate
xiv) Final 'As Built Drawings' and electronic media.

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The quantity 6nos of final drawings and documents to be submitted to client / consultant shall be as per contract with **good spiral binding/Binding** no loose documents/drgs shall be accepted.

The quantity of drawings and documents to be submitted to Owner / Consultant shall be as per contract.

06.14.00 LIST OF MANDATORY SPARES

Clause No.	List of Mandatory Spares
1	LOCAL INDICATORS 1 NO EACH TYPE
2	1NO each . DPT,LT,PT,
3	PLC – CPU-1no. Communication card-1no. Power Supply-1 no. DI card-2nos DO card-2nos AI card-1 no. AO Card-1 Interposing relay-50nos FTU- DI-2nos., AI-1nos, DO-1nos SIL3- TMR -1 module
4	SOV -25nos
5	Rota meter – 2nos
6	**CONTROL VALVES ACTUATORS AND ACCESSORIES**
	2 nos. complete set of critical application control valve

06.15.00 List of Laboratory Instruments

i. HAND HELD HART CALIBRATOR/Configurator-1no.

Type		Universal type, SMART, HART compatible shall be able to calibrate / configure different makes of Smart transmitters
Operating Temp. Range		upto 60 deg C min.

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Display		Wide Screen LCD
Key Pad for navigation		Necessary keys shall be available for navigation, Configuration, operation, etc.
Electrical Connection		i. 2 standard banana jacks, suitable for 1.5m (5 ft) lead set with insulated mini grabbers and alligator clips to be provided for Transmitter Connection.
		ii. Min. 1.5 mtr. USB cable for connection to PC.
		iii. Suitable cable for connecting to Battery charger / Power Socket.
Accessories		a. Leather case
		b. Battery assemblies(rechargeable disposable versions)
		c. Power adaptor/battery recharger with universal plug
		d. Elastic handle strap & rubber shell
		e. USB cable & leadset to the transmitter with minigrabbers
		f. Soft carry bag with adjustable shoulder strap
		g. DVD with PC tool software and HART library

ii. **Handheld mA Calibrator -1no.**

This instrument shall provide an accurate and reliable measure of milliamp signals for use in calibrating receiver type instrumentation. The instrument shall be power by a self-contained rechargeable battery pack and shall include a battery charging circuit which operates automatically when the instrument is connected to a 240V AC supply. The instrument shall be designed to operate from a 240V AC, 50 Hz supply with the battery pack removed. The instrument shall meet or exceed the following requirements

Input range – selectable	:	0 – 10 mA
	:	0 – 100 mA
Output Range – selectable	:	0 – 10 mA
	:	0 – 100 mA
Protection	:	100 % range
Accuracy	:	+/- 0.02% of selected span
Ambient temperature	:	0 – 50°C

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Ambient temp. error	:	0.05% of span

iv. Handheld Thermocouple Calibrator -1no.

Thermocouple calibrator shall be capable to accept all types of thermocouples (type J, K, T, E, R & S). Calibrator shall be digital LCD display and shall operate from built in rechargeable battery source. This shall be capable of both measurement and calibration mode of operation. Cold junction compensation shall be built in

Accuracy	:	Measure : 0.5deg C for K Type T/C between (-)150 to 750 deg C;
	:	1.0deg C for R/S Type T/C between 400 to 1750 deg C;
	:	0.4deg C for T Type T/C between 0 to 400 deg C;
Simulation	:	0.4deg C for K Type T/C between 190 to 1250 deg C;
	:	0.4deg C for R/S Type T/C between (-)50 to 800 deg C
	:	0.5deg C for T Type T/C between 150 to 400 deg C;
Ambient temperature	:	50°C (max.)
Temperature effect	:	0.01% per degree C or better
Power supply	:	240V AC UPS Power Supply for Table Mounted and in Rechargeable battery for field operation
Voltage protection	:	Equipment shall be protected against external voltage upto + 110V DC
Accessories	:	i. Carrying case
		ii. Connector leads
		iii. Extension cable
		iv. calibration certificate
		v. Battery with charger
		vi. Instruction manual

iv. **Handheld RTD Calibrator -1no.**

RTD calibrator shall be capable to accept 2, 3 & 4 wire platinum resistance thermometers of 100 ohms and copper resistance thermometer of 53 ohms. Calibrator shall be digital LCD display and shall operate from built in battery

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source. This shall be capable of both measurement and calibration mode of operation.

Accuracy		+/- 0.25% of full scale
		+/- 0.05°C or better
Ambient temperature		50°C (max.)
Temperature effect		0.01% per degree C or better
Power supply		240V AC UPS Power Supply for Table Mounted and in Rechargeable battery for field operation
Voltage protection		Equipment shall be protected against External voltage upto + 110V DC
Accessories		i. Carrying case
		ii. Connector leads
		iii. Extension cable
		iv. Calibration certificate
		v. Battery
		vi. Instruction manual

v. **Handheld Multi Function Calibrator-1no.**

The portable unit is intent to measure electronic transmitters, RTD's, Thermocouples and act as a source for calibration of secondary instruments and system inputs. The instrument shall be digital LCD display and shall display simultaneously both input measured value and output signal.

Data entry shall be through numeric entry function keys. Instrument shall have built in diagnostic and auto calibration facilities & shall also be capable of measuring voltage, current, thermocouples, RTD's & frequency and stimulation of corresponding primaries including two wire transmitters.

Accuracy		+ /-0.025% typical
Thermocouple		Type J,K,T,E,R&S
RTD		Pt-100 Ohms
Volts		0-10V, Resolution 0.2 mV
Millivolts		-10-120 mV, Resolution 2 Microvolts
Current		-5-60m Amp Resolution 1 micro amp
Ohms		0-4000 Ohms
Frequency		120-50 KHZ
Power supply		240V, AC 50 Hz

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Common Mode rejection		80 db at 60 Hz or better
Normal mode rejection		40 db at 60 Hz or better
Linearity		+/-0.005 percent of span
Repeatability		+/-0.005 percent of span
Ambient temp.effect		+/-0.005 percent/deg.C
Long term stability		+/-0.00025 percent/100 hr non-cumulative
Ambient temperature		50 deg.C
Input protection		Upto 140V DC
Input/output isolation		300V DC, 50 M Ohm

Calibrator shall be furnished with RTD simulation facility, external charged battery pack, test leads, set of fuses, instruction manual. In addition one set of spare battery pack as well as charger for spare battery pack shall be supplied with each instrument.

vi **Handheld Pressure Calibrator -1no.**

Type		Precision Electronic with digital display
Range		i. 0-500 mmwcl
		ii. 0-2500 mmwcl
		iii. 0-1.6 kg/cm2 g
		iv. 1.6-10 kg/cm2 g
		v. 0-16 kg/cm2 to 0 – 250 kg/cm2
Accuracy		+ /-0.002 + (+/- 0.05 % of Reading)
Resolution		1 mm
Over range protection		20 percent of span
Pressure sensing element		Capacitive transducer
Display		
- Type		LCD
- Digit		4.5
Function		Display for actual value and Percentage error.
Other functions		24V DC supply for two wire transmitter Contact monitoring for switch devices
Power supply		240V AC UPS Power Supply for Table Mounted and in Rechargeable battery

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		for field operation
Operating temp		60 deg.C
Pressure connection		1/8 and 1/4 inch BSP and NPT
Accessories		1. Calibration pressure pump
		2. Current output modules
		3. Instruction Manuals
		4. Carrying case
		5. Battery Charger
Application		Calibration of pressure / diff.pr. transmitters, pressure switches and converters etc.

vii. **Handheld Digital Multimeter-1no.**

Portable digital multimeters, with high voltage grade leads/probes and suitable casing including carrying strap are envisaged. Digital multimeter shall have 4 1/2 digits read out indicator with automatic decimal point and polarity indicator. Indication shall be in seven segment LCD display. Meters shall be complete with accessories for high voltage, DC current, temperature, Capacitance and frequency measurements.

Instruments offered, shall have built in overload protection feature. These shall have high resolution and low response time. For AC signals (True RMS) digital multimeter shall have good fidelity over a large range of frequencies. Signals and ranges required to be measured by the motor are furnished in a tabular form below :-

Sl.No.	Signal type	Range	Accuracy
1.	DC voltage	100 mV	+/- 0.02% +1 digit or better
		1 V	-do-
		10 V	-do-
		100 V	-do-
		500 V	-do-
		1000V	-do-
2.	AC voltage	Same as DC voltage	+/-0.5% of reading + 2 Digits or better
3.	Direct Current	200 micro amp.	+/-0.75 % of reading + 2 Digits or better
		1 mA	-do-
		10 mA	-do-
		100 mA	-do-
		1 A	-do-
		10A	-do-

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Sl.No.	Signal type	Range	Accuracy
4.	Alternating Current	Same as Direct Current	+/-1.0% of reading or better
5.	Resistance	0.1 K ohm	+/- 0.5% of reading + 2 digit
		1 K ohm	-do-
		10 K ohm	-do-
		100 K ohm	-do-
		1 M ohm	-do-
		10 M ohm	-do-
6	Input resistance	10 Meg ohms	
7	Ambient temp.	0-50 deg.C	
8	Ambient Temp.	0.1% of reading error from 0-50 deg.C	
9.	Indication Lamp	One red indication lamp shall indicate the overload.	
10.	Quantity	4	
11	Accessories	Test leads, One set of spare Alkaline battery, Software & hardware for interfacing, etc	

viii. Electronic Test Bench – 1 No.

Self contained test bench made of anodized aluminium for testing and repair of electronic instruments and gadgets shall be furnished. It shall be modular in design enabling easy change of arrangement. The test bench shall have approximate dimension (LxWxH) 1500x750x650 (mm) with thick laminated top. The front panel shall be made from 3 mm thick anodised aluminium plate and individually engraved in mimic style. Sufficient drawers shall be provided.

The test bench shall include the following module:

(1) Main Power supply module: It includes main switch for whole workstation 3 ground socket for other instrument, 240V 4A AC low-voltage output, earth leakage circuit breaker etc.
(2) Isolated supply module: It shall include main switch, circuit breaker, 240V AC ±0.5%, 1 phase, 50 Hz, 3 kVA supply socket, no. of socket – six, 110V AC, 10 Amp, 50 Hz supply socket, no. of socket – one
(3) Variable AC power supply: It shall include 0-260V AC*, 1 phase, 50 Hz, 10 Amp, socket and terminal, 0-50V AC/2A, terminals. Digital meter for

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current (resolution 0.01A) and voltage (resolution 0.1V) no. of socket - one

(4) Variable DC Supply: Module shall include 0-60V DC* 3A stabilised output voltage supply No load/full load regulation shall be ± 0.02% or better, Digital display for voltage and current no of socket - one

(5) Constant DC Voltage supply: ± 48V DC*, 3A, no. of Socket - Two, ± 24V DC, 6A, no. of Socket – Two, ± 12V DC*, 10A, no. of Socket – Two. Each unit shall include Digital meter for Volts and Ampere.

(6) Digital multimeter: One four and half digit digital multimeter for display of voltage, current, resistance and having 24 measuring ranges, accuracy ± 0.1%

The following facilities shall also be provided:

(1) One DC voltage stabilizer: Regulation ± 0.02% for (0 to 60V, 1A), 0-100% load variation

(2) One AC voltage stabilizer: Regulation ± 0.5% for (240V AC nominal), 0-100% load variation

*(Voltage level is tentative and shall be matched to supply requirements of Tenderer's range of products)

The test bench shall include socket holders, where the electronic gadgets under test may be plugged. The front equipment shall include multi point connectors and test jacks for inter-connection. There shall be connection between the connector and holder in which device under test shall be plugged in.

The standard high accuracy resistors shall be included to load and measure the current output of devices. Necessary control devices for voltage and current adjustment/control, switches for power supply to feeders, isolation etc., shall be included. All electric circuits shall be protected against overload by MCBs, whose holders are located on front of the panel. All electrical circuits and metal structure shall be properly grounded.

ix. Pneumatic Test Bench – 1 No.

The pneumatic test bench made of anodized aluminium and modular in design enabling easy change of layout/arrangement as and when required shall be provided. The test bench shall be complete with shut-off valves, air filter-cum-pressure regulators and pressure gauges for testing pneumatic transmitters, controllers, power cylinders, control valves etc. The dimension for the test bench shall be approximately 1500x750x600 mm (LxWxH).

The test bench shall be furnished as per the following general specification:

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(a) Complete with regulated air supply outlet of 0-20 psi and 0-30 psi, display plate with two four and half digit digital pressure indicator of range vacuum to 20,000 mm WG and 0-30 psi, accuracy ± 0.05% of full scale.
(b) Complete with Built-in selector for read out in five engg. units i.e. kg/sq.cm., psi, mm Wcl, bar, mm Hg.
(c) Complete with overload protection valve
(d) Complete with control plate with mimic panel incorporating three precision pressure regulators, filter reducing unit for the air supply, three 150 mm dial pressure gauges having ranges 0-2, 0-4 & 0-6 Kg/cm² respectively and accuracy ± 0.25% full scale.
(e) Complete with two 0-30V 0.5A max. Stabilized DC power supply sources
(f) Complete with current source of 0 to 55 mA, and mV source of 0-100 mV.
(g) Complete with set of supports for the instrument under test, desk with drawers and all other necessary accessories.

The Tenderer shall be responsible for connection of instrument air line from his tapping point and also keep provision of giving supply from Air-Sets also. Tenderer must ensure that the consumption of air in the test bench is within the design capacity of the above tapping/piping or source.

x **Dead Weight Tester – 1 No.**

Dual range dead weight pressure gauge tester with combined high range and low range position unit, allowing an automatic change of scale of 10:1 ratio, with dual area screw press with ball thrust and axially located hand wheel shall be furnished. Piston cylinder assembly unit shall be made of special grade die steel or any other suitable material. The tester shall be provided with pressure instrument, levelling screws and relief valves to prevent damage. The measuring range shall be 1-600 Kg/sq.cm with accuracy better than ± 0.015% of the pressure being measured. It shall be suitable for gauges having 1/8", 1/4", 1/2" NPT connection.

Dead weight tester to be provided with following weights: 4 weights corresponding to 10 or 100 kg/sq.cm, 1 weight corresponding to 9 or 90 kg/sq.cm.,1 weight corresponding to 5 or 50 kg/sq.cm., 2 weights corresponding to 2 or 20 kg/sq.cm., 1 weight corresponding to 1 or 10 kg/sq.cm., 1 weight corresponding to 0.5 or 5 kg/sq.cm., 2 weights corresponding to 0.2 or 2 kg/sq.cm., 1 weight corresponding to 0.1 or 1 kg/sq.cm., 1 weight corresponding to 0.05 or 0.5 kg/sq.cm., 2 weights corresponding to 0.02 or 0.2 kg/sq.cm., 1 weight corresponding to 0.01 or 0.1 kg/sq.cm.,

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Accessories to include spirit level, 8 bonded seals, pointer remover and punch, 2 spanners, one tool roll containing adapters for 1/4" & 1/2" NPT sizes, bottle of technical grade oil, dust cover, wooden carrying case etc.

Test certificate for accuracy and perfect cylindrical shape of the piston shall be furnished.

Software shall be provided to correct for effects of environmental factors such as gravity and temperature to determine the pressure generated by dead weight testers.

7.0 PA Communication System (PACS)

7.1. PA communication system shall be provided as per the specifications provided. The bidder shall take responsibility for the completeness of the system and furnish the details of the units during detail engineering. All the Switching/ Control units of this system are proposed to be located in the Control room. PA system shall be connected to IP EPABX system and VHF based radio system.

7.2. IP based PACS exchange shall be provided with redundant processor, tone generator, fully wired rack, redundant power supply, Telephone Interface, Fire alarm Interface, Access panel, PACS exchange, Radio Interface, N+1 Amplifier, speaker loop termination, Beacon loop termination, line blancing assembly, Zone controller card, multimedia interface, access panel interface, 10 x Field Station Interface, Modbus RS-485, TCP/IP communication provision for interfacing with PLC, SCADA, EPABX, VHF, FAP, etc for monitoring and transfer of all the parameters, alarms, data, etc., Ethernet Switch, input and output control module, surge protection modules, configuration, hardware (rack mount) and software complete with all accessories. All critical resources like controller, tone generator etc. shall be redundant. Minimum 8 Nos. of speaker loops shall be provided with speaker loop monitoring.

7.3. PA & Plant communication system consisting of Central switching unit , Multi function digital controller, Master Control Station with goose neck microphone, units for interfacing with IP EPABX , Station PLC, Fire Alarm Panel, VHF system, Group msg amplifier, CD player, USB player, fire fighting system, complete in all respect for broadcast routine, pre-programmed announcement/ speech & messages, emergency speech & alarms, shall be provided. Necessary interface units for interfacing PAGA with other sub-system shall be provided.

7.4. Fully wired free standing Panel as per the specifications shall be provided for PA system.

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7.5. Surge protection device for the power and communication shall be considered both internal and external type confirming to IEC or UL standards. Surge Protection devices shall be provided as per following philosophy-

- For all incomer power supply (UPS as well as Non-UPS)
- For each IP based phone station
- Earthing Circuit for lightning protection
- SPD for each Explosion proof camera supplied by bidder

7.6. All work required for integration in the existing EPABX system, including supply of all hardware, software, license etc. for complete integration purpose is included in the scope of the bidder without any cost implication to IGGL/ MECON.

7.7. A modern universal and high efficient communication / public address system utilizing IP technology, is required. The system will be used for the transmission of voice & alarms in industrial surroundings. The system shall be applicable for the applications such as

- Public Address
- Warning & Alarming
- Control and Monitoring

7.8. To meet the current and the future communication demands, the system shall be designed as an open, modular system, which facilitates system integration and future expansions. The main purpose of the system is to realise communication, public address and/ or warning functions. However, in addition the system shall be able to realise interfaces to other communication systems.

- Telephone systems for initiation of paging calls
- Control systems via potential free contacts
- Network management systems / SNMP
- Fire & Gas alarm systems via potential free contacts

7.9. The system shall offer, as a minimum, the following main features:

- Possibility to address the industrial plant publicly via the loudspeaker groups with amplifiers installed in the central exchange unit.
- Various voice messages and tone signals (freely programmable signal and tone sequences) can be released.
- Freely programmable communication and public address and general alarm system
- Unblocked communication
- Permanent self-monitoring of the system for immediate recognition of failures
- Control of all functions, software driven
- Numerous standard interfaces to external systems
- Centralized power supply of all connected components (no local power required)

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To meet the latest safety standards, the offered system shall realise the following monitoring functions:

• Permanent monitoring
• Identification of failures and
• Independent generating of failure messages

The monitoring functions shall be there for the following components:

• Components of the central exchange unit (central control board, amplifiers etc.)
• Loudspeaker line monitoring

The system should guarantee communication in normal workflow and/ or in emergency cases. Information, working instructions and alarm messages are transmitted to personnel via access panels, telephones etc.

7.10. IGGL shall confirm areas of manned stations to be covered during detail engineering; however, the speakers shall cover the following areas as minimum –

• Control Building
• Substation
• Pigging Area
• Metering Area
• Complete Compressor Area
• Fire Water Area including pump area
• Security Gate Entry to terminal
• Warehouse
• Admin Building

7.11. The system shall comprise of central exchange(s) consisting of system control hardware, master control station located as mentioned elsewhere in bid document, and paging loud speakers complete with all interconnections. All interconnection cabling shall be of copper conductor, shielded and colour coded. Power supply to be drawn from the plant UPS supply at one point of the exchange. Configuration software with laptop shall be provided for the configuration of supplied PAGA System.

7.12. Central Exchange

The central exchange shall be a pre-programmed exchange with amplifier circuitry mounted in a central cabinet with individual rack mounted amplifiers. The cabinet shall be naturally ventilated, dust and vermin proof with IP – 41 enclosures as a minimum. It shall be possible to locate faults by monitoring from the central cabinet.

The central exchange shall have a processor module for the control of the central exchange. The exchange shall have a completely non-blocking type switching system and associated circuitry for call recognition and acknowledgement. Distinct push buttons shall be provided for various tones and their re-setting.

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7.13. Alarm / Interface

• Alarm tones and priorities shall be configured according to the requirement so that alarm tones are generated under different conditions. Higher priority alarms shall be configured to override those of a lower priority.

• The paging system should have different tones for ESD and FSD siren and the system shall be hooked up with the fire and gas detection system.

• It shall also be possible to operate an alarm call from master control station(s) over all the loudspeakers during an emergency.

• A tone / speech generator shall provide a minimum of three (3) tones in priority sequence. These tones are user selectable, distinct signals that are factory programmed.

• Any other equipment / module required for the safe and satisfactory operation, control, protection, monitoring and testing of the system shall be included in the supply, even if not specifically mentioned herein.

7.14. Flashing Beacon

In areas with an expected noise level of 85 dbA or greater, a Xenon flashing beacon (15 Joules, yellow color lens) shall be installed in a prominent position. Noise level shall be assessed based on the acoustic study. The flashing beacon shall be minimum IP-65 and weatherproof or explosion proof (Ex'd, Zone-1, IIA/IIB, T3) depending upon the area of installation. It shall work on 230V AC. Vendor to note that junction box for beacon installed in hazardous area shall be Zone-1, IIA/IIB, T3 and Ex"d" certified. The cost of the flashing beacon shall be included in the quoted price of PAC system.

7.15. This system shall have PA/ Paging / Loudspeaker stations and connected paging speakers placed in the safe and hazardous areas. The output of the paging speakers shall be sufficient to announce the messages in the operating areas. Safe areas shall have normal speakers and hazardous areas shall be provided with FLP speakers. The exchange shall be suitable to accept min 10 Nos. potential free contacts from owner's fire alarm panel. The contacts shall be used to generate public address alarms through the loudspeakers connected to MCS.

7.16. The system shall allow making announcements / paging to selectively/ Group from any telephone extension provided in safe & hazardous area and also from a mobile VHF handset.

7.17. 2 Nos. Dedicated managed industrial Layer-2 Ethernet Switch for PAC system shall be considered.

7.18. The configuration of paging system shall be as under:

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- Paging amplifiers shall be installed in the safe area, which shall be connected with number of 15/30 Watt FLP paging speakers to be placed at hazardous area.
- Paging amplifiers shall be installed in the safe area, which shall be connected with number of 15 Watt paging speakers to be placed at safe area.

7.19. One USB enabled CD player with integration with PA system shall be provided and installed in control room.

7.20. Separate and independent Desktop mounted Workstation with all required software shall be provided for PA system configuration.

7.21. Non FLP Type Desktop Master Control Station shall be provided in the control room for Announcement, Emergency Operation and to provide back-up services complete in all respect for broadcast emergency announcement/ speech & messages, emergency speech & alarms etc.

7.22. Supply of Intrinsically Non- Intrinsically Safe (Non FLP type) ; wall /column mounted with separate individual speaker unit, working on 230 V AC supply, weather proof canopy , locking arrangement and fitted with switch amplifier chord, rechargeable Ni-cad batteries, rotary switch handset with preset communication. The system shall be as per IS 5780 -1980. The peak output of the speaker shall not be less than 7 watts .

7.23. The Phones shall have the provision for receiving Outside Calls directly through the EPABX / Central control station.

7.24. Ceiling speaker / Horn type Intrinsically safe speaker / Horn type speaker / Box Type Speaker / Cone Type speaker with necessary mounting accessories, junction boxes, mounting brackets, clamps, nuts etc suitable for installation of Ceiling / false ceiling of inside / outside building (as required) complete in all respect. Speakers shall be provided in all the rooms (including cable cellar) of each building in plant. The quantity of speakers shall be provided such that sound level of 75dB is achieved at any place of each room of each building.

7.25. All phone stations (FLP as well as Non-FLP) shall be provided inside suitable enclosures and noise cancellation headphones shall be provided with each phone station for communication. The head phones shall be connected to the respective phone station.

7.26. Non FLP phone stations shall be provided tentatively at following locations–

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- One Number shall be provided in guard room, One Number shall be provided in substation building, one no. In each building other than control room building.

7.27. FLP (Flame proof/ Intrinsically safe) phone stations shall be provided tentatively at following locations–

- One Number shall be provided in each compressor shed.

7.28. Horn Type IS/ exproof speakers shall be provided tentatively at following locations–

- In pump house, In Process Area ; the quantity shall be provided such as to cover the entire pump house and entire process area

7.29. Non IS Horn Type speakers shall be provided tentatively at following locations –

- near main gate, near fire water tank, near transformer area, Outside the control room

7.30. The location details provided are tentative and may be subject to change as per the requirement and as per the direction of EIC at site. The installation of PA system components shall be done as per the decision taken at site.

8.0 VHF communication with Walkie Talkie system for Compressor Station:

8.1. VHF communication system is required for Voice communications at Compressor station with base station, Intrinsically Safe Type **Walkie Talkie sets (12 nos**) & antenna as required **shall be considered.** New VHF tower shall be provided, if required for VHF coverage of the entire compressor station. New bandwidth, necessary licence, obtaining frequency allocation, providing necessary software for programming of Hand-held and base stations & SCAFA clearance from respective statutory organisations is in bidder scope. All works related to liasioning and obtaining license in name of IGGL is included in scope of the bidder.

8.2. The Very High Frequency (VHF) Radio system shall provide coverage within the vicinity of Plant facility for personnel communications within the coverage zones. The radio shall be designed to provide full coverage within 1 km at compressor station. Vendor to ensure radio coverage in the 1 km radius, all required hardware and antennas as required shall be offered by bidder. Bidder shall provide 1 nos. of Fixed Radio with fist microphone and 12 nos. of Explosion Proof Handhelds. Repeaters as applicable shall be provided to meet the required coverage shall be provided by bidder without any additional cost implication to IGGL. The offered Radio system shall support a minimum 10 nos. of channels

8.3. The system shall have an Integrated Wireless Network System that shall integrate the IP Exchange (EPABX) with the wireless communication system. The system

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shall consist with base stations, interface unit, power supply unit, antenna, cables, etc. located in the safe area and numbers of handsets.

8.4. The handsets shall be provided with DTMF keypads, logic cards, Maintenance Free batteries & battery charging unit and must be PESO approved.

8.5. Handheld sets shall be intrinsically safe suitable for Hazardous area application (Zone 1, Group IIA/IIB, T3). Hand held equipment shall be provided with good quality carrying case & water resistance covers and associated accessories. A handset/ telephone shall be connected at each of the base stations. Handheld mobile shall have rechargeable batteries.

8.6. It shall be possible to have two-way semi-duplex communication between handset with handset, handset with any of the extensions of the intercom system and vice versa. The wireless communication system shall also announce paging messages through the paging speakers.

8.7. It shall be possible to have communication from the VHF sets & base stations to outside P & T lines.

8.8. The VHF system shall be provided for area coverage of 1 KM from base station to Handsets and 1 Km from handset to handset. Any number of repeater station required to meet the area coverage is included in scope of the bidder and shall be provided without any cost implication to IGGL/ MECON.

8.9. Bidder has to submit VHF area coverage study along with VHF technical document.

8.10. Intrinsically safe type Walkie Talkie sets with dialling facilities (with batteries & charger unit) - Supply of Intrinsically Safe (I S) VHF hand held sets with DTMF key pad suitable for integration with the Plant PA system & outside Telephone (BSNL/ Mobile) network through Central Exchange with all the user friendly features.

8.11. Spare Batteries for above handsets - Supply of spare battery with charger unit for the VHF hand held sets supplied for above batteries.

8.12. All necessary arrangement & formalities, (including all communication with the service provider, etc) to provide the end solution shall be Bidders responsibility. Owner's responsibility shall be limited to issue of necessary request letters seeking permission, as required.

9.0 Explosion Proof PTZ Camera with in-built IR–

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9.1. Explosion proof PTZ camera is required at the compressor station for monitoring. The Explosion proof PTZ camera with in-built IR as per the specification shall be provided along with all accessories, licenses etc as required. The camera shall be provided by the bidder and shall be handed over to other contractor for installation and integration. However, bidder shall provide all the support required for installation and integration of the supplied explosion proof cameras along with necessary licenses in the camera as required for integration.

9.2. The quantity of the camera shall be provided inside each compressor shed so as cover the entire area inside the compressor shed of each compressor. The coverage study along with drawing shall be provided by the bidder for approval.

10.0 Specification of PA Communication System (PACS), VHF based Walkie-talkie system , Explosion Proof PTZ camera

10.1. ENVIRONMENTAL SPECIFICATIONS

All equipment shall be capable of maintaining the guaranteed performance with operational lifetime of 10 years minimum when operating continuously under the following environmental conditions:

1.	Temperature	Operate: (Except EPABX, Test Instruments Ethernet Tester, IT hardware) : 0^0C to + 40^0 C (guaranteed) & up to + 55^0 C (degraded)
2.	Humidity	At any relative humidity up to 95% within the temperature range of 0 ^{0}C to 40^0 C
3.	Altitude	At any altitude up to 2000m above sea level.
4.	Sand and Dust	The housing to be supplied along with the equipment should be in such a way that entry for dust, insect / rodent is totally prohibited.
5.	Tropicalisation	Shall be fully tropicalised with all cards & conformal coated with lacquer.

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6.	Shock and vibration	Shall withstand transportation and handling by air, sea and road under packed conditions.
7.	Salt, fog and mould	Shall withstand continuous usages in Marine growth environment.
8.	Electromagnetic	Shall meet the requirements as per IEC Compatibility-801.

10.2. General Design Criteria:

i. Generally, all hardware, software and firmware upgrades required within the designated periods shall be supported without the requirement for a complete
ii. overhaul or upgrade for any of the telecommunications equipment. The design of the systems and subcomponents shall facilitate upgrades to the hardware and software to ensure that the systems continue to be operational throughout their planned service life.

iii. All equipment shall be considered against any End of Life (EoL) notices issued by the Vendor / Manufacturer. All associated end of service, end of support and end of spares notices shall also be considered when determining the maximum design life of the equipment. Industry standard practice shall be followed as far as is practicable. This shall apply to equipment sizes, mounting methods, electrical and optical interfaces, terminations, cable entries and all other relevant criteria.
iv. All equipment shall be new and selected from its manufacturer's standard product line. Specially modified or adapted equipment and/or modules shall not be used. Similarly, bespoke equipment and software shall be avoided unless specifically requested by Owner.

10.3. Material Selection:

All materials shall be as detailed in this specification and other reference documents and standards mentioned in this document. All materials shall be new and free of defects and identifiable against their certification. All outdoor equipment shall be of industrial grade suitable to work minimum up to 55 Deg.

10.4. DESIGN GUIDELINES FOR TELECOMUNICATION EQUIPMENTS:

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1. The system design shall be flexible enough to meet future expansion program up to the maximum capacity of each system and sub-system without deteriorating the performance of the system.

2. In general, specifications provided throughout this document shall apply. In case of conflict more stringent specifications shall override specifications given elsewhere and decision of the Owner/Engineer in all such cases shall be final.

3. Equipments shall conform to the similar housing standards and shall preferably be integrated in one 42U or slim rack or ETSI rack for at stations.

4. The optical and multiplexing equipment should be able to work continuously in non air-conditioned environment (guaranteed performance) under prevailing environmental conditions of the sites.

5. All venting, cooling shall be natural. However, in case of equipment internal forced cooling with suitable dust filters may be used, if required.

6. All equipments shall have sufficient number of alarms and supervisory indications and shall be provided with self-diagnostic facilities. All alarms and monitoring & diagnostic facilities shall be built-in & shall be displayed on the front panel of the equipments for ease of maintenance. It shall be displayed on the front panel of the equipments for ease of maintenance. It shall be possible to transmit these indicators, parameters to the control stations/NMS.

   a. The point shall be available on the front panel for system monitoring and easy fault- location.
   b. The healthy condition of the units shall be displayed by green LED's, unhealthy condition by red LEDs.
   c. All-important switches shall be provided with controls on the front panel with suitable safeguard to avoid accidental operation. Manual changeover should be performed by more than one Sequential operating procedure to avoid accidental operation.

7. The equipments shall be fully based on solid-state technology. The system hardware shall be modular to have flexibility to meet any demand for expansion or modification with minimum changes.

8. All equipments shall be immune to EMI, RFI interferences generated by any nearby source & shall meet the latest international standards in this regard.

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9. The equipments shall be capable of functioning with minimum maintenance and shall be preferred to have no requirement of any preventive maintenance.

10. All PCBs used shall be glass epoxy type and shall not chip owing to repeated soldering/de-soldering. The PCBs shall not warp on any account.

11. All wiring-including field interconnection wiring shall be cabled and clamped to the chassis. The wiring shall follow standard color-code. All patch cords shall be provided with connectors matching to the cable used and shall have identification markings.

12. All sub-assemblies or modules, switches and controls and the circuit components shall be so mounted as to permit their replacement without appreciable disturbance to other components.

13. Vendor to specify the power requirement of the offered Telecom system at each telecom station.

14. If the vendor is not using distributed power supply system on individual module basis then the Power Supply cards shall be duplicated (1+1). However, one standalone power supply card shall be able to run the system for its entire lifetime & there shall be sharing of load between the two power supply cards under normal conditions.

15. The vendor shall carryout site survey / inspection as required for design, engineering, installation, integration & commissioning of equipment at site by deploying its competent technical manpower and test/measuring equipment / instruments, tools & tackles. The mentioned site survey & inspection, measurements need to be undertaken following standard test / measurement procedures using calibrated test/measuring equipment / instrument by the vendor

16. The vendor shall be fully responsible for detailed engineering and design of the proposed system. The vendor shall design the network in a scalable fashion so as to support the future bandwidth and service needs.

17. Racks for all the equipment of individual system, sub-system shall be provided from the reputed manufacturers only and they shall adhere to all the quality norms.

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18. The equipment construction should be such that it does not allow ingress or entry of rodents, insects, and dust. For this, equipment should be suitably sealed from all sides, top and bottom.

19. All the special tools and tackles, etc. shall be procured and supplied as a package with its carrying cases, accessories (interconnecting cables, connectors, lamps, batteries, fuses etc.) for their respective manufacturer.

20. Termination for all used interfaces shall be provided with 100% spares capacity.

21. All equipment racks, housings shall be provided with antistatic wristbands.

22. Vendor shall be totally responsible for the completion of the project. Owner/Engineer reserves the right to modify, revise and alter the specifications of equipments and systems prior to acceptance of any offer. System requirements may be modified after selection of successful vendor to meet operational requirements not envisaged at the time of selection of Vendor.

23. Owner/Engineer reserves the right to modify the system requirements till such time the system is ready for final acceptance. Vendor shall undertake to meet the revised requirements without any financial implication to the Owner provided to additional equipments of selection as required.

24. In case at the time of implementation there is any change in the network design & configuration to meet the owner's operational requirements, the vendor shall undertake all the activities such as design, manufacturer, supply, Installation, etc. of additional equipment hardware and software for which additional financial implication, if any, shall be approved by the owner on the basis of sufficient details and justifications being provided by the vendor.

25. If during the course of execution of the work any discrepancy or inconsistency, error or omission in any of the provisions of the contract is discovered, the same shall be referred to the Owner/Engineer who shall give his decision in the matter and issue instruction directing the manner in which the work is to be carried out. The decision of the Owner/Engineer shall be final and conclusive and the Vendor shall carry out the work in accordance thereof at no additional cost to IGGL/ MECON.

26. The Vendor to give full documentary proof of satisfactory worked of the system.

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27. Equipment Panels shall be free standing and conform to minimum IP 42 requirement. The panels shall have lockable front and rear doors and bottom cable entry and provided with gasket and fitting to keep out moisture, salt, dust, greases and corrosives. The panel shall be naturally cooled also fans shall be provided for ventilation. Panel shall be provided with anti vibration pad. Necessary positive electrical isolation for earthing shall be considered as per the requirement of Telecom equipments.
28. All doors, drawers, trays and other weight supporting parts shall be fabricated of metal and adequately reinforced to limit vibrations. All components and devices inside the panel shall be well highly and the panel shall have a tidy look.
29. The equipment cabinet to be supplied shall be constructed to allow free airflow to dissipate heat generated. Construction shall be such that ventilation grills will not be obstructed when equipment is mounted in its installed position. In order to effectively remove dissipated heat from the cabinets, Min 4 Nos. fans along with vent louvers backed by wire fly screen shall be provided. Vendor shall calculate the heat dissipation and where the calculations prove the necessity, then air flow ventilation shall be assisted by integral low power silent running air extraction fans and same shall be included in vendor's scope. Inlet ventilation grills shall be filled with dust filters.
30. The Vendor shall guarantee satisfactory functioning of the system hardware mounted in the panels even in the event of failure of air-conditioning unit.
31. Hardware mounted and wired panels of all systems included in the scope of the Vendor shall be subjected to burn-in operation for minimum 15 days before dispatch to site.
32. Power supply separate feeder for Cooling fans, panel door switches, space heater, maintenance socket and Tube lights front & rear end shall be provided.

Finish

i. All frame and steel work of the cabinets shall be degreased, then phosphate treated or coated with primer, followed by at least two undercoats
ii. All the cabinets shall have 'Nameplates' and 'Tag Plates' correlating with the type and location of the cabinet at both side front & back. Name Plate shall incorporate the Project Details (Client, PMC, Contractor, Project name etc.) and Tag plate shall incorporate type of panel and station type.
iii. The color shall be Front & Rear colour RAL 9002 (Grey white), End Panel side RAL5012 (Light Blue) internal colour shall be brilliant white (It will be finalized in detailed engineering)

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iv. All equipment panel specification shall be as per the specification of PLC panel provided elsewhere in tender. However, the width of panel for PA system shall be 800mm.

10.5. ENGINEERING REQUIREMENTS

i. The equipment shall be fully solid state and adopt state of the art technology. The equipment shall be compact and in composite construction and light weight. The manufacturer shall furnish the actual dimensions and weight of the equipment.

ii. All connectors shall be reliable and of standard type of ensure failure free operation over long periods and under specified environmental conditions. All connectors and the cable used shall be of low lost type and suitably shielded.

iii. The equipment shall be housed in standard 19” rack, or ETSI rack and with front access. The equipment shall have natural cooling and Fan based cooling arrangement.

- MTBF for fan shall be better than 60,000 hours.

iv. The plug-in units shall be suitable type to allow their removal/insertion while the equipment is in energized condition. The mechanical design and construction of each card/unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement and storage.

v. Each sub-assembly shall be clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram in the handbook. Each terminal block and individual tags shall be numbered suitably with clear identification code and shall correspond to the associated wiring drawings.

vi. All controls, switched, indicators, etc. shall be clearly marked to show their circuit diagrams and functions.

10.6. MAINTENANCE REQUIREMENTS

i. Maintenance philosophy is to replace faulty units/subsystems after quick online analysis through monitoring sockets and alarm indications. The actual repair will be undertaken at centralized repair centres. The corrective measures at site shall involve replacement of fault units/subsystems.

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ii. The equipment shall have easy access for servicing and maintenance. Extension of degraded paths to test access point for diagnostic work after traffic is switched over to the healthy path should be provided.

iii. Suitable alarms shall be provided for identification of faults in the system and faulty units. Suitable potential free contacts should be provided for extension of summary alarms.

iv. As and when bugs found/determined in the software, the manufacturer will provide patches/firmware replacement if involved free of cost for three years. Modified documentation (hard copies and soft copies) wherever applicable shall also be supplied free of cost. Ratings and types of fuses used are to be indicated by the supplier.

10.7. POWER SUPPLY

i. Any AC to DC or DC to DC or DC to AC converter as required will be in Vendor's scope. Power supply / Converters cards shall be of N+1 configuration.

ii. Nominal power supply is with a variation over the range of 20 %, the equipment shall operate over this range without any degradation in performance. Power shall be provided at one point, further cabling and distribution is in the Vendor's scope.

iii. The power consumption shall be minimal. The actual power consumption has to be furnished by the manufacturer during detailed engineering.

iv. The derived DC voltages in the equipment shall have protection against over voltage, short circuit and overload.

10.8. EQUIPMENT SAFETY AND PROTECTION REQUIREMENTS

i. The equipment shall have a terminal for grounding the rack. Protection against short circuit/open circuit in the accessible points shall be provided.

ii. All switched/controls on front panel shall have suitable safeguards against accidental operations. The equipment shall be adequately safeguarded to prevent entry of dust, insects and lizards.

- OPTICAL SAFETY REQUIREMENTS

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iii. All optical interfaces should comply to optical safety standards as mentioned elsewhere in the technical specification.

- OPERATING PERSONNEL SAFETY REQUIREMENTS

iv. The operating personnel should be protected against shock hazards as per IS-8437 (1993) "Guide on the effects of current passing through the human body" (equivalent to IEC publication 479-1-1984).

10.9. ELECTROMAGNETIC COMPATIBILITY (EMC)

i. The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein:

ii. Conducted and Radiated Emissions – To comply with class A [for low capacity (below 34 Mbps data rate)] of C ISPR 22 (1993). "Limits and methods of measurement of radio disturbance characteristics of information Technology Equipment".

iii. All equipment shall be designed to prevent the emission of and susceptibility to Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI). Equipment shall not be unduly affected by emissions from nearby equipment, nor shall the equipment itself produce emissions which would affect other equipment nearby. Emissions shall not initiate unpredictable or undesirable actions or responses, measurement errors, communication faults etc. All equipment shall comply with all local regulations and codes in connection with Electromagnetic Compatibility. All equipment shall conform to the recommendations of IEC 61000.

Electrostatic Discharge

To comply with IEC 1000-4-2 "Testing and measurement techniques of Electrostatic discharge immunity test" under following test levels

- Contact discharge level 2 (+ 4 KV)
- Air Discharge level 3 (+ 8 KV)

Fast transient common mode burst

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To comply with IEC 100-4-4 “Testing and measurement techniques of electrical fast transient/burst immunity test” under level 2 (1 KV for DC power lines: 1 KV for signal control lines)

Immunity

IEC 1000-4-3 “Radiated RF electromagnetic field immunity test” Under Test level 2(Test field strength of 3 V/m)

Surges Common and differential mode

To comply with IEC-4-6 “Immunity to conducted disturbances” indicated by radio frequency field.”

10.10. EARTHING SYSTEM

i. Earthpit shall be constructed for telecom system by bidder as per requirement and is included in the scope.

ii. The Bidder shall ensure that all requirements for system earth and earth bonding are considered and included in the system cabinets. Bidder’s earthing arrangement in cabinets should be in accordance with electrical standards. Each cabinet shall be provided with earth bus bars with their frames. All lugs/strips shall be properly secured to the electrical earthing bus with an earthing wire of suitable size. All system grounds of various cards and equipment’s, shields of instrument cables shall be connected to system ground bus which is electrically isolated from the AC mains earthing bus.

iii. All doors, swing frame and removable cabinets shall be provided with earth studs, which shall be strapped to the main frame using flexible braided copper wire. Screens for cables from other control cabinets shall be connected in the system. Screens for inter system cables shall be connected at one end only. Each cabinet, marshalling unit, local panel or junction box shall have a separate earth bar or 10mm earthing stud. Instrument/Clean Earth-Cable screens shall be run continuously from each instrument through the junction box to the telecom earth bus bar in the centrally mounted telecom equipment room. The screen shall be earthed at the equipment room only and tied back and insulated at the instrument device. Each telecom earth bar must be insulated from steel or any other earth system. All field instruments / junction boxes shall be bonded to earth using 2.5mm² minimum conductor size earth cables. The cable shall be terminated to an external earth stud on the field device and terminated to the nearest structural steel member with a suitable nut and bolt arrangement. Earth cable insulation shall be coloured green / yellow.

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iv. Shielded copper wires shall be provided for earthing system.

v. Bidder shall provide 48V DC and 240V AC earthing in separate bus bars in cabinet for cabinet requiring both 48V DC and 240V AC. AC and DC earthing isolation shall be done in such cabinets.

- Standard: IS 3043-1966 or equivalent BIS & IEC standard
- The earthing material to be used shall be Electrolytic Copper having the material specifications confirming to the IS standards.
- The dimension of the Earthing strip, which shall be connected between Earth pit & the equipment or the earthing distributor, shall not be less than 25 mm X 5 mm
- The earthing pit should have water-pouring facility.
- Earthing resistance should be less than 2 ohms or should be suitable for the equipment to which the earthing is extended.

Approval shall be taken for all drawings and the distributions up to equipment as per the directions of Engineers In charge.

10.11. PUBLIC ADDRESS / LOUD SPEAKER COMMUNICATION SYSTEM (PACS system)

I. GENERAL

The description given below is for the main system units/ components and may not cover all. The tenderer shall take responsibility for the completeness of the system and furnish the details of the units not covered here, along with the offer. All the Switching/ Control units of this system are proposed to be located in the Control Panel room of the Security Gate Complex or main control room (Terminal area)

II. CENTRAL SWITCHING UNIT AND CONTROLLER

This is the most important and critical unit for the system. The unit shall consist of two sub-units namely the Switching unit and Multifunction digital controller.

III. SWITCHING UNIT

This shall employ a microprocessor based digital PCM-TDM, Fully non-blocking switching to provide a physical path between the caller and called party under the instructions from the various calling party. The switch shall provide at least 48

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ports to meet the present requirement. It shall also contain its own power supply unit working from normal single-phase mains.

IV. MULTIFUNCTION DIGITAL CONTROLLER:

This is a multi-function controller and shall facilitate various functions and cater to the specific requirements like interfacing with client's IP EPABX, Zone formation, Tone generation, Paging message routing, Barge-in facility etc. Signals for the performance of the various functions are generated and routed in accordance with the requirements.

The following facilities shall be provided in this unit:

i. COMMUNICATION FACILITIES:	
Number of External or trunk lines	Min. 4 Nos
Number of ports for Subscribers/ Field stations	Minimum 48.
Communication feasibility between field stations	100%
ii. SIGNALS/ TONES GENERATED	
Signals/ Tones Generated	Siren Signal, Chime or Alert Tone, Busy tone, Dial tone, Error tone etc. It shall be able to announce pre recorded messages also, the messages will be made available during commissioning stage. There shall be no limit in voice messages.
iii. CONTROLS	
Controls	Mains ON/OFF switch with Fuse Protection
iv. INDICATIONS (LED):	
LED Indications	Power ON status, Trunk line ON status
v. OTHER FEATURES:	
a. Zone formation facility (User programmable).	
b. Paging Message routing for Individual zone, Multiple zones or All zones	
c. Interrupt or Barge-in facility	
d. Interfacing the music source for paging the same into selected/ all zones	

The housing for the unit shall be 19 inch Rack mountable and constructed of Powder Coated Anodised Aluminium of 1.6 mm minimum thickness. The unit shall operate from 240V +/- 10%, 50 +/- 5%Hz, Single phase AC.

V. MASTER CONTROL STATION

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The master control station shall be designed to facilitate both private and public communication i.e. telephonic conversation and paging announcements, from a centralized location, in the Plant. The station, supplemented by the multifunction digital controller shall carry out the various functions, with the operation of specific function keys.

Various components of the unit are –

i. Handset with 2 meter coiled chord.
ii. Key Pad with 12 push button keys (0 thru 9, # & * keys), Display with 2 rows of 16 character LCD for Caller /called party identification, Zone indication and Function display.
iii. Dynamic Gooseneck microphone for Paging in hands-free mode.
iv. 2 watt built-in speaker for hands-free mode.
v. Line/ Page amplifier
vi. 1 watt (minimum) loud speaker
vii. The master control station shall have an Ethernet communication interface with the central exchange.
viii. The PAGA system shall have modbus facility for interfacing with PLC system, RTU, FAP, etc over modbus and ethernet simultaneously for read and write. Redundancy shall be available on different communication cards. Ethernet connections shall be available for communication both read and write to third party devices and for configuration.
ix. Selector switch for hands-free mode of operation.
x. Function switches/ KEYS for special functions like Memory Dialing (MEM), Call Acknowledge (ACK), Redial (RDL), Calls hold, Release (REL), Call Transfer (TRF), Answer (ANS), Interrupt/Barge-in
xi. Indications (LED) for System Status ON/OFF, Zone busy/ free, Trunk Line Status etc.
xii. For Page functions, a common Page switch with various other combination switches shall be provided. The page switch in combination with one more function switch corresponding to different functions shall activate various functions like Initiate siren, Terminate Siren, Zone Selection, All Zone selection etc. The Page switch and all other related switches should be placed in a group.
xiii. All Functions Keys shall be Illuminated keys.
xiv. All Terminations shall be through Connectors mounted at rear side.
xv. The unit shall be desk-top type, surface mountable, made of min. 1.6 mm thick powder coated Anodised Aluminium, working on 240 V, Single phase AC.
xvi. The microphone assembly shall comprise of microphone, suitable gooseneck desk stand with press - to – talk switch with minimum 10-meter long flexible cable and connectors. The microphone shall be of robust construction, unidirectional type, matching with the amplifier, immune to stray magnetic fields and with noise cancelling characteristics. It shall have a frequency response

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covering frequency range of amplifier and noise free true reproduction of human speech shall be possible with the microphones.

VI. FIELD STATION

The field station (also called handset station) is intended for use in the plant at various locations, both indoor and outdoor, covered under the Plant communication system.

These stations have limited features.

a) The field stations shall be designed to suit Wall/column mounting or Desk/Table mounting as per requirement.
b) The Desk/Table top type model is to be designed for mounting inside rooms /buildings either partially or fully protected from an environment of heat, humidity and ingress of water & dust.
c) The wall/Column mounted model is to be suitable for mounting both inside and outside buildings with exposure to harsh environmental conditions prevailing in a Plant of this nature and therefore shall be suitably designed. Wherever a field station is to receive the page calls only and not required to talk back, the station shall be provided with only a loudspeaker and the amplifying unit.

The minimum facilities to be provided in a Field station shall be:

i. COMMUNICATION FACILITY:	
Hand set	With noise cancelling microphone (Or Built-in Mic and Speaker in case of Pilfer-proof station)
Key Pad	With 4x3 Matrix numerals, 0 thru 9
Display	LCD display for alphanumeric user-friendly message during call initiation, call recognition etc
ii. INDICATIONS LED:	
Station Status	Busy
Ringer Status	Ringer ON
iii. OTHER FEATURES:	
Pre and Line Amplifier	Built-in
Power Amplifier	Built-in, 20W
iv. CONSTRUCTION FEATURES:	
Type	Box
Material	LM-6, Minimum 3mm thick
Finish	MATT.

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Paint Colour	Shade 692, as per IS-5 with epoxy coating
Protection class	IP-65 for Wall Mounting station. IP-54 for Desk Mounting station
Power supplies requirements	240V, single-phase 50Hz. AC supply

FLAME PROOF FIELD STATION:

The flameproof station is to be designed for use in hazardous locations inside plant. They shall be suitable for Wall/column mounting and designed for both indoor and outdoor applications. All outdoor field call stations shall be provided with canopy.

In addition to the features for normal FCS as described above the station shall be suitable for the following -

Area Classification - Div./Zone- 1, GAS GROUPS IIa and IIb Indoor/ Outdoor
Class of Protection - IP 65 min.

VII. AMPLIFIER SPECIFICATION: (FOR MASTER AND FIELD STATIONS)

I. LINE AMPLIFIER:

Input sensitivity	5mV rms. At 1 kHz
Output sensitivity	4V rms. At 600Ohms line transmission
Mode of operation	Balanced At 600Ohms line transmission
Signal to noise ratio	60dB
Frequency response	200Hz –10000Hz (+/-3dB)
Total harmonic distortion	Less than 1% at full load
No signal current drawn in	Approx. 30mA
Maximum current drawn at full	210mA.

Digital power amplifiers shall be provided for driving the speakers in the field and indoor locations. Each amplifier shall not be loaded with more than 80% of its rated power. The amplifiers shall be protected in N+1 configuration.

The zone selection module shall be provided to distribute the amplifier power to different selectively addressable zones / loudspeaker groups.
The exchange shall also house all-call module, alarm tone generator module, line interface cards and amplifiers etc.

The offered system shall be flexible and modular in construction with the possibility of expanding to a bigger system in the future. The construction of the

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panel shall be designed to allow for at least 25% expansion for future additions without involving any major modifications in the system.
The central exchange shall have built-in fault diagnostic unit using test and monitoring modules. It shall be possible to locate faults by visual signalling and monitoring by means of test plugs from the central cabinet.

All hardware necessary for fault isolation and troubleshooting shall be supplied as a part of the exchange.

POWER AMPLIFIER:

Input sensitivity	1V rms. At 1 kHz
Operating Voltage	240 V AC, matching transformer for 70V , 110V
Input Impedance	10K Ohms balanced
Output power	250/500 Watt continuous power per output
Signal to noise ratio	> 80dB
Frequency response	200Hz –10000Hz (+/-3dB)
Total harmonic distortion	Less than 1% at full load
Controls	Tone and Volume
No signal current drawn in	Approx. 25mA
Maximum current drawn at full	Approx. 850mA

B. HANDSET SPECIFICATION:

TRANSMITTER:	
Type	Dynamic with noise canceling.
Impedance at 1k Hz	300 Ohms
Sensitivity at 1k Hz	56dB
Frequency Response	200Hz-7000Hz(+/-3dB)
RECEIVER:	
Type	Dynamic with noise cancelling
Impedance at 1kHz	300 Ohms
Sound level at 1 kHz	24+/-4dB
Length of coil cord	2 meter- coiled (ABS plastic)

VIII. LOUD SPEAKERS:

The loud speakers shall be designed to cater to the needs of audibility of announcement in a plant. Depending on the ambient noise and sound output

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requirement the speakers shall be either cone type or horn type. The Cone type speaker shall cater to enclosed space like control rooms, office rooms etc, while the Horn type speakers caters to open space like Plant buildings/ locations. The horn type speakers shall provide output, which is 6dB above the surrounding industrial noise of approximately 80 dB. Control rooms with false ceiling shall be provided with 'Ceiling mounted speakers', which shall be flushed with the ceiling. The speakers shall be complete with mounting brackets and accessories.

Explosion/ Flameproof Loudspeakers shall be provided in specified locations and wherever explosion proof FCS have been provided.

The applicable details of each type are given below:

Construction Material for Cone speaker	Aesthetically designed wooden cabinet
Construction Material for Horn speaker	LM-6, min.3 mm thick
Construction Material for Flame proof speaker, Driver unit housing	LM-6, min 3 mm thick
Finish	MATT.
Mounting	Wall/Column

IX. OTHER SPEAKERS -

A. CONE TYPE SPEAKER:

These shall be permanent magnet, cone type speaker with 6 watts power, line matching transformer housed in sturdy wooden enclosure suitable for wall mounting and generally shall be used indoor premises like Control rooms, Electrical rooms etc. The speaker shall be provided with volume level adjustment with a selector switch. The cabinet shall have grilled metal faceplate to diffuse high frequencies and prevent damage to the speaker. Housing shall be treated with acoustic under-coats to prevent resonance.

Technical parameters for these units shall be as follows:

Output power	RMS-6W
Voice coil impedance	1kHz, 8 ohms
Frequency response	200Hz – 10000Hz, +/-3dB
Volume control	To be provided
Protection-class	IP-54

B. CEILING MOUNT SPEAKER:

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Power Min Max	 3 W 6 W
Frequency Response	100 Hz to 8000 Hz
	Loop In/Loop Out Terminals
Type	Indoor
Mounting	Ceiling
Impedance	8 Ohms
SPL at 1 kHz	93 dB
Weight	150 g.
LMT	Optional
Size	260 mm. Dia (typical)
Material	FRP

Indoor Ceiling Loudspeaker

It shall be false ceiling mount models complete with white grilles, fire dome type, selectable tapping and equipped with a line transformer.

Ceiling speakers shall be provided with necessary support for installing in false ceiling. Bidder shall select ceiling speaker to ensure that the weight and mounting arrangements of offered ceiling speaker shall be within the weight bearing properties of false ceiling material.

Indoor Wall Mount Loudspeaker

Power: 10W

It shall be wall mount models complete with selectable tapping and equipped with a line transformer. Indoor wall mount loudspeakers shall have loop in / loop out terminals. Junction box shall be provided by the bidder if the same is required at field.

• SPL 1W/1m: 87 dB
• SPL rated power: 95 dB
• Tapping: 10W/5W/2.5W

C. HORN-TYPE SPEAKER:

They shall be of power rating 20 Watts complete with driver units, impedance matching transformers, weather canopies, mounting brackets suitable for wall /column mounting and other accessories, suitable for outdoor use normally in Factory shop floors, Gantries, Open areas etc. These shall be designed to have uniform sensitivity, high efficiency and shall provide crisp clear speech reproduction. The mounting bracket shall be with adjustable base, suitable for vertical and horizontal mounting. Firm fixing arrangement with spring/ washers

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shall be provided. These speakers shall be weatherproof conforming to IP 65-protection class. **Explosion proof/ Intrinsically safe units shall also be provided wherever specified.**

Technical parameters for these speakers shall be as follows:

Output power	RMS 20W
Voice coil impedance	1kHz, 8 ohms
Frequency response	200Hz – 10000Hz, +/-3dB
Protection-class	IP-65
	• GRP Material • SPL 1W/1m: 106 dB. • SPL rated power: 119 dB +/- 3 dB. • Power tapping's, via integral transformer Vendor to note that loudspeakers and junction box installed in hazardous area shall be Zone-1, IIA/IIB, T3 and Ex"d" certified

X. STATION JUNCTION BOX

Power Supply	
Input	240V +/-10% AC 50Hz Single Phase
Output	To house conversion equipment for AC, DC as per requirement
Protection	MCB in incoming side and Fuses in outgoing side
Controls	ON/OFF Toggle switch
Arrangement for earthing	To be provided
Terminations	For AC/ DC Power supply, GND, PAGE, PVT, Call MCS etc.
Construction Material	LM-6, 4mm Thickness
Finish	MATT
Colour	Shade –692 as per IS-5
Mounting	Wall/Column
Cable entry	Provision for entry from top and bottom
	junction box installed in hazardous area shall be Zone-1, IIA/IIB, T6 and Ex"d" certified

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XI. LOUDSPEAKER JUNCTION BOX

Connector	Screw type
Cable Entry	From bottom to top through glands
Construction Material	LM-6, 4mm thick
Colour	Shade 692 as per IS-5
Protection	IP-65
	junction box installed in hazardous area shall be Zone-1, IIA/IIB, T6 and Ex"d" certified

XII. PROGRAMMING UNIT:

A PC based programming unit shall be provided along with all necessary hardware and software to facilitate programming of all user functions including the communication chart at site. One set of original software in CDs /DVDs/removable media shall be also provided by the vendor which shall be handed over to Client after commissioning of plant communication system.
The specifications of the PC shall be as follows-

Sr. No	Parameter	Minimum Requirement	Compliance /details	Remarks/ Comments
1	**Make**			
2	**Model**			
3	**Processor**	Intel latest Core-i9 processor , cores >=4, 64 bit, clock>=2.3 GHz, Turbo-boost, memory controller supporting DDR-4 2400 MHz or higher, minimum 2 memory channels, built-in graphics capable of supporting minimum resolution of 1920x1080p, 32bit colour resolution		
4	**Motherboard**	OEM Motherboard		
5	**Memory**	8 GB DDR4-2400 RAM expandable upto 16 GB		
6	**Hard Disk Drive & controller**	1 TB SATA. Support for RAID 0 & 1		
7	**Optical Drive**	Super Multi DVD writer, Min 16x		
8	**Graphics**	Integrated Intel Graphics		
9	**Audio**	Integrated Realtek HD ALC221		
10	**Ethernet**	Intel X540-T2 1 GbE Dual Port Adapter		

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11	**Slots**	Total : 4 (1) low profile PCI slot, (1) low profile PCI Express x1 slot, (2) low profile PCI Express x16 slots		
12	**Ports and Connectors**	**Front I/O:** (4) USB 3.0, headphone and microphone **Rear I/O:** (4) USB 3.0 (2) USB 2.0, (2) PS/2, (2) RJ-45, (1) VGA port,(1) DVI Port, (1) Display Port, (1) audio in, (1) audio out, (1) HDMI		
13	**Form Factor**	Tower		
14	**Monitor**	32 " Color with minimum FHD (1920 x 1080 @ 60 Hz) resolution. Input connector (1 VGA & 1 DVI)		
15	**Keyboard**	Wireless keyboard		
16	**Mouse**	Wireless 2 Button Scroll Mouse		
17	**Software**	Latest Windows Operating System , Latest Microsoft office Suite , Anti Virus, Latest Adobe Acrobat Pro, PA system software		
18	**Operating System**	Latest Windows operating system compatible with NMS software		
19	**Recovery Tool**	Restore CD		
20	**Drivers for different Operating systems**	Drivers should be freely available on OEM's web site		

XIII. SYSTEM FEATURES AND MODE OF OPERATION FOR PLANT COMMUNICATION:

i. The purpose of this system is to provide quick and efficient communication through paging/ private mode and emergency communication to the operating personnel at various locations.

ii. The system shall be designed to provide two-way page/ private communication and based on “distributed amplifier “ principle with signal amplification at each subscriber location so that the communication process is not affected with shut down of any particular station. The announcement shall be carried out in two modes namely ‘Page’ and ‘Private’. In page mode the announcement is made into loudspeakers of all zones or selected zone(s) for broadcasting an important/ emergency message. This mode is also used for inviting attention of any particular field station in a zone and requesting him to call back/ respond.

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The called party then comes to his FCS and converts the conversation into private mode by activating page/ private mode switch and continues the conversation using his handset just like a telephone. Once the private mode operation starts all the speakers of the zone(s) are free to receive the next page call. The total area of operation shall be divided into smaller zones by grouping the subscribers as per the functional requirement.

iii. It shall have the following paging and communication facilities-

a) Call back from any of the field call stations to the master control station(s).
b) Muting facility for silencing the loudspeaker connected to the booster amplifier.
c) Conference call between multiple field call stations at the discretion of the master call station.
d) Initiation of call from any of the field calls stations to master control station.
e) Monitoring the health of the system.
f) Operating an alarm call from master control station(s) over all the loudspeakers during an emergency (An alarm).
g) Speakers may be muted during general pages, but not muted when alarms are initiated, allowing alarm broadcasts to be heard throughout the system.
• Where more than one master control station has been specified, priority communication between the master control stations shall be possible.
• The paging shall be hooked up with the fire and gas detection system
The system shall provide the facility for monitoring speakers and speaker loop status.

Following types of communication shall be possible in the system by selection and suitable programming –

a) Master control station (MCS) to any Field control station (FCS) in any zone and vice-versa.
b) MCS to any one zone, multiple zones or all zones in page mode
c) Paging shall be done from Master Control Station located in the control room.
d) FCS to FCS in same zone
e) FCS to FCS in different zone through MCS
f) Selected FCS(s) to any or all zones in page mode
g) Selected FCS(s) to any FCS without routing through MCS
h) The communication chart shall be prepared after consultation with client and completely user programmable at site. All necessary hardware, software and programming instructions shall be included in supply, so as to facilitate any change of the communication chart by the client in future without help of the equipment supplier.

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i) All page announcements shall be preceded by an alert tone of Apprx. 20-second duration for call attention of the working personnel in the area.

j) The system shall also have additional facility to interface auto announcement module during emergencies like fire, explosion etc. This module shall have top most priority for relaying pre-recorded messages to all the speakers. Facility for making such announcements shall be given only at the MCS and a few no. of FCS through programming.

XIV. FAULT INDICATION AND DIAGONOSIS:

Any failure of any of the main system units like Switching unit, MFDC, MCS shall be annunciated through Audio-Visual means at the location of the Main panel/ Programming console.

XV. PRE TIMED AND RECORDED TONES AND MESSAGES:

The system shall be programmed to announce messages at a pre-determined time or for sirens or 'end of shift' signals to be triggered at fixed times as per site requirement.

The Integral Microprocessor controller shall automatically balance call requirement by employing a call priority algorithm, which shall have a signal hierarchy, this means that signals (calls, messages or alarms) with a higher priority can interrupt and override those of less priority/ importance and lower priority signals can not interrupt or override those of higher priority.

XVI. LOCAL LS MUTE:

While making a page announcement, the loud speaker of the announcing station shall automatically get muted to eliminate the acoustic feedback.

Other facilities of the system shall be –

- It shall have provision to take analog inputs from the telephone network so as to be able to page into the specified areas from designated telephones, anywhere in the telephone network.
- The system shall be 100% expandable with addition of FCS only.
- The system shall directly take an input from the Fire alarm system and shall be able to trigger the appropriate pre recorded voice emergency message to the required areas.

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XVII. INTERFACE BETWEEN PLANT COMMN. SYSTEM AND THE EPABX:

The central page controller shall have an interface with the local EPBX using a number of extension / junction lines. Specified telephones through programming of COS in the EPBX shall have access to dial on to the page controller and make announcement in the required zone(s).

Field Station Interface
PAGA System shall be equipped with interface for min 10 nos. of field intercom station.

Interfacing with Other Systems
PAGA System shall have interface with the following systems:
• Fire & Gas detection System - Hardwired (Potential free Contact)
• EPABX System- SIP protocol
• VHF Radio
• Station PLC Hardwired (Potential free Contact)

XVIII. POWER SUPPLY:

Provision is being made for one no. of feeder of 240 V, 50 Hz. Single ph. AC of suitable rating at a single location i.e. UPS DB at the Control Room in Admn Building. The same shall be used for both Telephone Exchange as well as Plant communication System. Requirement of power for all main and sub units shall be met from this location by use of proper distribution and cabling. For this purpose, all necessary distribution boards, sockets (including explosion proof sockets/ JBs wherever required) hardware, cabling, termination etc. beyond the outgoing terminals of the UPS DB, shall be considered by the tenderer in his scope.

10.12. VHF Based Walkie-Talkie COMMUNICATION SYSTEM:

I. For facilitating ease in operation and maintenance, hand-held VHF Sets (exp proof Walkie-Talkie) are envisaged in Terminal. The sets shall be complete with Rechargeable battery set, Battery charger with detachable Power chord, Set cover and other required accessories. Bidder's scope shall include the responsibilities for obtaining the allotment of three frequencies from the statutory allotment authorities. For this, all necessary liasoning work shall be in the bidder scope. All the cost related to same is included in bidder's scope. The coverage area of the system shall be complete boundary limit of the terminal as covered in suggestive telecom drawing. The system design & approval as per the requirement of statutory requirements is in bidder's scope.

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II. VHF Radio system shall be designed for frequency range of 136 – 174MHz. VHF Radio system Handsets with 1 channels configured based on frequencies allotted from relevant government authorities. The use of these channels shall be for Communications within Plant Area of compressor station.

III. Handheld radio sets used shall be Intrinsically Safe (IS) sets suitable for Area Classification Zone 1 IIA/IIB T3 and certified by PESO. Each VHF hand set shall be provided with dedicated single unit charger.VHF radio antennas shall be supplied and installed at suitable heights to obtain the required 2 Km operation range. The offered Radio equipment shall be based on recent ITU-R and technology standards

IV. **Fixed Radio**

i. Fixed radio shall be installed in the Control Room of Control Building The radios are provided with end-to-end encryption capabilities and operate 136-174 MHz VHF frequency band for voice. The radios shall be supplied with associated antenna and mounting pole, power supply, bracket for console mounting and external microphone and speaker. Fixed Radio shall operate on 240V AC, 50 Hz Power supply.

V. The handheld radio shall have a wide band operation capability to cover the entire frequency range from 136 MHz to 174 MHz. The hand-held VHF radios shall be rugged and approved for both the ATEX and IEC Ex standards, intrinsically safe for use in hazardous areas suitable for Area Classification Zone 1 IIA/IIB T3 and certified by ATEX.

VI. The VHF system shall be provided with portable radio (handheld) programmed with the frequencies allotted & allocated for VHF communications. All handheld shall be intrinsically safe as specified by IEC 60079-14 and shall be certified by CCoE / PESO (Mandatory).

VII. Handheld units shall be splash proof, having an enclosure protection IP 65 as minimum. 6-way multiple charging unit shall be provided at the location where handheld is kept, and the battery chargers should be capable of rapid charging. Accessories like leather case with belt, belt hooking clip, antenna, charger etc. shall be supplied along with each handheld radio set.

VIII. Handset shall have mini- mum 14-character alpha numeric LCD display & keypad. Handheld units shall have operating temperature 0 to 50 Degree.

IX. Handset shall have switch-able RF power level to optimize coverage to conserve battery consumption. Battery charger with proper adapter suitable for 240 V AC, 50

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Hz shall be supplied with each hand- held radio. Intrinsically safe batteries shall be provided and shall have minimum 12 hrs backup.

X. The offered Radio equipment shall have the following features:

1. Display
2. Self-diagnostics
3. Group call
4. Selective programmable call
5. General call
6. Scanning

XI. VHF Radio Interface with other System

i. The VHF Radio System shall interface with the EPABX system, to facilitate communication between telephone users and radio users. Interface with the telephone system shall allow telephone users to dial specific talk groups within the radio system. The VHF Radio System shall also interface with the PAGA system, to allow a radio user to record a message on a voice recorder in PAGA system.

ii. This message will then be transmitted as a broadcast message over the PAGA system after the radio user stops speech recording.

TECHNICAL DETAILS OF VHF SETS:

A. GENERAL

- Frequency- 136- 174 MHz VHF band or UHF Band (Supplier free to suggest any other band considering the topology details)
- Channel capacity- 64 or better channels.
- power supply: To be provided through rechargeable NiMH batteries (Charger and batteries to be included in the offer)
- Protection class- Min. IP 54, Intrinsically safe.
- Resistance against Shock/Vibration- To confirm MIL std 810 C/D/E and TIA/EIA 603.
- Battery strength indication- Through Tri-colour LED.
- Power level adjustment- Switchable.
- Channel sparing- 12.5/25 KHz, switchable/programmable.
- Signalling- PTT-ID.

Other features-Channel scan, Time-out-Timer, Busy channel lockout.

B. TRANSMITTER

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Operating temperature	Maximum 600C
Frequency stability	+/- 0.00025%.
Power	5 W.
FM Hum & Noise	-40dB
Conducted / Radiation emission	-36dBm
Audio response	300-3000Hz
Audio distortion	Less than 3%.

C. RECEIVER

Sensitivity	0.25 micro volt
Inter modulation	70 dB
Adjacent channel selectivity	60 dB @ 12.5 KHz / 70 dB @ 25 KHz
Spurious rejection	70 dB
Rated audio	500 mW
Audio distortion	< 3%.
Hum & Noise	-45dB @ 12.5 KHz, -50 dB @ 50 KHz.
Audio response	300-3000 Hz
Conducted spurious emission	-57 dBm

XII. Bidder shall be responsible for liasioning in arranging operating licenses, including radio frequency licenses, License –in-principle and operating license, for systems and equipment supplied. Bidder shall provide VHF license to add the VHF sets being supplied for new frequency, bidder shall be required to carry out all the works including preparation of application, getting the same approved by Owner, submission of the same to concerned authorities, assist in replying to queries, arrange for inspection/ survey of sites by authorities. Owner will provide administrative support where appropriate in the application by the Bidder for radio frequency licenses and equipment on behalf of Owner.

XIII. Only Annual Frequency charges shall be borne by Owner. All statutory regulations shall be fulfilled before start of installation of system. Licenses shall be in favor of Owner from statutory authority for all VHF units covered under the supply scope. The wireless systems shall be designed to cater for future additions of units and licensing from statutory authority for additional sets.

XIV. Liasioning services shall be provided for obtaining additional frequencies & operating license for additional channels in favor of Owner from statutory authority for VHF units. Bidder to indicate fee charges required for frequency allocation of single channel & its license. Bidder shall also indicate their government liaison charges for above services. Bidder to consider all liasioning charges including

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application charges in their bid, no additional payment shall be provided for the same.

XV. Vendor should carry out necessary liasioning for obtaining the "Decision to grant of License & Operating License" from the Wireless Planning Coordination Committee (WPC), Ministry of Communications-New Delhi. Entire Scope of Job is divided into five (5) steps in sequence:

Step 1:
Successful bidder has to submit the application for new license for new VHF Handsets & Base Stations, Repeater station (if any). Acknowledgement of application has to be submitted to IGGL.
Step 2:
Vendor has to co-ordinate with WPC for processing the application and for generation of demand note (Letter of Intent-LOI) by WPC. Demand note to be submitted to IGGL.
Step 3:
After getting the demand draft for amount mentioned in demand note from IGGL, Vendor has to submit the demand draft to WPC. Necessary co-ordination to be made by vendor for timely getting the Letter of Agreement (LOA) to IGGL.
Step 4:
After getting the LOA vendor has to supply VHF Handsets & Base Stations to IGGL to carry out necessary programming of VHF handsets & Base Stations. Post supply of VHF handsets & Base Stations, Vendor has to submit Invoice, Dealer Possession License (DPL), Covering letter to WPC.
Step 5:
Vendor has to ensure the processing of above-mentioned documents (mentioned in step 4) and to carry out necessary co-ordination with WPC officials for getting the original license.

Note: Time period for Step 2 onwards will be started from the date WPC has started processing the applications. The date mentioned in WPC circular will be taken as staring date. Entire process from Step 2 to Step 5 has to be completed in Sixteen Weeks from the date mentioned in WPC circular.

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Specification For EXPLOSIVE PROOF PTZ CAMERA

		EXPLOSIVE PROOF PTZ 2 MP CAMERA
S.No.	**Parameter**	
1	Compression	A. The IP Camera shall process and compress video images into digital data files utilizing H.264 or better compression technology.
2	Integration	The camera shall integrate with VMS of the approved makes.
3	Lens	MFZ Lens min range (4.5 to 6.5mm) and maximum range (135 to 140 mm) Motorized Focus 10 X digital Zoom, 30 X optical zoom or better
4	Video Streams	Minimum 3 Compressed streams from the IP Camera; 1st stream- 2 MP at 25 fps 2nd stream- 1080p at 15 fps 3rd stream- vendor to specify
5	Power over Ethernet	Provision shall be there for both PoE as well as without PoE power supply
6	Resolution	2MP Full HD images up to 25 fps
7	Low Light Performance	Camera shall offer Infrared LED illuminators that function to a range of up to 200 meters which can be set to automatic, always on, or always off) ; Day – 0.3lux , Night – 0.01 lux.IR sensor inbuilt or external shall be acceptable to meet the performance
8	Camera Operating System	The IP camera shall utilize an embedded stable OS that resides on onboard non-volatile flash memory. It shall not reside on internal or external Hard Disk Drives. The camera shall not use a standard PC based OS and should not require constant virus or OS patch management for proper security protection
9	Storage and Network Optimisation	The camera shall provide a constant bit rate mode where the bit rate and the quality parameters can be set to perfectly match the storage and network requirements

10	Pickup Device	1/2.8" or better type CCD/CMOS/MOS Sensor
11	Authentication and protection	The camera shall use an Unalterable Image Format to maintain the security and integrity of the digital video files.
12	Communications	Ethernet Port along with programmable capability for static or dynamic (DHCP) IP addressing
13	Protocol Support	The camera shall support the following protocols: TCP/IP, HTTP, UDP, DNS, SMTP, RTP, RTSP, SNMP, IGMP,HTTPS protocols
14	Remote Programming Functions	a. Ability to change the network configuration of the camera, including IP address, gateway and port information, transmission protocols, security protocols and other values pertaining to standard network configuration
		b. Simple video stream viewing and PTZ control via the webclient
		c. Ability to adjust compression levels d. Ability to adjust the frame rate
		e. Ability to adjust traditional CCTV camera settings including:
		i. White balance iii. Contrast
		v. DC auto-iris control vi. Shutter speed
		vii. Exposure time
		f. Network Throttling
		g. Password Management h. Camera title
15	Environmental protection (Housing)	A. Operating Temperature: 0° to 60 ° C
		B. Humidity: 10 to 90% non-condensing.
		C. IP66 Compliance

		Enclosure: Stainless Steel – SS316 or better , Electro polished construction
16	Regulatory and Compliance	A. UL
		B. FCC
		C. CE
		D. PESO, Exd IIC T6 and IP66 or better
17	Effective Pixels	1920*1080(2MP)
18	Scanning System	Progressive Scan
19	Day & Night	TDN (Auto ICR / Color / B/W)
20	Image setting	Brightness,Contrast,Saturation,Sharpness,Anti-flicker,Exposure,White Balance, WDR, BLC,Mirror,Flip,3D NR
21	AGC	On / Off
22	Signal-to-Noise Ratio	More than 50dB
23	Wide Dynamic Range	(Min 120 DB) or better
24	Television System	PAL
25	ONVIF S & G profile compliance	Required
26	Bit Rate	32kbps - 8Mbps continuously adjustment CBR/VBR
27	On-board storage	supportable up to 64 GB SDXC/SD Memory recording
28	Video Compression	H.265
29	Ethernet	10Base-T / 100Base-TX, RJ-45 connector
30	Streaming	Simultaneously multi-profile streaming Controllable frame rate and bandwidth Constant and variable bit rate
31	Users	At least 5 users
32	View Material	Vandalproof (IK-10 or equivalent) with Poly Carbonate
33	Power supply	Vendor to specify.
34	Power Consumption	As per POE standard.
35	Mounting	Shall be pole with stand/wall mounted/ceiling mounted with suitable brackets

36	Surge/Lightening Protection	Required (Internal/External) in compliance with IEC 62305 requirements
37	Security	Authentication, IP Filter, User access log, Digest Authentication, IEEE802.1x
38	SD Card	Mandatory. The camera shall be able to record during an alarm/ event or in case of network failure. constant overwrite or to stop recording when the
		card is full and notify the administrator that the card is full
		It shall be provided with 64 GB SD Card
39	Backlight Compensation	ON/OFF
40	Color, Brightness,Contrast	Functionality Required
41	Electronic Shutter	1/25 to 1 / 10000 s or better
42	Digital Noise Reduction/ 3D noise reduction	ON/OFF
43	Automatic Lens Control	Automatic Iris
44	Focus	Automatic
45	Cooling Fan /Heater	Required
46	Upgrade	Through web browser, online, firmware upgrade
47	Controls	Camera shall be remotely controllable and configurable.
48	Pan/Til and Zoom and speed	Pan – complete 360 Degrees Continuous; Pan speed - minimum 0.1° to 20°/sec variable-speed operation . Tilt +/- 90 degrees with auto flip ;tilt speed- 0.1° to 20°/sec variable-speed operation
49	No of presets	Min. 100 nos. Minimum 2 Programmable tours
50	Hazard Classification	Hazard Classification:Class 1 Group A,B,C,D) Class2 (E,F,G) T6 . Class 1 , Zone 1 , A ,Ex d IIC , IP66 , CCOE

07.00 QUALITY SYSTEM, INSPECTION & TEST OF PLANT & EQUIPMENT AT MANUFACTURER'S PREMISES

07.01 General

Inspection & testing of plant & equipment shall be witnessed by MECON / CLIENT as per approved QAP at the works of successful tenderer during manufacturing and / or on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, manufacturing drawings and applicable national / international standards.

07.02 Quality System Requirements

The successful tenderer must recognise the importance of quality and follow defined quality programme in all stages of. manufacturing and quality control activities of the product. Contractor must define and implement the tasks and controls that will provide needed assurance, in case manufacturing of product is sub-contracted either partly or fully and/or for the procured components of the product. All bought-out equipment or component shall be procured from preferred vendor list of concerned project.

MECON / CLIENT reserve the right to verify the quality programme of tenderer & its vendors/sub- vendors to assure the effectiveness of the programme to meet the intended and specified quality of the product.

07.03 Quality Assurance Plan (QAP)

07.03.01 The successful tenderer shall furnish Quality Assurance Plan (QAP) for all equipment in respective packages after finalization of billing schedule / equipment identification number for MECON's approval at least one month prior to start of manufacturing in accordance with clause 3.2 and 3.3 of this chapter.

07.03.02 QAP shall be prepared & furnished separately by Contractor in Form Nos. 11.20(DQM)F-09,10,11 Ed.3 Rev 1 (specimen blank enclosed) for structural, mechanical, electrical, instrumentation and refractory items respectively , including major bought-out items. QAPs must be submitted in requisite sets as per contract for approval and shalll be duly stamped and signed by the successful tenderer. Also, column no. 4,5 & 7 of QAP formats are tentative and for reference purpose only. QAP submitted in any format other than those mentioned above will not be accepted.

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07.03.03 The successful tenderer shall submit copies of P.O., Sub-P.O., T.S., approved GA drawings/ data sheets & detailed manufacturing drawings(if asked for) as backup reference materials for scrutiny & final approval of QAP by MECON. All billable items as per approved billing schedule of same category (i.e mechanical, electrical, structural, refractory etc) shall preferably be submitted in a single lot, serial wise, to avoid unnecessary delay in the process of QAP Approval.

07.03.04 Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular equipment. Any, additional type or special tests or routine tests if found necessary to establish the intended quality after detailed engineering, then same have to be incorporated in the QAP without any commercial implication.

07.03.05 QAPs shall be prepared by the successful tenderer in consultation with their Sub-contractors / Manufacturers to avoid any complicacy later .

07.03.06 Soft copies may be forwarded in advance for intimation. However, hard copies shall be submitted in requisite sets to enable Client/MECON to forward comments if any.

07.03.07 Approval of QAP does not give approval of make. Make shall be as per contract.

07.04 Calibration of Measuring Equipment

07.04.01 All the measuring equipment used for inspection & testing shall be of appropriate accuracy class and shall have valid calibration certificate with traceability to national standards of NPL / NABL accredited laboratories with unbroken chains of comparison. The calibration certificates shall be submitted to MECON/ CLIENT for review prior to inspection.

Calibration certificate shall also indicate reference no. of calibration standards calibrated by NPL / NABL accredited laboratories and copies of such calibration certificates of calibration standards shall be furnished in the compiled dossiers of inspection/test results if asked for.

07.04.02 In case valid calibration certificates are not available, inspection may not be carried out using uncalibrated instruments. Successful tenderer/contractor shall be responsible for any delay due to re-inspection / revisit.

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07.05 Test Certificates and Documents

07.05.01 For each of the items/equipments offered for inspection, following test certificates and documents as per approved QAP in requisite copies, duly endorsed by the Manufacturer and successful tenderer/contactor with appropriate linkage to project, purchase order and acceptance criteria etc. shall be submitted to MECON/ CLIENT.

i) Raw materials identification & physical and chemical test certificates for all materials used in manufacture of the equipment.

ii) WPS, PQR & WPQ documents as per applicable code.

iii) Details of stage-wise inspection & rectification records for fabricated items, castings, forgings and machined articles if asked for by MECON/Client.

iv) Control dimension chart with records of alignment, squareness etc.

v) Manufacturer's material and performance/relevant test certificates for all bought-out items.

vi) Details of heat-treatment and stress relieving charts as per specification.

vii) Non-Destructive Test reports as per respective code carried out by NABL accredited laboratory.

viii) Static/dynamic balancing certificate for rotating components/machines.

ix) Hardness test certificate.

x) Pressure / Leakage Test Certificates.

xi) Performance Test Certificates for all characteristics.

xii) Routine / Type / Calibration /Acceptance / Special tests (Type Tests etc) certificates for electrical/ power electronics/ automation/ instrumentation items as identified in QAP. Furnishing valid type test certificate for similar design of above items is mandatory until unless exemption is granted specifically in technical specification for any item. In case, type test certificate of similar design is not available, successful tenderer shall organize to carry out such tests at his cost without affecting the project schedule.

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xiii) Surface preparation and painting certificates.

xiv) Certificates from competent authority for the items coming under statutory regulations (IBR/ FM/ UL/ CMRI/ NEPA/ Weights & Measures etc.).

xv) Environmental test reports for electronics/ automation items.

07.05.02 Where physical and chemical test certificates of raw material are not available, the successful tenderer/Sub-contractor shall arrange to have specimens and test samples of the materials, tested in NABL accredited laboratory at his cost and submit the copies of test results in requisite numbers to MECON/CLIENT for review. Number of test samples against each heat/cast/lot or batch of materials, as applicable shall be as per relevant Indian or International Standards. This is admissible only if specific makes are not indicated in the contract.

07.06 Internal Inspection by Successful Tenderer/ Manufacturer

07.06.01 Inspection and tests shall be carried out by Contractor and Manufacturer in accordance with approved drawings/datasheet/material specification/T.S/P.O., relevant standards (BIS/ASME/IEC/DIN/API etc.) and approved QAP. Records shall be maintained for each inspection and test carried out and signed documents shall be submitted to CLIENT/MECON for verification.

07.06.02 The successful tenderer shall carry out their internal inspection and obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety (NEPA/ UL/ FM etc.), IE rules, CMRI etc. prior to offering any equipment for CLIENT/MECON's inspection in accordance with approved QAP.

07.06.03 The successful tenderer/ Manufacturer shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification/rework, rejected etc.

07.06.04 The successful tenderer shall establish and maintain procedures to ensure that the product that does not conform to specified requirements, is prevented from inadvertent use or supply/ installation. The description of non-conformity that has been accepted subsequently by MECON/ CLIENT by concession and/or of repairs, shall be recorded.

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07.06.05 Where facilities for testing does not exist in the successful tenderer / Sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the successful tenderer/Sub-contractor in presence of MECON / CLIENT and sealed sample shall be sent to any NABL accredited laboratory for necessary tests at former's own cost.

07.06.06 The MECON / CLIENT shall have the right to be present and witness all tests being carried out by the successful tenderer / Sub- contractor at their own laboratory or approved laboratories. Also, the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

Repaired and reworked product shall be offered for re-inspection to MECON/ CLIENT along-with records of corrective action taken.

07.07 Manufacturing and Inspection Schedule

Successful tenderer shall submit the schedule for manufacturing and inspection indicating equipment / components, sub- assembly/ assembly, date of approval of drawings / data sheets, address of manufacturer with contact person and scheduled date of inspection. Such reports shall be submitted to respective MECON Inspecting Offices with a copy to Inspection Co- ordinating Office once in a month. These monthly reports shall state the planning for next three months. Submission of first reports must commence one month prior to commencement of manufacturing activities of the product.

07.08 Method of Undertaking Inspection & Testing By MECON/ Client

07.08.01 Inspection call shall be given only on readiness of the equipment/ assembly/ sub-assembly and after approval of all relevant drawings and QAP. Client/MECON shall be given 14 working days notice period to organize inspection for indigenous items and 30 working days notice period for imported items after receipt of hard copies of inspection call. In case, equipment/ assembly/ sub-assembly offered for inspection are found not ready on or after proposed date, Inspection Memo shall be issued then and there and the call shall be cancelled. All the cost of visit of Client/MECON's engineer shall have to be borne by the successful tenderer. Photographic evidence to support readiness of material may be required to be furnished along with fresh inspection call.

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If the equipment/assembly / sub-assembly after inspection found not acceptable, requiring rework or involve MECON's re- inspection, Successful tenderer/contractor shall be responsible for any delay due to re-inspection / revisit.

07.08.02 Inspection call shall be raised to MECON through IMS (Inspection Management System). Soft copy of all documents like test Certificates, Internal Inspection Reports, P.O., Sub-P.O., T.S., Approved QAP, approved GA drawings/ data sheets/manufacturing drawings and all other relevant certificates as per approved QAP shall be attached with inspection call in IMS. All TC's shall be signed and endorsed by successful tenderer. Inspection calls without above documents shall be treated as invalid and be liable for rejection. Also, the hard copy comprising of all documents along with signed and stamped inspection call shall be submitted to Counsultant/ Client for further processing. Scrutinizing of call documents shall start after receipt of hard copies of inspection call and shall be processed within 14 working days.

IMS user manual and vendor registration process/forms are clearly demonstrated in attached ANNEXURE-1.

07.08.03 The successful tenderer shall offer substantial quantities of items for inspection considering economical aspect of inspection with respect to size of order.

07.08.04 On receipt of the Inspection call, pertaining to particular package / equipment / item, Inspection& QA group of MECON (Co-ordinating office for Inspection activities) shall organize inspection visit or will issue Inspection assignment to other MECON's office (based on location of vendor's manufacturing works / relevant job expertise) as per approved QAP.

07.08.05 For items where inspection has been waived as per approved QAP, calls shall be processed on the basis of document review within 14 days, upon receipt of complete hard copy documents.

07.08.06 Observation/ Comments if any, forwarded by client/MECON through IMS / mail to be complied within 1 month from the date of such comments. In case the compliance is not submitted within 1 month by successful tenderer, inspection call shall be liable to be cancelled. New inspection call shall be raised as per regular inspection calls in accordance with approved QAP.

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07.08.07 In absence of complete documents viz. relevant Approved QAP, Approved Drawing / datasheet / Technical Specification, manufacturer's test reports, inspection call will be commented / sent for clarification through IMS. Compliance submitted shall be reviewed within 14 working days by MECON/ Client.

07.09 **Obligations of Successful Tendrer**

07.09.01 Inspecting Engineer of MECON/ Client shall be provided with all facilities and full & free access to manufacturer premises at any time, during contract period by successful tenderer / contractor, to facilitate inspector to carry out inspection & testing of the product during and/or after manufacturing of the same.

07.09.02 The successful tenderer shall nominate a Representative / Co-ordinator to liaison with MECON/ CLIENT on all inspection matters. Representative of successful tenderer shall be present during all inspection at Sub-Contractor's works.

07.09.03 The successful tenderer shall comply with instructions of MECON/ CLIENT fully with promptitude.

07.09.04 The successful tenderer shall provide all instruments, tools, necessary testing and other inspection facilities to MECON / CLIENT free of cost for carrying out inspection.

07.09.05 The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the successful tenderer .These tests need to be witnessed & approved by ASNT/ISNT Level-II qualified NDT personals

07.09.06 The successful tenderer shall ensure that the equipment / assembly / component of the plant and equipment required to be inspected, are not dismantled or dispatched before inspection.

07.09.07 The successful tenderer shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by MECON/ CLIENT.

07.09.08 The successful tenderer shall ensure that equipment and materials once rejected by the MECON/CLIENT, are not re-used in the manufacture of the plant and equipment. Where parts rejected during inspection have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

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07.10 **Stamping and Issue of Inspection Documents**

07.10.01 Inspection Memo(IM):- For items, which do not conform to Technical Specification in one or more quality characteristics requiring rectification / rework, Inspection Memo [Form No.- 11.20(DQM)F-18] shall be issued indicating therein the details of observation & remarks. All the non-conformities with respect to specification of the product shall be indicated in the Inspection Memo for further quality control by successful tenderer.

07.10.02 Inspection Certificate(IC):- On satisfactory completion of final inspection & testing, all accepted plant & equipment shall be stamped suitably and Inspection Certificate[Form No.11.20(DQM)F-19] shall be issued by the MECON for the accepted items.

07.10.03 Inspection Waiver Certificate(IWC):- MECON shall release Inspection Waiver Certificate [Form No. 11.20(DQM)F-20] for the items, which are identified under waiver category in the approved QAP, upon verification of all inspection & test reports as indicated in the QAP.

07.11 **General Clause**

07.11.01 Inspection & tests carried out by MECON / CLIENT shall not absolve the responsibility of the successful tenderer/ Manufacturer to provide acceptable product as per the terms of contract nor shall it preclude subsequent rejection.

07.11.02 CLIENT/ MECON reserve the right to inspect any product at any stage of manufacturing beyond pre-identified stages and hold points of approved QAP.

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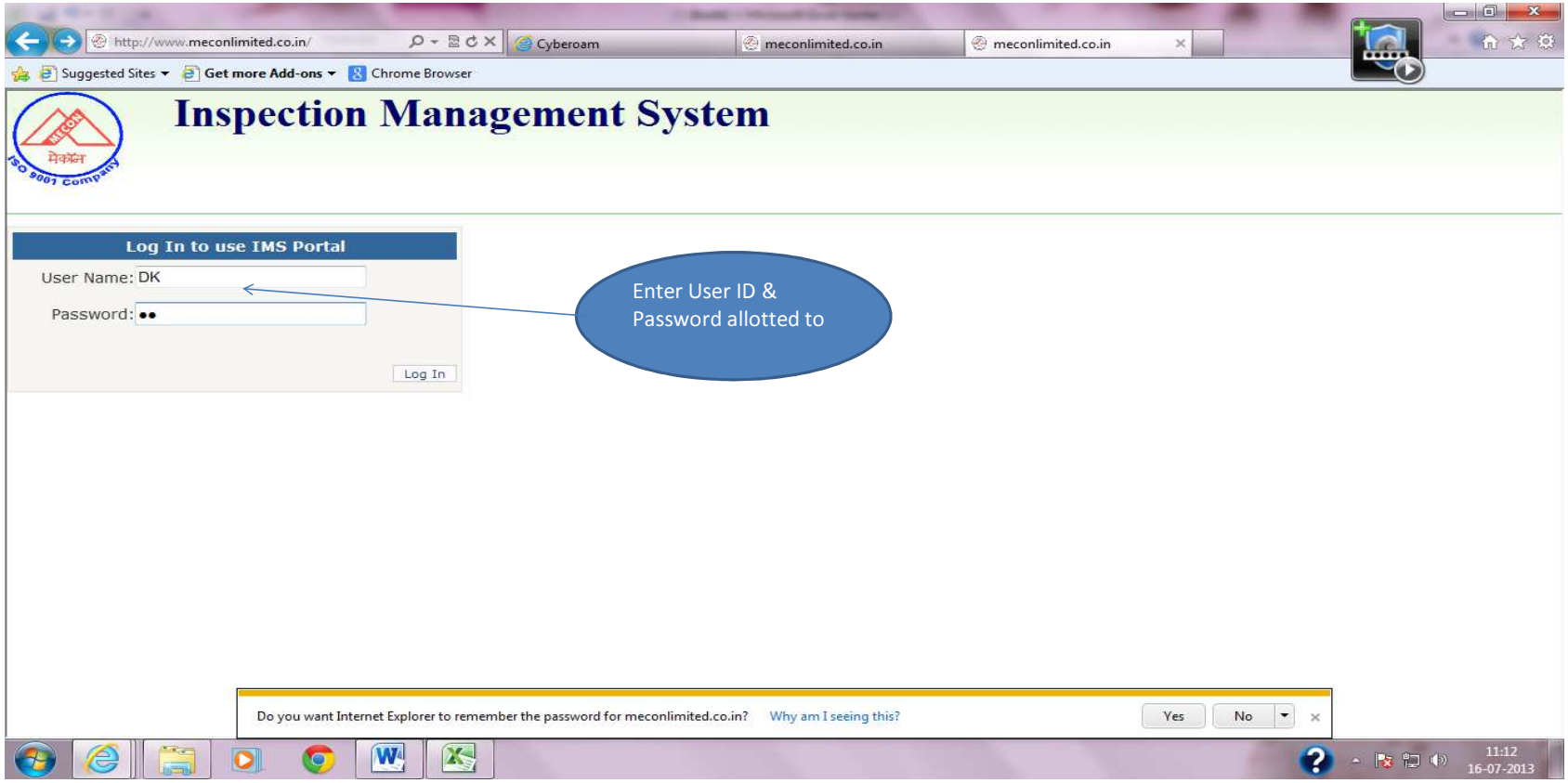
Annexure – 1

User Manual for IMS

http://www.meconlimited
.co.in/
or
To Raise inspection
call click on "CALL
CALL FOR INSPECTION
Final results of Selection of Manage
About Us | Product & Services | Active Tenders | HR in MECON | Contact Us
MECON LIMITED
(A Government of India Enterprise)
50 Years of Nation Building
Strategic Business Units
Metals
Power
Oil & Gas
Infrastructure
A House of Engineering Excellence
....Aiming beyond
>> Flash News <<
VENDOR REGISTRATION
RIGHT TO INFORMATION ACT 2005
TRANSPARENCY & INTEGRITY PACT


http://www.meconlimited.co.in/
Cyberoam
meconlimited.co.in
meconlimited.co.in
Suggested Sites
Get more Add-ons
Chrome Browser
Inspection Management System
Log In to use IMS Portal
User Name: DK
Password:
Log In
Enter User ID & Password allotted to
Do you want Internet Explorer to remember the password for meconlimited.co.in?
Why am I seeing this?
Yes
No
11:12
16-07-2013

Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Under Process | Processed | Rejected

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

To raise fresh call, click to "Add New

Open Call(s)

No. of Open Call(s) : 14

Add New Call

LIST of Inspection Calls raised by

Call No.	Date	Details	Sub Contractor	Contact Person	Type	Status	
qwww	06-Jul-2013	inspection	wwww	444	Final	Call Received	View
12	06-Jul-2013	hghg	hghghg	gfgfg bjhjhjh	Final	Call Received	View
jadjlasj	05-Jul-2013	ads	adasda	asdasf	Final	Call Received	View
sdsdsd	05-Jul-2013	sdsdsd	sdsdsds	dsdsdsds	Final	Call Received	View
EPIL	05-Jul-2013	WAIVER	ADASA	DASDASDAS	Final	Call Received	View
Call 001	05-Jul-2013	NA	M/s XYZ	88888555555	Final	Call Received	View
TMPL/ BSL/030/001	05-Jul-2013	NA	Hirel , Gandhinagar, Phone No- Email	Mishra Phone Email-	Final	Call Received	View
dfdfdf						eived	View
101						eived	View

Do you want Internet Explorer to remember the password for meconlimited.co.in? Why am I seeing this? Yes No

http://www.meconlimited.co.in/ | Cyberoam | meconlimited.co.in | meconlimited.co.in

Suggested Sites | Get more Add-ons | Chrome Browser

Open Calls | Back to Prev. Page

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

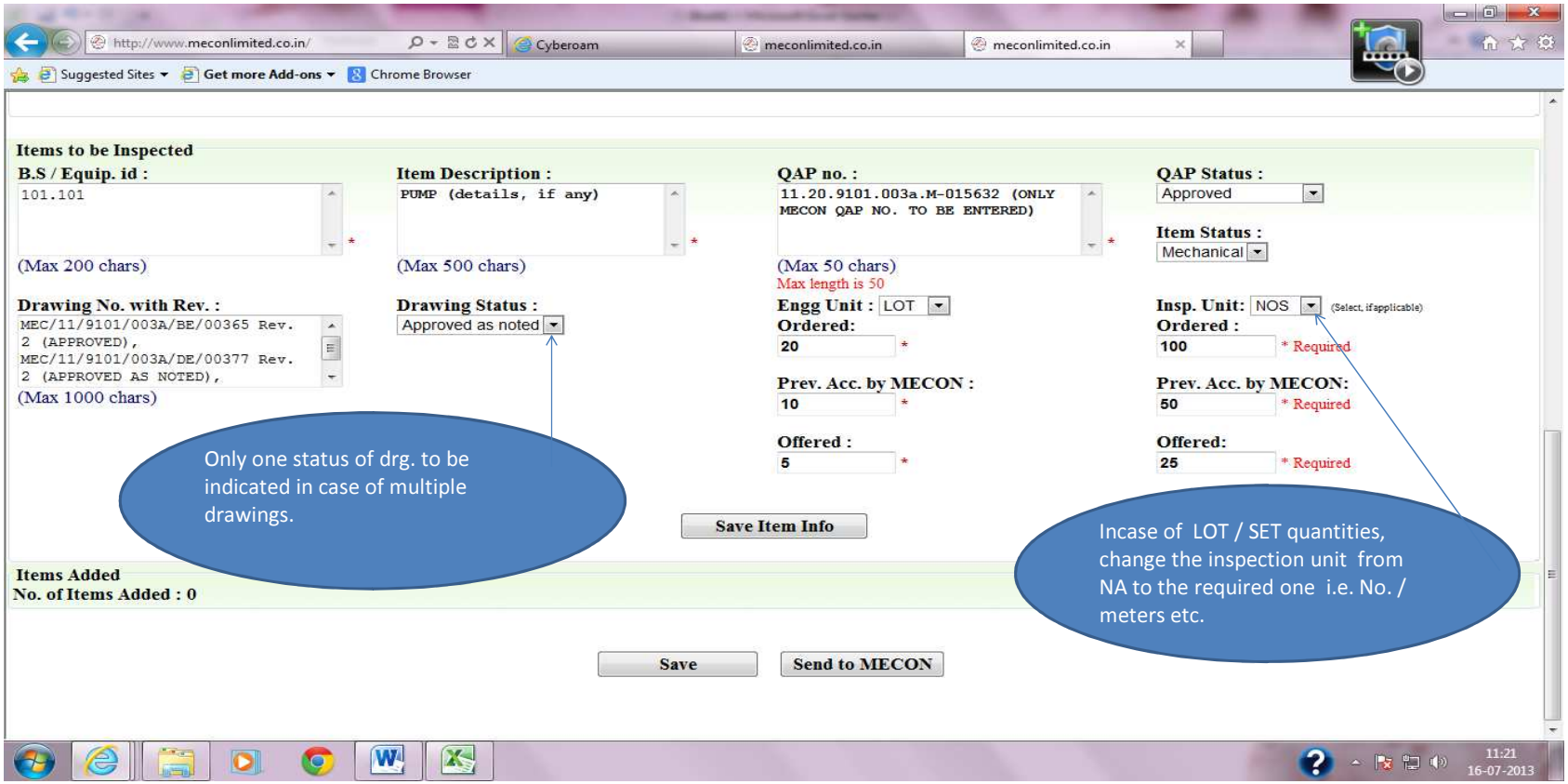
Call Informations

1. Call No. : 101 (Max 150 chars)
2. Call Date : 16 JUL 2013 *
3. Call Remarks : PUMP M&P KOLHAPUR (Max 500 chars)
4. Sub Contractor details : Mather & Platt (Max 1000 chars)
5. Sub contractor P.O No. : 1012124222352 dtd. 01.05.2012 (Max 100 chars)
6. Inspection place (address) : KOLHAPUR-6545655 MAHARASHTRA Ph. No.: 546556565 (Optional, Max 500 chars)
7. Contact Person with no. : Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com (Max 500 chars)
8. Proposed Date : 20 JUL 2013 *
9. Inspection type : Stage / Final *
10. List of Documents : 1. INDEX 2. QAP (APPROVED) 3. DRAWING / DATASHEET (APPROVED) 4. TECHNICAL SPECIFICATION & PO 5. INTERNAL INSPECTION REPORT (Max 100 chars)
11. Special Notes / Off day : Offday : SUNDAY AS per QAP, item under inspection caetgory of MECON. (Optional, Max 500 chars)

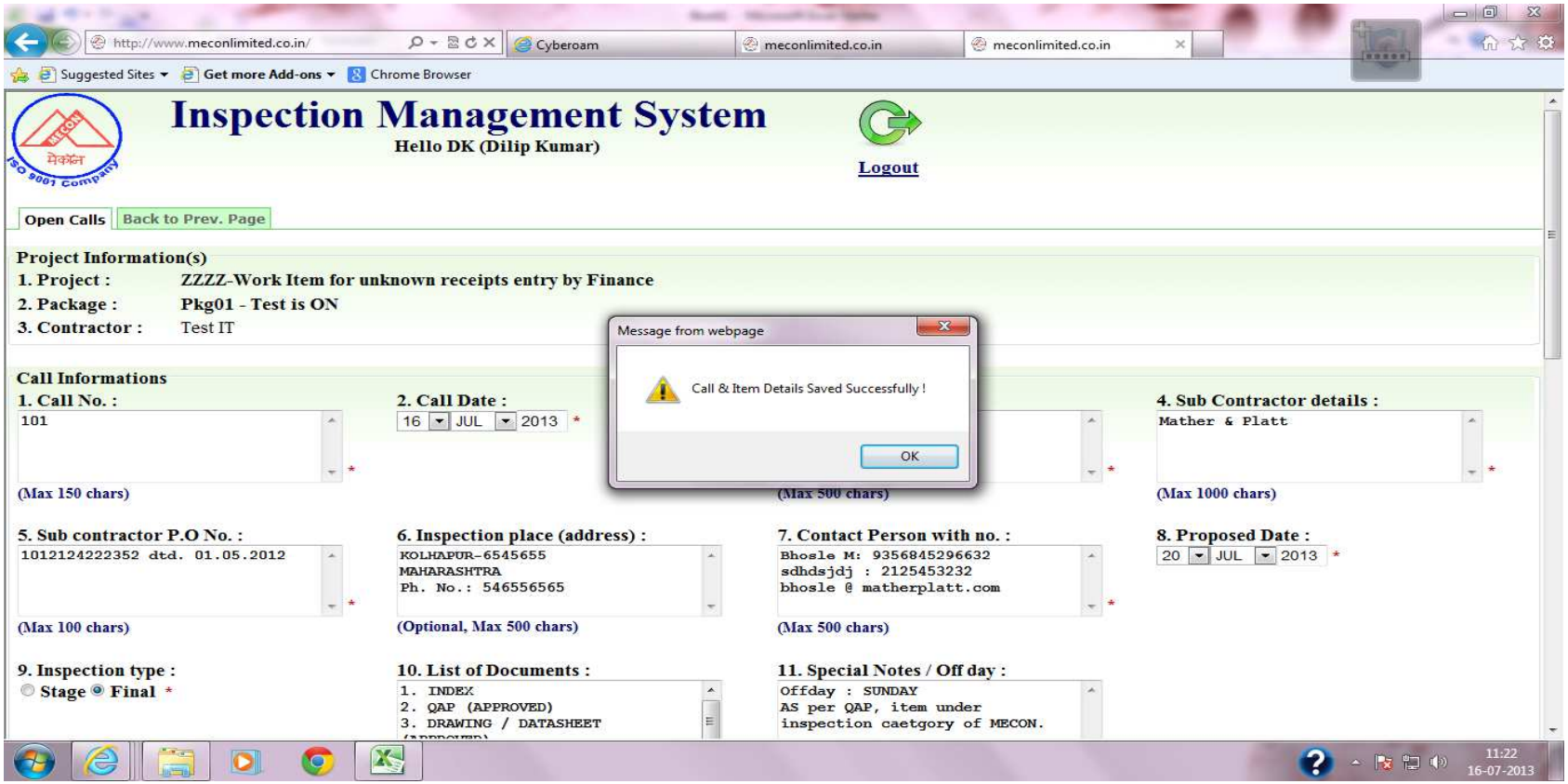
Enter all the details of the inspection call.

11:17 16-07-2013

NOTE : Proposed date of inspection can not be earlier than the inspection call date.



NOTE : For COMMENTED drawings, inspection call can not be raised.



NOTE : After entering all the mandatry fields, kindly "SAVE" the call.

http://meconinfo/insp/AddCall.aspx | Cyberoam | meconlimited.co.in | meconlimited.co.in | meconinfo

Suggested Sites | Get more Add-ons | Chrome Browser

Save Item Info

Items Added

No. of Items Added : 1

B.S /Equip. id	Item Description	Item Type	Dwg. Status	QAP	QAP Status	Engg & Insp. Unit	Ordered	Accepted	Offered		
101.101	PUMP (details, if any)	Mechanical	AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015632	A	LOT, NOS	20 , 100	10 , 50	5 , 25	Edit	Remove

Attachment

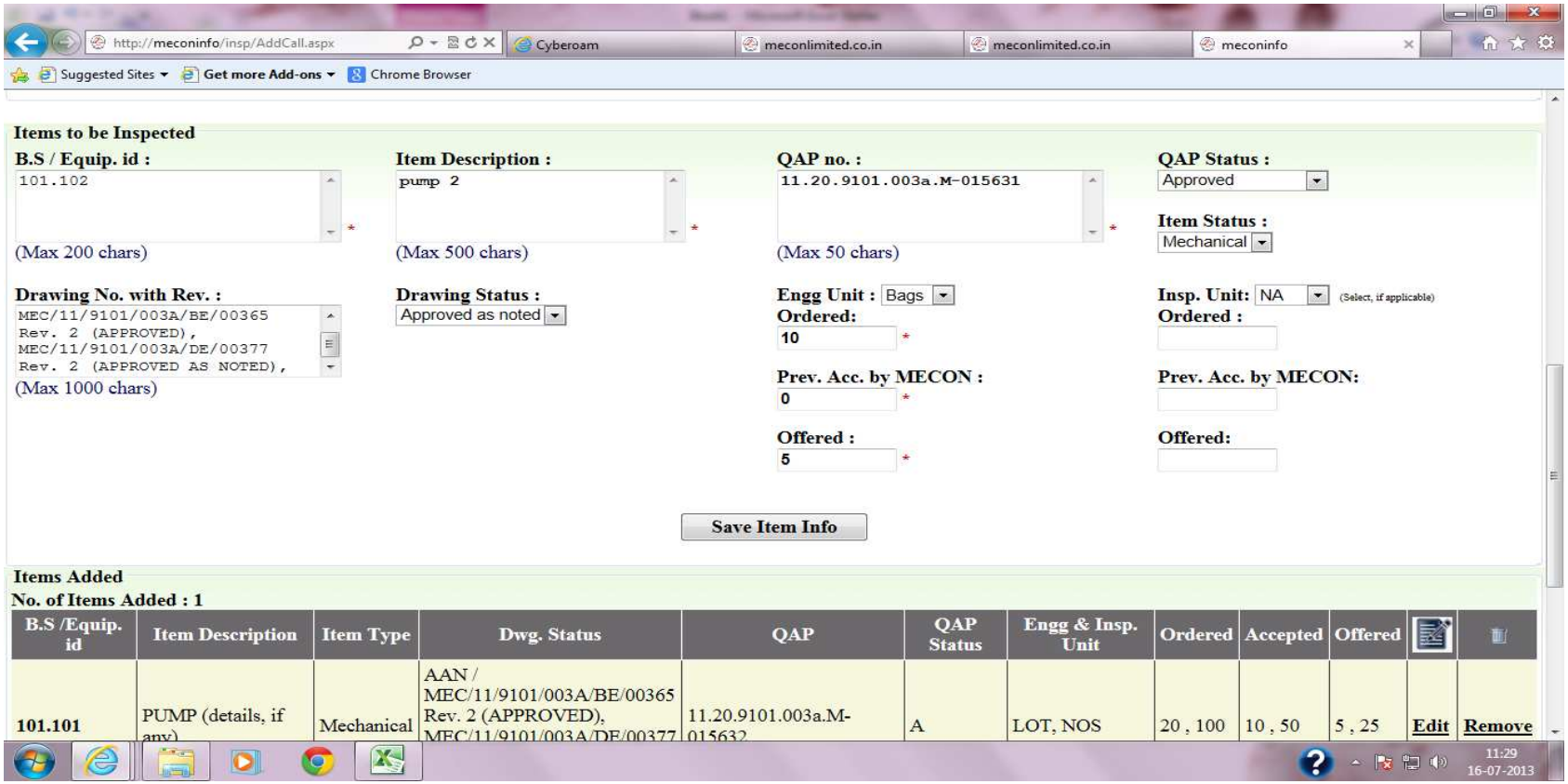
Attachment (if any) : Browse... Add this file

File Name	
11.20.9101.02079.IC.01.pdf	Remove
amd.iwc.9101.01041.IW.01.docx	Remove
fixtures final.xlsx	Remove
IWC No..11.20.9101.01406.IW.01 Dtd.02.05.2013.pdf	Remove
scan.rar	Remove

1. Attach all the relevant documents as indicated in the call.
2. All test reports shall be duly endorsed by the principal contractor.

Save | Send to MECON

11:27 16-07-2013



NOTE: The saved item will be shown as above in the Items added portion.

http://meconinfo/insp/AddCall.aspx

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Suggested Sites | Get more Add-ons | Chrome Browser

Save Item Info

Call & Item Details Saved Successfully !

Items Added

No. of Items Added : 2

B.S /Equip. id	Item Description	Item Type	Dwg. Status	QAP	QAP Status	Engg & Insp. Unit	Ordered	Accepted	Offered		
101.101	PUMP (details, if any)	Mechanical	AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015632	A	LOT, NOS	20 , 100	10 , 50	5 , 25	Edit	Remove
101.102	pump 2	Mechanical	AAN / AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015631	A	Bags	10	0	5	Edit	Remove

Attachment

Attachment (if any) : Browse... Add this file

File Name	
11.20.9101.02079.IC.01.pdf	Remove
amd.iwc.9101.01041.IW.01.docx	Remove
fixtures final.xlsx	Remove
IWC No..11.20.9101.01406.IW.01 Dtd.02.05.2013.pdf	Remove
scan.rar	Remove

Save | Send to MECON

11:30 16-07-2013

NOTE: Multiple items will be shown as above in the Items added portion.

http://meconinfo/insp/AddCall.aspx

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Back to Prev. Page

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Message from webpage

Successfully Sent to MECON !

OK

Call Informations

1. Call No. : 101 (Max 150 chars)
2. Call Date : 16 JUL 2013
4. Sub Contractor details : Mather & Platt (Max 1000 chars)
5. Sub contractor P.O No. : 1012124222352 dtd. 01.05.2012 (Max 100 chars)
6. Inspection place (address) : KOLHAPUR-6545655 MAHARASHTRA Ph. No.: 546556565 (Optional, Max 500 chars)
7. Contact Person with no. : Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com (Max 500 chars)
8. Proposed Date : 20 JUL 2013
9. Inspection type : Stage / Final
10. List of Documents : 1. INDEX 2. QAP (APPROVED) 3. DRAWING / DATASHEET (APPROVED) 4. TECHNICAL SPECIFICATION & PO 5. INTERNAL INSPECTION REPORT
11. Special Notes / Off day : Offday : SUNDAY AS per QAP, item under inspection caetgory of MECON.

11:30 16-07-2013

NOTE: Upon entering and saving all details, kindly "SEND to MECON". Please check all the details before sending.

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Items Added

No. of Items Added : 2

B.S /Equip. id	Item Description	Item Type	Dwg. Status	QAP	QAP Status	Engg & Insp. Unit	Ordered	Accepted	Offered		
101.101	PUMP (details, if any)	Mechanical	AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015632	A	LOT, NOS	20 , 100	10 , 50	5 , 25	Edit	Remove
101.102	pump 2	Mechanical	AAN / AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015631	A	Bags	10	0	5	Edit	Remove

Attachment

Attachment (if any) : Browse... Add this file

File Name	
11.20.9101.02079.IC.01.pdf	Remove
amd.iwc.9101.01041.IW.01.docx	Remove
fixtures final.xlsx	Remove
IWC No..11.20.9101.01406.IW.01 Dtd.02.05.2013.pdf	Remove
scan.rar	Remove

To Print inspection call, click Print Letter.

Save | Send to MECON | Print Letter

Successfully Sent to MECON !

http://meconinfo/insp/AddCall.aspx

11:31 16-07-2013

NOTE: While printing ensure 'POP UPS'are enabled.

http://meconinfo/insp/AddCall.aspx

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Suggested Sites | Get more Add-ons | Chrome Browser

Items Add

No. of Iter

B.S /Equ	Status	Engg & Insp. Unit	Ordered	Accepted	Offered		
101.101		LOT, NOS	20 , 100	10 , 50	5 , 25	Edit	Remove
101.102		Bags	10	0	5	Edit	Remove

Attachme

Attachmen

11.20.910
amd.iwc.9
fixtures fi
IWC No..
scan.rar

Letter

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http://meconinfo/insp/DK-ACK432.pdf

Inspection Call Proforma

Form No. 11.20(DQM)F-05/2 Rev. 0
Page 1 of 2

Call Date : 16-Jul-2013

Inspection Call no. : 101

Submitted On : 16-Jul-2013

Project :	ZZZZ - Work Item for unknown receipts entry by Finance...	Package :	Pkg01 - Test is ON
Contractor :	Test IT	Proposed Date :	20-Jul-2013
Sub-Contractor :	Mather & Platt	Sub Cont. Order No. :	1012124222352 dtd. 01.05.2012
Place of Inspection :	KOLHAPUR-6545655 MAHARASHTRA Ph. No.: 546556565	Contact Person :	Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com
Remarks :	PUMP M&P KOLHAPUR	Note/ Off day :	Offday : SUNDAY AS per QAP, item under inspection caetgory of MECON.

List of Items offered for Inspection to MECON :

A=Approved, AAN=Approved as Noted, INF=Information Category

Item identification no. /B.S no.	Description	Drawing No. with revision	Drawing approved status	QAP Status/ No.	Unit	Quantity		
						Ordered	Already Accepted	Offered
101.101	PUMP (details, if any)	MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED)	AAN	A /11.20.9101.003a.M-015632	LOT, NOS	20 100	10 50	5 25

11:33
16-07-2013

http://meconinfo/insp/AddCall.aspx

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Items Add
No. of Iter

B.S /Equ									Status	Engg & Insp. Unit	Ordered	Accepted	Offered		
101.101										LOT, NOS	20 , 100	10 , 50	5 , 25	Edit	Remove
101.102										Bags	10	0	5	Edit	Remove

Attachme
Attachmen

11.20.910
amd.iwc.9
fixtures fi
IWC No..
scan.rar

Letter

http://meconinfo/insp/DK-ACK432.pdf - Windows Internet Explorer

http://meconinfo/insp/DK-ACK432.pdf

		3A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/00 3A/DE/00377 Rev. 2 (APPROVED AS NOTED),		3a.M-015631				

List of Documents & Test Certificates enclosed in four (4) sets :

1. INDEX
2. QAP (APPROVED)
3. DRAWING / DATASHEET (APPROVED)
4. TECHNICAL SPECIFICATION & PO
5. INTERNAL INSPECTION REPORT
5.

Inspection Call Proforma

Form No. 11.20(DQM)F-05/2 Rev. 0
Page 2 of 2

Call Date : 16-Jul-2013

Inspection Call no.: 101

Submitted On : 16-Jul-2013

For Contractor/Sub-Contractor

Name & Designation with stamp

11:34
16-07-2013

http://meconinfo/insp/Default.aspx | Cyberoam | meconlimited.co.in | meconlimited.co.in | Inspection Management Sy...

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Under Process | Processed | Rejected

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Check the status of your call.

Open Call(s)

No. of Open Call(s) : 15 Add New Call

Call No.	Date	Details	Sub Contractor	Contact Person	Type	Status	
qwww	06-Jul-2013	inspection	wwww	444	Final	Call Received	View
12	06-Jul-2013	hghg	hghghg	gfgfg bjhjhjh	Final	Call Received	View
jadjlasj	05-Jul-2013	ads	adasda	asdasf	Final	Call Received	View
sdsdsd	05-Jul-2013	sdsdsd	sdsdsds	dsdsdsds	Final	Call Received	View
EPIL	05-Jul-2013	WAIVER	ADASA	DASDASDAS	Final	Call Received	View
Call 001	05-Jul-2013	NA	M/s XYZ	88888555555	Final	Call Received	View
TMPL/ BSL/030/001	05-Jul-2013	NA	Hirel , Gandhinagar, Phone No- Email	Mishra Phone Email-	Final	Call Received	View
dfdfdf	04-Jul-2013	fdfdf	dfdfdf	dfdfdfdf	Final	Call Received	View
101	03-Jul-2013	TEST EDIT	asas	sassss	Final	Call Received	View
bbbb	01-Jul-2013	bcadghafdghf	sadasdggh	dbvdfg	Final	Call Received	View
6757576	10-Jun-2013	ghghgh	fdhdfhfdh	dfgdgg	Final	Call Received	View
sass	16-Jul-2013	sasas	sasasa	asasas	Final	Sent to MECON	View
101	16-Jul-2013	PUMP M&P KOLHAPUR	Mather & Platt	Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com	Final	Sent to MECON	View
2qeq	10-Jul-2013	etet	yryher	3424512	Final	Sent to MECON	View
2222	04-Jul-2013	tewgw	erqer	22	Final	Sent to MECON	View

11:36 16-07-2013

http://meconinfo/insp/ViewDetail.aspx | Cyberoam | meconlimited.co.in | meconlimited.co.in | meconinfo

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Call Details | Back to Prev. Page

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Call Informations

1. Call No. :
101, dated 16-Jul-2013
Print Letter

2. Call Remarks :
PUMP M&P KOLHAPUR

3. Sub Contractor :
Mather & Platt

4. Order No. :
1012124222352 dtd. 01.05.2012

5. Inspection place :
KOLHAPUR-6545655 MAHARASHTRA Ph. No.: 546556565

6. Contact Person :
Bhosle M: 93568452966632 sdhdajdj : 2125453232 bhosle @ matherplatt.com

7. Proposed Time :
20-Jul-2013

8. Inspection type :
Final

9. List of Documents :
1. INDEX 2. QAP (APPROVED) 3. DRAWING / DATASHEET (APPROVED) 4. TECHNICAL SPECIFICATION & PO 5. INTERNAL INSPECTION REPORT 5.

10. Special Note (if any):
Offday : SUNDAY AS per QAP, item under inspection caetgory of MECON.

11. Call Status :
Sent to MECON

12. Status Date :
16-Jul-2013

13. Remarks from MECON

Attachment (if any)

File Name
11.20.9101.02079.IC.01.pdf
amd.iwc.9101.01041.IW.01.docx
fixtures final.xlsx
IWC No..11.20.9101.01406.IW.01 Dtd.02.05.2013.pdf
scan.rar

Items Added
No. of Items Added : 2
A: Approved, AAN: Approved as Noted, INF: Information Category

B.S /Equip. id	Item Description	Item Type	Dwg. Status	QAP	QAP Status	Engg & Insp. Unit	Ordered	Accepted	Offered
101.101	PUMP (details, if any)	Mechanical	AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015632	A	LOT, NOS	20 , 100	10 , 50	5 , 25
101.102	pump 2	Mechanical	AAN / AAN / MEC/11/9101/003A/BE/00365 Rev. 2 (APPROVED), MEC/11/9101/003A/DE/00377 Rev. 2 (APPROVED AS NOTED),	11.20.9101.003a.M-015631	A	Bags	10	0	5

11:36
16-07-2013

Inspection Management System (IMS)

Samik Sarkar, Design Engineer, Inspection & QA, Ranchi

Tuesday, July 16, 2013

- Administration
- Masters
- Online Portal
  - Users
  - Submitted
  - Rejected
  - Clarification
- Calls
- Assignments
- Certificates
- Query

Calls Submitted Online

Filter Your Search

Select WINO : **Package:** Show Call List

Your inspection call will appear like below in our system.

Calls Submitted

No. of Calls found in this search : **53**

WINO	Package	Call no.	Submitted By	Submitted On	Remarks	Stage	Proposed Time	
9103	084	102	rspjusco84	16-Jul-2013	Waiver catagory	Final	Jul 23 2013	View Call
ZZZZ	Pkg01	sass	DK	16-Jul-2013	sasas	Final	Jul 16 2013	View Call
ZZZZ	Pkg01	101	DK	16-Jul-2013	PUMP M&P KOLHAPUR	Final	Jul 20 2013	View Call
9101	020	L&T/BSP-SP/EI-085	Int20bsp	15-Jul-2013	Inspection Waiver	Final	Jul 15 2013	View Call
Q6QZ	001	Inspection call/Stacker-Reclaimer/92	bhelisg	15-Jul-2013	Waiver category	Final	Jul 15 2013	View Call
9103	091	10016550/1	mbecl91	15-Jul-2013	Inspection of electric hoist	Final	Jul 18 2013	View Call
9103	032	RSP-ROURKELA/GLOBEGAS/13/27/DE/0828	rspglobegas32	15-Jul-2013	Inspection Waiver for DP Type Level Transmitter	Final	Jul 15 2013	View Call
E24F	099	10	bslace099	15-Jul-2013	IWC	Final	Jul 18 2013	View Call
9101	020	L&T/BSP-SP/EI-084	Int20bsp	15-Jul-2013	IMCPs (Intelligent + Conventional)	Final	Jul 19 2013	View Call

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Inspection Management System (IMS)

Samik Sarkar, Design Engineer, Inspection & QA, Ranchi

Tuesday, July 16, 2013

HOME

- Administration
- Masters
- Online Portal
  - Users
  - Submitted
  - Rejected
  - Clarification
- Calls
- Assignments
- Certificates
- Query

Attachements (if any)

File Name	
11.20.9101.02079.IC.01.pdf	Download
amd.iwc.9101.01041.IW.01.docx	Download
fixtures final.xlsx	Download
IWC No..11.20.9101.01406.IW.01 Dtd.02.05.2013.pdf	Download
scan.rar	Download

Process this Call

1. Action Taken : ○ Accept ○ Reject ◉ Clarification Needed

2. Category : ◉ Inspection ○ Waiver

3.Comment :

```
1. Relevant drawings not enclosed.
2. Annexure of QAP not furnished.
3. Documents submitted are unsigned. (Contractor shall ensure that all attached documents are duly
signed by him.)
```

Process

Incomplete / Incorrect documets may lead to following preliminary comments from MECON.

11:41 16-07-2013

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Under Process | Processed | Rejected

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Check the current status change after comments from MECON.

Open Call(s)

No. of Open Call(s) : 15 | Add New Call

Call No.	Date	Details	Sub Contractor	Contact Person	Type	Status	
qwww	06-Jul-2013	inspection	wwww	444	Final	Call Received	View
12	06-Jul-2013	hghg	hghghg	gfgfg bjhjhjh	Final	Call Received	View
jadjlasj	05-Jul-2013	ads	adasda	asdasf	Final	Call Received	View
sdsdsd	05-Jul-2013	sdsdsd	sdsdsds	dsdsdsds	Final	Call Received	View
EPIL	05-Jul-2013	WAIVER	ADASA	DASDASDAS	Final	Call Received	View
Call 001	05-Jul-2013	NA	M/s XYZ	88888555555	Final	Call Received	View
TMPL/ BSL/030/001	05-Jul-2013	NA	Hirel , Gandhinagar, Phone No- Email	Mishra Phone Email-	Final	Call Received	View
dfdfdf	04-Jul-2013	fdfdf	dfdfdf	dfdfdfdf	Final	Call Received	View
101	03-Jul-2013	TEST EDIT	asas	sassss	Final	Call Received	View
bbbb	01-Jul-2013	bcadghafdghf	sadasdggh	dbvdfg	Final	Call Received	View
6757576	10-Jun-2013	ghghgh	fdhdfhfdh	dfgdgg	Final	Call Received	View
101	16-Jul-2013	PUMP M&P KOLHAPUR	Mather & Platt	Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com	Final	Clarification Needed	View
sass	16-Jul-2013	sasas	sasasa	asasas	Final	Sent to MECON	View
2qeq	10-Jul-2013	etet	yryher	3424512	Final	Sent to MECON	View
2222	04-Jul-2013	tewgw	erqer	22	Final	Sent to MECON	View

11:42
16-07-2013

http://meconinfo/insp/AddCall.aspx

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Back to Prev. Page

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Call Informations

1. Call No. : 101 (Max 150 chars)

4. Sub Contractor details : Mather & Platt (Max 1000 chars)

5. Sub contractor P.O No. : 1012124222352 dtd. 01.05.2012 (Max 100 chars)

8. Proposed Date : 20 JUL 2013

9. Inspection type : Stage / Final

10. List of Documents :
1. INDEX
2. QAP (APPROVED)
3. DRAWING / DATASHEET (APPROVED)
4. TECHNICAL SPECIFICATION & PO
5. INTERNAL INSPECTION REPORT
5.
(Max 100 chars)

11. Special Notes / Off day :
Offday : SUNDAY
AS per QAP, item under inspection caetgory of MECON.
ALL COMMENTS BY MECON INCORPORATED & RESENT.
(Optional, Max 500 chars)

12. Comment from MECON :
1. Relevant drawings not enclosed. 2. Annexure of QAP not furnished. 3. Documents submitted are unsigned. (Contractor shall ensure that all attached documents are duly signed by him.)

MECON's preliminary comments

Message from webpage

Kindly Verify these informations : B.S No. or Equipment Identification no., Item Description, QAP No., Drawing No. with Revision, Ordered Unit wrt. Engg. unit, Accepted Unit wrt. Engg. Unit, Offered Unit wrt. Engg. Unit,

OK

Items to be Inspected

B.S / Equip. id : (Max 200 chars)

Item Description : (Max 500 chars)

QAP no. : (Max 50 chars)

Approved

Item Status : Refractory

Drawing No. with Rev. :

Drawing Status :

Engg Unit : Recs

Insp. Unit : NA

11:44 16-07-2013

http://meconinfo/insp/AddCall.aspx

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Back to Prev. Page

Project Information(s)

1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Call Informations

1. Call No. : 101 (Max 150 chars)
2. Call Date : 16 JUL 2013
4. Sub Contractor details : Mather & Platt (Max 1000 chars)
5. Sub contractor P.O No. : 101212422352 dtd. 01.05.2012 (Max 100 chars)
6. Inspection place (address) : KOLHAPUR-6545655 MAHARASHTRA Ph. No.: 546556565 (Optional, Max 500 chars)
8. Proposed Date : 20 JUL 2013
9. Inspection type : Stage / Final
10. List of Documents :
1. INDEX
2. QAP (APPROVED)
3. DRAWING / DATASHEET (APPROVED)
4. TECHNICAL SPECIFICATION & PO
5. INTERNAL INSPECTION REPORT
5.
(Max 100 chars)
11. Special Notes / Off day : Offday : SUNDAY AS per QAP, item under inspection caetgory of MECON. ALL COMMENTS BY MECON INCORPORATED & RESENT. (Optional, Max 500 chars)
12. Comment from MECON : 1. Relevant drawings not enclosed. 2. Annexure of QAP not furnished. 3. Documents submitted are unsigned. (Contractor shall ensure that all attached documents are duly signed by him.)

Message from webpage

Successfully Sent to MECON !

OK

Upon compliance of all preliminary comments, resend to MECON.

Items to be Inspected

B.S / Equip. id : (Max 200 chars)

Item Description : (Max 500 chars)

QAP no. : (Max 50 chars)

Approved

Item Status : Refractory

Drawing No. with Rev. :

Drawing Status :

Engg Unit : Bscs

Insp. Unit: NA

11:45 16-07-2013

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Inspection Management System

Hello DK (Dilip Kumar)

Logout

Open Calls | Under Process | Processed | Rejected

Project Information(s)

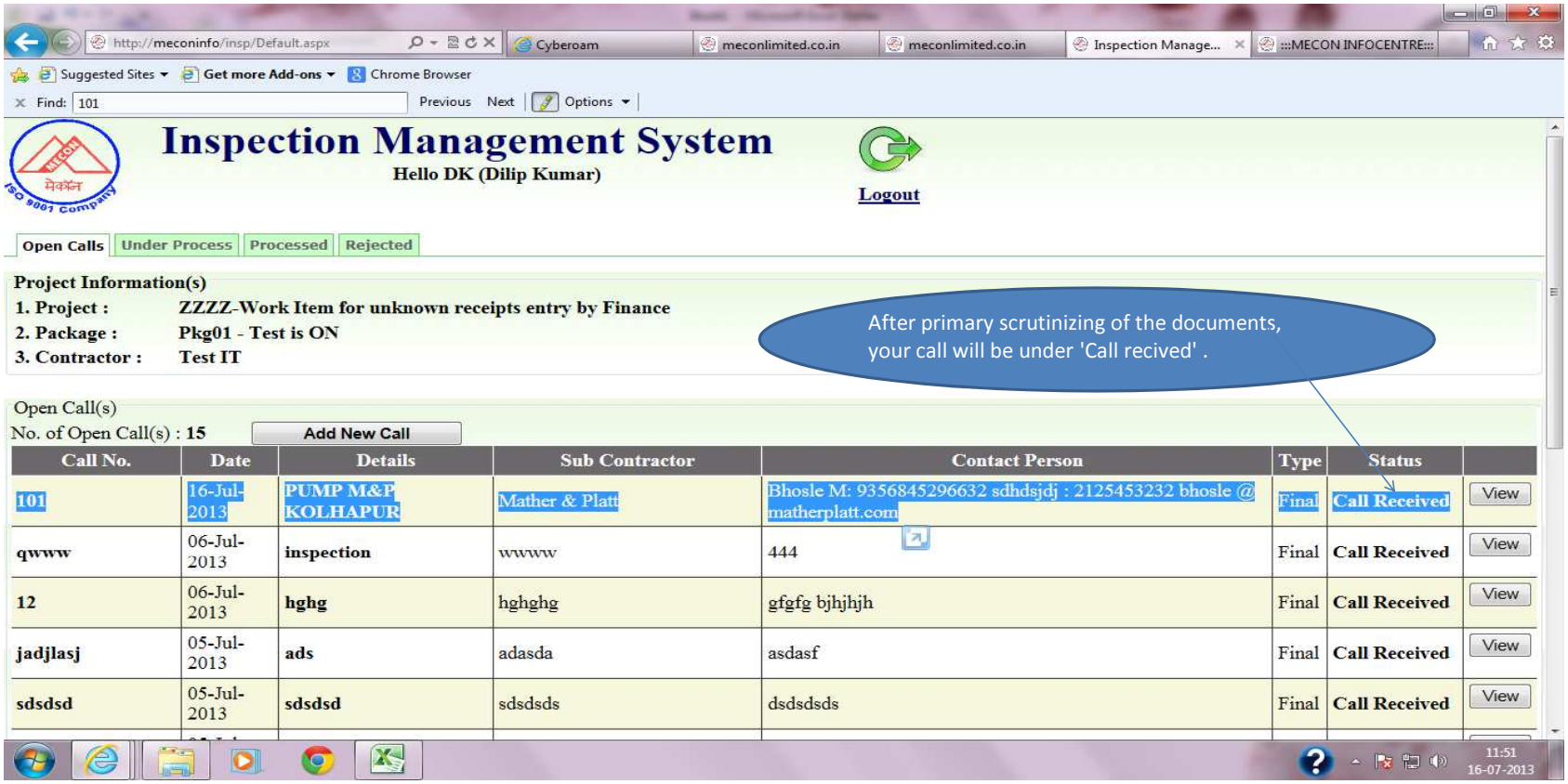
1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT

Open Call(s)

No. of Open Call(s) : 15 Add New Call

Call No.	Date	Details	Sub Contractor	Contact Person	Type	Status	
qwww	06-Jul-2013	inspection	wwww	444	Final	Call Received	View
12	06-Jul-2013	hghg	hghghg	gfgfg bjhjhjh	Final	Call Received	View
jadjlasj	05-Jul-2013	ads	adasda	asdasf	Final	Call Received	View
sdsdsd	05-Jul-2013	sdsdsd	sdsdsds	dsdsdsds	Final	Call Received	View
EPIL	05-Jul-2013	WAIVER	ADASA	DASDASDAS	Final	Call Received	View
Call 001	05-Jul-2013	NA	M/s XYZ	88888555555	Final	Call Received	View
TMPL/ BSL/030/001	05-Jul-2013	NA	Hirel , Gandhinagar, Phone No- Email	Mishra Phone Email-	Final	Call Received	View
dfdfdf	04-Jul-2013	fdfdf	dfdfdf	dfdfdfdf	Final	Call Received	View
101	03-Jul-2013	TEST EDIT	asas	sassss	Final	Call Received	View
bbbb	01-Jul-2013	bcadghafdghf	sadasdggh	dbvdfg	Final	Call Received	View
6757576	10-Jun-2013	ghghgh	fdhdfhfdh	dfgdgg	Final	Call Received	View
sass	16-Jul-2013	sasas	sasasa	asasas	Final	Sent to MECON	View
101	16-Jul-2013	PUMP M&P KOLHAPUR	Mather & Platt	Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com	Final	Sent to MECON	View
2qeq	10-Jul-2013	etet	yryher	3424512	Final	Sent to MECON	View
2222	04-Jul-2013	tewgw	erqer	22	Final	Sent to MECON	View

11:49
16-07-2013


http://meconinfo/insp/Default.aspx
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Inspection Manage...
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Suggested Sites
Get more Add-ons
Chrome Browser
Find: 101
Previous
Next
Options
Inspection Management System
Hello DK (Dilip Kumar)
Logout
Open Calls
Under Process
Processed
Rejected
Project Information(s)
1. Project : ZZZZ-Work Item for unknown receipts entry by Finance
2. Package : Pkg01 - Test is ON
3. Contractor : Test IT
After primary scrutinizing of the documents, your call will be under 'Call recived' .
Open Call(s)
No. of Open Call(s) : 15
Add New Call
Call No. | Date | Details | Sub Contractor | Contact Person | Type | Status
101 | 16-Jul-2013 | PUMP M&P KOLHAPUR | Mather & Platt | Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com | Final | Call Received | View
qwww | 06-Jul-2013 | inspection | wwww | 444 | Final | Call Received | View
12 | 06-Jul-2013 | hghg | hghghg | gfgfg bjhjhjh | Final | Call Received | View
jadjlasj | 05-Jul-2013 | ads | adasda | asdasf | Final | Call Received | View
sdsdsd | 05-Jul-2013 | sdsdsd | sdsdsds | dsdsdsds | Final | Call Received | View
11:51
16-07-2013

http://meconinfo/insp/Closed.aspx

Find: 101

test1 rev.1	Jul-2013	KBL PUNE	ajsgajhshgasas	mbhjshjsnhmsns, M-214554655235256454121	Final	Processed	317	
10	06-Jul-2013	aa	aa	aa	Final	Processed	331	View
CALL2	06-Jul-2013	CALL REMARKS	JJJ	KKK	Final	Processed	337	View
CALL 3	06-Jul-2013	CALL REMARKS	LLL			Processed	338	View
CALL 3	06-Jul-2013	ON TOUR TO MUMBAI	KKK			Processed	339	View
101	16-Jul-2013	PUMP M&P KOLHAPUR	Mather & Platt	Bhosle M: 9356845296632 sdhdsjdj : 2125453232 bhosle @ matherplatt.com	Final	Processed	432	View

Upon issuing of certificate (IC / IWC / IM) status of your call will change to 'PROCESSED'.

http://www.meconlimited.co.in/
Cyberoam
meconlimited.co.in
Suggested Sites
Get more Add-ons
Chrome Browser
Find: 101
Previous
Next
Options
Click 'TOOLS' or Type (Alt+X) in Internet Explorer.
CALL FOR INSPECTION
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inal results of Selection of Management Trainee Technical (MTT) through GATE–2013
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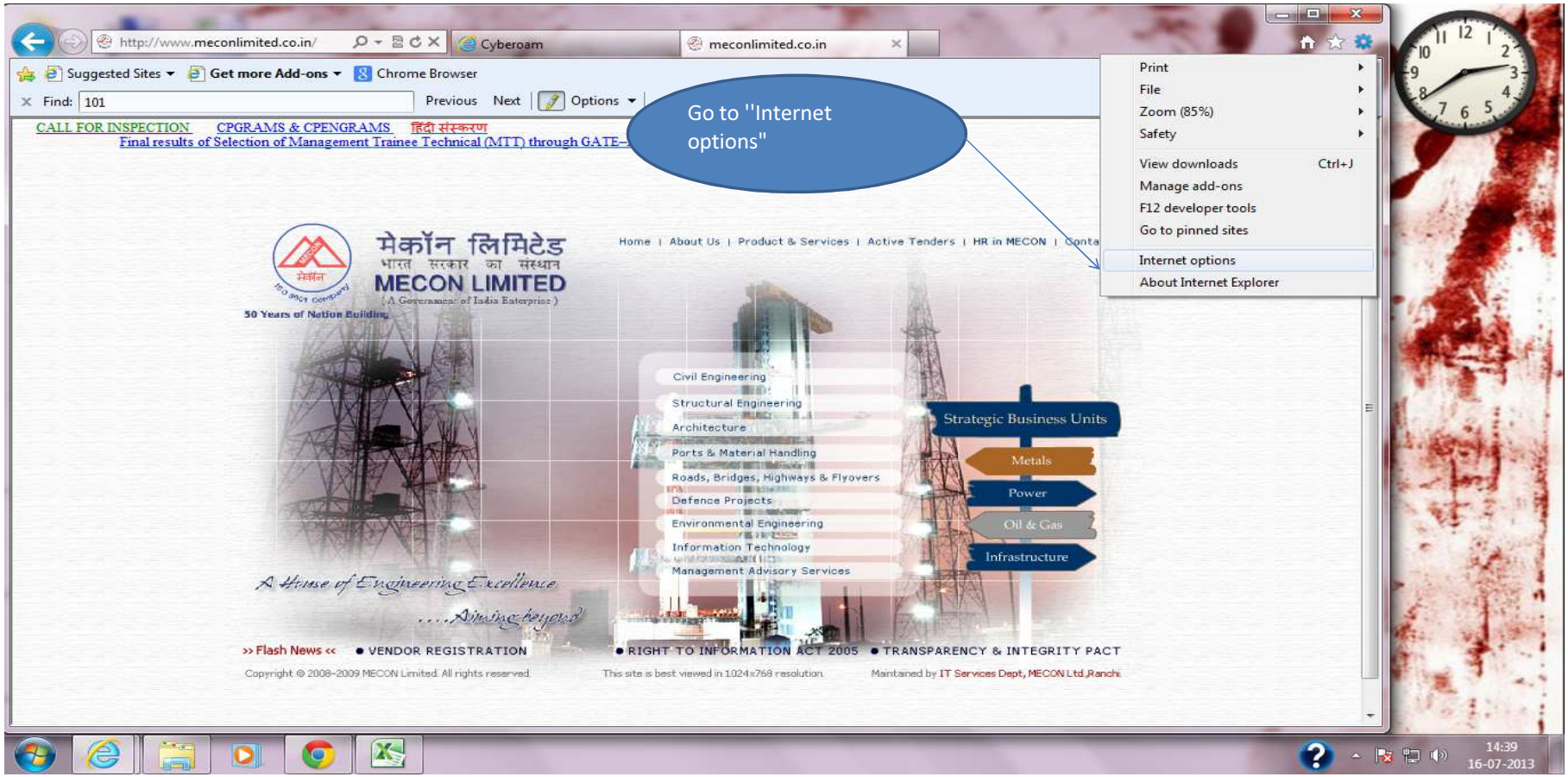
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Options
Go to "Internet options"
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Final results of Selection of Management Trainee Technical (MTT) through GATE
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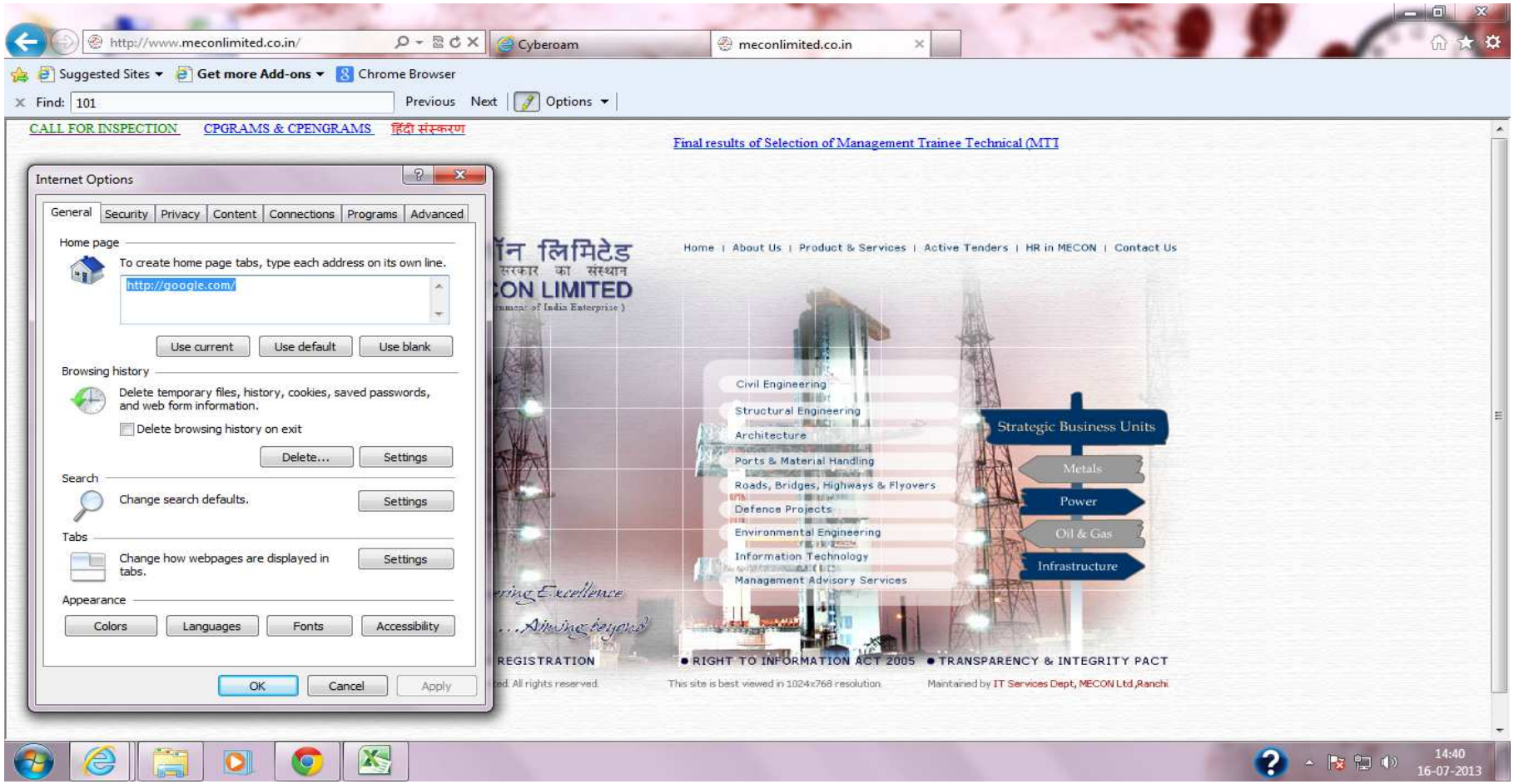
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Cyberoam
meconlimited.co.in
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Get more Add-ons
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Find: 101
Previous
Next
Options
CALL FOR INSPECTION
CPGRAMS & CPENGRAMS
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Final results of Selection of Management Trainee Technical (MTT
Internet Options
General
Security
Privacy
Content
Connections
Programs
Advanced
Home page
To create home page tabs, type each address on its own line.
http://google.com/
Use current
Use default
Use blank
Browsing history
Delete temporary files, history, cookies, saved passwords, and web form information.
Delete browsing history on exit
Delete...
Settings
Search
Change search defaults.
Settings
Tabs
Change how webpages are displayed in tabs.
Settings
Appearance
Colors
Languages
Fonts
Accessibility
OK
Cancel
Apply
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Structural Engineering
Architecture
Ports & Material Handling
Roads, Bridges, Highways & Flyovers
Defence Projects
Environmental Engineering
Information Technology
Management Advisory Services
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Metals
Power
Oil & Gas
Infrastructure
REGISTRATION
RIGHT TO INFORMATION ACT 2005
TRANSPARENCY & INTEGRITY PACT
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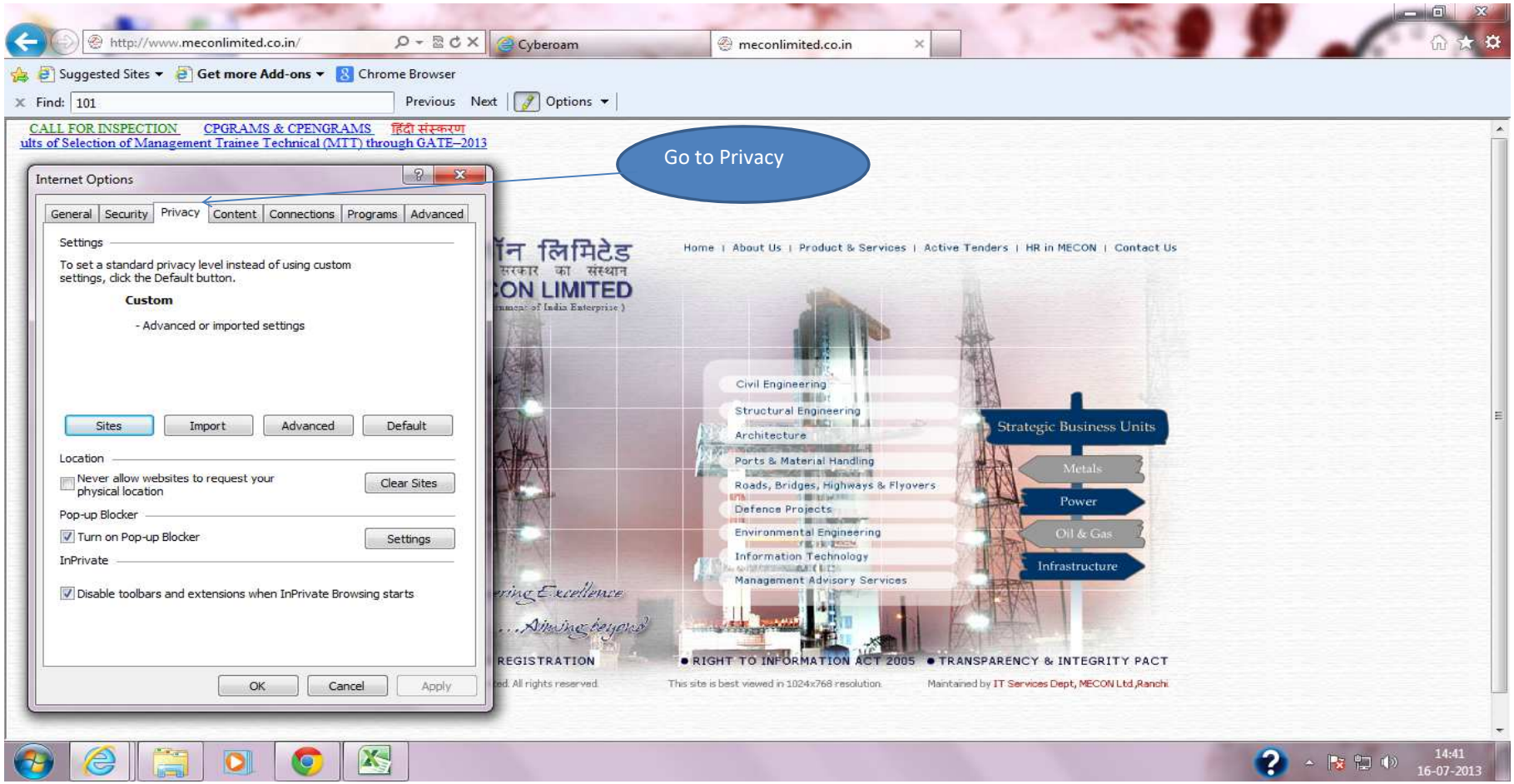
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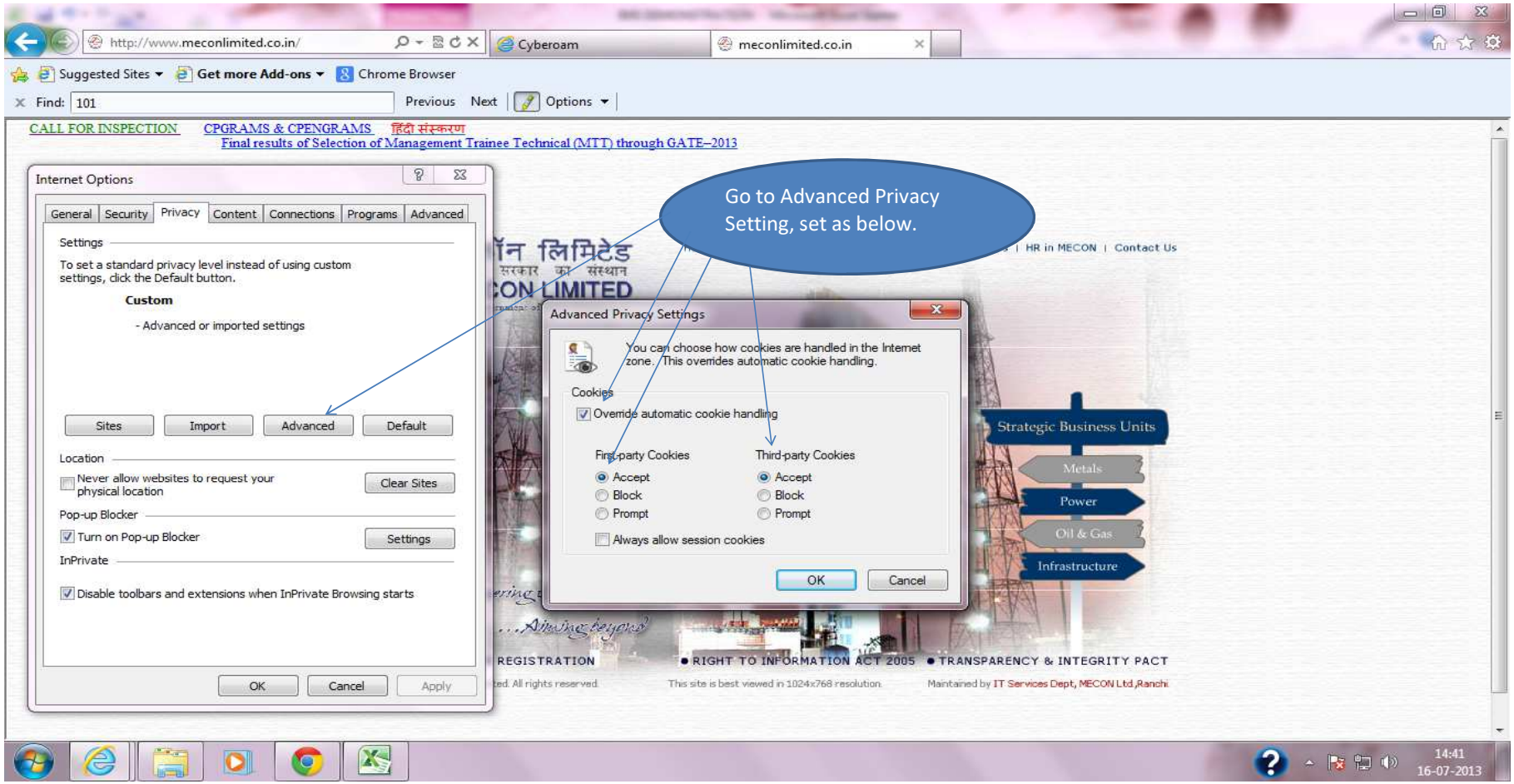
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A sample details are filled for reference.

Sl. No.	Project	Package No.	Package description	Contractor details.	Contact person details	User Id	Password	e-mail id & Mobile No.
1	BSP Expansion	26	Continuous Casting Plant	M/s.SVAI	Mr.X	XYZ123	TRF1223	x@svai.co.in
2								

मेकॉन ISO 9001 Company	CONTRACTOR	MECON Limited	QUALITY ASSURANCE PLAN	WORK ITEM NO.	
	ORDER NO. & DATE		FOR	PROJECT	
	SUB - CONTRACTOR/ MFR		STRUCTURAL & MECHANICAL EQUIPMENT	PACKAGE NO.	
	ORDER NO. & DATE			PACKAGE NAME	

INSTRUCTIONS FOR FILLING UP :

1 QAP shall be submitted for each of the equipment separately with break up of assembly / sub-assembly & part/component or for group of equipment having same specification.

2 Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment.

3 Separate identification number with quantity for equipment shall be indicated wherever equipment having same specification belonging to different facilities are grouped together.

4 Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

ABBREVIATIONS USED :

RS: RANDOM SAMPLING
CONTR : CONTRACTOR
MFR : MANUFACTURER
W : WITNESS
R: REVIEW
RS1: One/type/Size/Lot
RS2: 10%/type/Size/Lot

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS :

Code Description

1. Visual(Welding etc.)
2. Dimensional
3. Fitment & Alignment
4. Physical Test(Sample)
5. Chemical Test (Sample)
6. Ultrasonic Test
7. Magnetic Particle Test(MPT)
8. Radiography test
9. Dye Penetration Test
10. Metallographic Exam.
11. Welder's Qualification & Weld Procedure Test
12. Approval of Test and Repair Procedure
13. Heat Treatment
14. Pressure Test
15. Leakage test
16. Balancing
17. Vibration Test
18. Amplitude test

Code Description

19. Sponge test
20. Dust/Water Ingress test
21. Friction Factor Test
22. Adhesion Test
23. Performance Test/ Characteristic curve
24. No. Load/Free running Test
25. Load/Overload Test
26. Measurement of speeds
27. Accoustical test
28. Geometrical Accuracy
29. Repeatability and Positioning Accuracy
30. Proving Test
31. Surface Preparation
32. Manufacturer's Test Certificate for bought out items
33. IBR/Other statutory agencies compliance certificate

Code Description

34. Internal Inspection report by Contractor
35. Hardness test
36. Spark test for Lining
37. Calibration
38. Safety device test
39. Ease of Maintenance

D1. Approved GA drawings
D2. Information and other reference drg / stamped drgs released for mfg.
D3. Relevant catalogues
D4. Bill of Matl./ item no./ identification.
D5 Matchmark details
D6 Line/Layout diagram
D7 Approved erection procedures
D8 Unpriced sub P.O.with specification and amendments, if any
D9. Calibration Certificate of all measuring instrument and gauges.
D10 Guarantee certificate

	EQUIPMENT DETAILS						INSPECTION AND TESTS								
							Raw Material and Inprocess stage Inspection			Final Inspection / Test by			Test Certificates & documents to be submitted	Acceptance Criteria Standards/IS/BS/ ASME/Norms and Documents	REMARKS/ SAMPLING PLAN
Sl. No.	Description (with equipment heading,place of use and brief specification)	Identification No.	Quantity No / M	Quantity T	Manufacturer's Name and Address	Expected Schedule of Final Inspn	MFR	CONTR	CLIENT / CONS	MFR	CONTR	CLIENT / CONS			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

For Sub Contractor/MFR (Stamp & Signature)

For Contractor (Stamp & Signature)

QAP NO.	REV. :- 0
SHEET : 1 of 2	

CONTINUATION SHEET

FORM NO. 11.20 (DQM) F-09, Ed.-3 REV-1

	EQUIPMENT DETAILS						INSPECTION AND TESTS								
Sl. No.	Description (with equipment heading,place of use and brief specification)	Identification No.	Quantity		Manufacturer's Name and Address	Expected Sche-dule of Final Inspn	Raw Material and Inprocess stage Inspection			Final Inspection / Test by			Test Certificates & documents to be submitted	Acceptance Criteria Standards/IS/BS/ ASME/Norms and Documents	REMARKS/ SAMPLING PLAN
			No / M	T			MFR	CONTR	CLIENT / CONS	MFR	CONTR	CLIENT / CONS			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

NOTES to Contractor and / or Manufacturer:

(1) Ultrasonic test of plates (lamination check) will be done as per ASTM A-435 (or equivalent) for equal to and above 20mm thick plate.
(2). Ultrasonic test of forged & Rolled rounds will be done as per ASTM A - 388 (or equivalent) for equal to and above 50 mm dia round and acceptance standard to be mutually agreed upon.
(3). All the relevant test reports/certificates shall be submitted during inspection.
(4) Dye penetration test shall be as per Art - 24, Sub section B, code SE 165, ASME Section - V.
(5) All NDT - DPT / UT / RT / MPT/ Leak test / pressure test of weld joints are to be carried out wherever drawing / TS calls for as per applicable standards.
(6) Mill TC for major raw materials to be submitted. In absence of which physical & chemical testing reports will be submitted from NABL accredited laboratory.
(7).WPS/PQR/WPQ to be submitted for review wherever required. All welding shall be done by qualified welders. Duly endorsed documents will be submitted to MECON.
(8) Electrical & refractory items / equipments coming under this QAP should be followed as per relevant electrical & refractory QAP.
(9) Column '14' will be inclusive for all the inspection check points under column 'Inspection & Tests' (Column No. 8-13) and all documents of (Column 15) Acceptance Criteria.
(10). All statutory items including CCOE / IBR items etc. shall be generally under waiver category of MECON. Inspection documents for such items will be submitted for review in accordance with the reference codes.
(11). D9 to be submitted for measuring instruments.
(12). Painting shall be done as per approved Specification.
(13). List of equipments with quantity to be furnished under the unit 'set' or 'lot' as annexure along with inspection call.
(14). Manufacturer's 'Quality Control Procedure' shall be submitted along with inspection call, wherever in existence.
(15) Only type test certificate of same design and same Material of Construction of equipment to be sumbmitted, wherever required.
(16) All the manufacturers shall be from prefered make list of General Technical Specification (GTS) / Contract Technical Specification (CTS) / Approved drawing/datasheet.
(17) Relevant Tests, required as per Approved- drawing / technical datasheets / relevant standards /codes/procudure; to be carried out by Manufacturer and/or Contractor (as applicable) and reports shall be submitted.
(18) Contractor/Manufacturer's scope is not limited to test codes indicated herewith and contractor to ensure compliance to all requirments stipulated in approved drawing/datasheet/TS and CTS.
(19) Correct & proper entry of Billing Schedule / Identification No. and quantity is the sole responsibility of the contractor.
(20) Inspection Call to be raised only after the respective approved drawing / datasheet is submitted by contractor and processed (A / AAN) by MECON.
(21) QAP approval does not give approval of Manufacturer/Vendor.

For Sub Contractor/MFR (Stamp & Signature) **For Contractor (Stamp & Signature)**

QAP NO. **REV. :- 0**

SHEET : 2 OF 2

FORM NO.11.20(DQM) F-10, Ed.-3 REV-1

	CONTRACTOR	*	QUALITY ASSURANCE PLAN	WORK ITEM NO.	*
	ORDER NO. & DATE	*	FOR	PROJECT	*
	SUB - CONTRACTOR		ELECTRICAL & INSTRUMENTATION EQUIPMENT	PACKAGE NO.	*
	ORDER NO. & DATE			PACKAGE NAME	*

INSTRUCTIONS FOR FILLING UP :

1 QAP shall be submitted for each of the equipment separately with break up of assembly / sub-assembly & part/component or for group of equipment having same specification.

2 Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment.

3 Separate identification number with quantity for equipment shall be indicated wherever equipment having same specification belonging to different facilities are grouped together.

4 Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

ABBREVIATIONS USED :

CONTR : CONTRACTOR R : Review

MFR : MANUFACTURER W : Witness

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS :

Code Description

1. Visual
2. Dimensional
3. Fitment & Alignment
4. Physical Test(Sample)
5. Chemical Test (Sample)
6. Ultrasonic Test
7. Magnetic Particle Test(MPT)
8. Radiography test
9. Dye Penetration Test
10. Measurement of IR Value :
    a) Before HV Test
    b) After HV Test
11. High voltage test/Dielectric test.
12. Routine test as per relevant IS/other standard.
13. Type tests as per relevant IS/ other standard.

Code Description

14. Impulse Test.
15. Partial Discharge Test.
16. Heat run test/Temp. rise test.
17. Enclosure protection Test.
18. Calibration.
19. Noise & Vibration.
20. Test Certificates for bought out components.
21. Tank pressure
22. Paint shade & thickness verification.
23. Short time rating.
24. Operation & functional check.
25. Overspeed Test.
26. Flame proof test
27. Clearance and creepage distance.
28. Acceptance Test
29. Verification of BOM
30. PI Value check
31. Earthing provision & Ferruling Check
32. HV &IR test of BTD, RTD & Space heater
33. Galvanization test
34. Continuity test
35. FRLS test
36. Dynamic balancing test
37. Shaft voltage measurement
38. SFRA test
39. Functional test for RTCP
40. Load/overload test
41. Specific fuel consumption rate check
42. Tan delta test
43. Harmonic test

DOCUMENTS :

D1. Approved L-2 drawings
D2. Approved single line / schematic diagram.
D3. Approved Catalogues / Approved data sheet.
D4. Approved bill of materials.
D5. Unpriced P.O.copy and approved BS copy
D6. Calibration Certificate of all measuring instruments and gauges.
D7 . Approved FAT procedure
D8 . Manufacturer TC /Certificate of compliance
D9 . Inspection report for contractor
D10. Conformity certificate
D11. Gurrantee/Warranty certificate
D12. Compatibility certificate
D13. Screenshot of FAT

	EQUIPMENT DETAILS						INSPECTION AND TESTS								
							Raw Material and Inprocess stage Inspection			Final Inspection / Test by			Test Certificates & documents to be submitted to MECON	Acceptance Criteria Standards/IS/BS/ ASME/Norms and Documents	REMARKS/ SAMPLING PLAN
Sl. No.	Description (with equipment heading,place of use and brief specification)	Identification No./ Billing Schedule No.	Quantity No / M	Quantity T	Manufacturer's Name and Address	Expected Schedule of Final Inspn	MFR	CONTR.	MECON	MFR	CONTR.	MECON			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
*	*		*	*						*	*	*	*	*	

* Mandatory field

for MECON (Stamp & Signature)

For contractor/sub-contractor (Stamp & Signature)

(QAP No. to be alloted by MECON)
MECON QAP NO.
SHEET : OF
REV. :

CONTINUATION SHEET

FORM NO.11.20(DQM) F-10, Ed.-3 REV-1

	EQUIPMENT DETAILS						INSPECTION AND TESTS								
							Raw Material and Inprocess stage Inspection			Final Inspection / Test by			Test Certificates & documents to be submitted to MECON	Acceptance Criteria Standards/IS/BS/ ASME/Norms and Documents	REMARKS/ SAMPLING PLAN
Sl. No.	Description (with equipment heading,place of use and brief specification)	Identification No.	Quantity		Manufacturer's Name and Address	Expected Sche-dule of Final Inspn									
			No / M	T			MFR	CONTR.	MECON/NMDC	MFR	CONTR.	MECON/NMDC			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

(QAP No. to be alloted by MECON)

MECON QAP NO.

SHEET : OF

REV. :

for MECON (Stamp & Signature)

For contractor/sub-contractor
(Stamp & Signature)

08.00 PAINTING

08.01 Painting and Protective Coatings

All carbon steel surfaces, fittings, supports and structural steel skid shall be coated in accordance with protective coating and painting specifications. All equipment shall be final painted at vendor's shop, except Stainless steel components; which shall not be painted.

The hot process piping from compressor discharge to coolers including discharge pulsation dampeners shall be insulated with Aluminium cladding, wherever the surface temperature exceeds 60 °C.

Painting protective coating and the procedures used for the preparation of surface shall be specified in the Painting Specifications. Where painting is specified, the entire vessel shall be painted, including inside any skirt, outside bottom head, the entire base ring and all skit, outside bottom head, the entire base ring and all skirt attachments. Nozzles shall be painted on the flange edges, inside bolt-holes, and upto the gasket surface. Fireproofed or insulated surfaces shall be grit blasted and given one coat of primer only.

08.02 Internal and External Coating

Surface coatings shall be applied as required to achieve the design life of each specific vessel. Internal Coatings and External Coatings should also comply with Painting Specifications.

All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale, rust, dirt and other foreign materials by wire brushing and sand blasting, as applicable. Minimum acceptable standard in case of power tool cleaning shall be St. 3 and in case of blast cleaning shall be Sa $2^{1/2}$ as per Swedish Standard SIS: 055900 (latest edition).

Non-ferrous materials, austenitic stainless steels, plastic or plastic coated materials and insulated surfaces of equipment not are painted.

Stainless steel surfaces both inside and outside shall be pickled and passivated.

Machined and bearing surface shall be protected with rust preventive agent like varnish or thick coat of grease.

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Depending on the environment, following primer and finish coats shall be applied.

Sl. No.	Environment	Description		
1.	Normal Industrial	Primer	:	2 coats of Red oxide zinc chromate, each 25 microns (min.) thick.
		Finish	:	2 coats of Synthetic enamel, each 25 microns (min.) thick.
2.	Corrosion Industrial	Primer	:	2 coats of Epoxy zinc chromate each 35 microns (min.) thick.
		Finish		2 coats of Epoxy high build paint, each 100 microns (min.) thick.
3.	Coastal and Marine	Primer	:	2 coats of High build chlorinated rubber zinc phosphate each 50 microns (min.) thick.
		Finish	:	2 coats of Chlorinated rubber
4.	All environments (Temp. 80250ºC)	Finish	:	2 coats of Heat resistant Aluminium paint suitable for 250ºC each of thickness 20 microns.
5.	All environment (Temp. 250400ºC)	Finish	:	2 coats of Heat resistant Aluminium paint suitable for 400ºC each of thickness 20 microns.

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09.00 PROJECT SCHEDULE & PROGRESS MONITORING

09.01 The project envisages installation of natural gas compressor station near Guwahati for compression of the natural gas (being received at NEGG battery limit) that it is delivered at NRL (Numaligarh Refinery Limited) battery limit at 40 Kg/cm2. The location of the station is at Barpalaha near Guwahati, Assam. The natural gas compressor station along with auxiliary equipment and facilities shall be commissioned in 18 months from Zero date which shall be reckoned as effective date of contract on a TURNKEY supplier. Zero date and commissioning as mentioned above and shown in the schedule shall be same as defined in the technical and commercial part of the specification.

An indicative Implementation Schedule, in line with the total time period and indicating the major activities, is shown in drg. no. MEC/11/PY/23UU/TS/0001/R-0 for reference.

09.02 Project Schedule

09.02.01 The Tenderer shall submit the following along with the offer.

i) Overall bar-chart schedule

The overall bar-chart schedule should be planned in weeks. The heads to be covered in the schedules shall broadly be as follows:

- Basic engineering and approval
- Preparation and issue of ordering / technical specifications for sub-vendors
- Placement of orders on sub-vendors
- Detailed design and engineering
- Submission and approval of drawings for civil & structural works
- Manufacture and supply of all equipment/ piping/ cables etc
- Fabrication and supply of buildingand technological structures
- Submission and approval of erection drawings and manuals
- Civil work
- Erection of building and technological structures
- Erection of equipment, piping, cables etc.
- Testing and commissioning

The major milestones for the project are to be highlighted in the schedule.

ii) The overall erection plan

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- Provision of construction water and power shall be arranged by tenderer.
- Area within Battery limit should be utilized for construction and storage area. However, if additional area outside the battery limit is available, the client may permit the bidder to utilize the same.

iii) Off-site/ on-site organization chart for execution of the project

09.02.02 The Tenderer shall submit the following before finalization of contract.

i) Deployment schedule of construction man power

ii) Deployment schedule of equipment and machinery, tools & tackles, etc.

In case simultaneous erection work is carried out along with civil and structural works, the movement of men, machine and materials at site shall be planned suitably.

09.02.03 The successful Tenderer shall have to submit the following -

i) The Level-II network (Detailed Project Schedule) both in hard and editable soft copy in Primavera covering further details of project activities, area-wise, within 1 monthfrom effective date of contract for approval and finalization of the Purchaser / Consultant.

ii) The format of progress report to be discussed and agreed upon within 1 month of effective date of contract.

iii) Updated Level-II network (Detailed Project Schedule) in hard & soft copies shall be submitted every month.

iv) The progress report (in approved format) shall be submitted every month.

09.03 Progress Monitoring

09.03.01 An effective system of progress monitoring is to be evolved by the contractor to ensure timely completion of all project activities. A monthly progress report showing current status of various activities shall be submitted by the Contractor to the Purchaser and his consultant. The monthly progress report shall indicate progress of various activities against targeted dates and targeted quantities. Reasons for shortfalls, if any, shall be clearly brought outand

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proposed remedial measures to arrest the delays shall be indicated by the Contractor in the progress report, wherever applicable.

In general, progress of the following major activities is to be reported.

- Issue of ordering / technical specifications and placement of orders on sub-vendors for bought out items / components
- Detailed design and engineering including submission of drawings and their approval, subsequent revisions and resubmissions
- Manufacturing activities at the works of the contractors / associates / sub-vendors
- The progress report on inspection status
- Dispatch of equipment to site
- Site activities including receipt of material / equipment at site, construction and erection, testing and commissioning

Two months prior to start of site activities, the contractor shall submit a schedule for site-execution, along with quantitative program of month-wise physical targets. After the site activities are started, the contractor shall furnish information on site activities viz: daily, weekly and monthly progress reports on construction / erection, receipt of equipment against the monthly construction / erection plan, etc. The contractor shall also indicate resource deployment at site, highlights of critical areas and constraints faced, in the site progress reports.

Other information related to site activities as may be required by the Purchaser and Consultant, shall also be submitted by the contractor.

In the interest of timely completion of the project, if required, the priority of construction / erection may be altered by the Purchaser and Consultant, in consultation with the contractor.

09.03.02 The Purchaser / Consultant shall also have the right to:

- Invite the Contractor for daily / weekly / monthly meetings to review the progress of the project.

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- Depute Purchaser's authorized representatives for ascertaining / expediting progress at contractor's works.

- Suggest remedial actions to bridge-up time gap between planned progress & observed progress.

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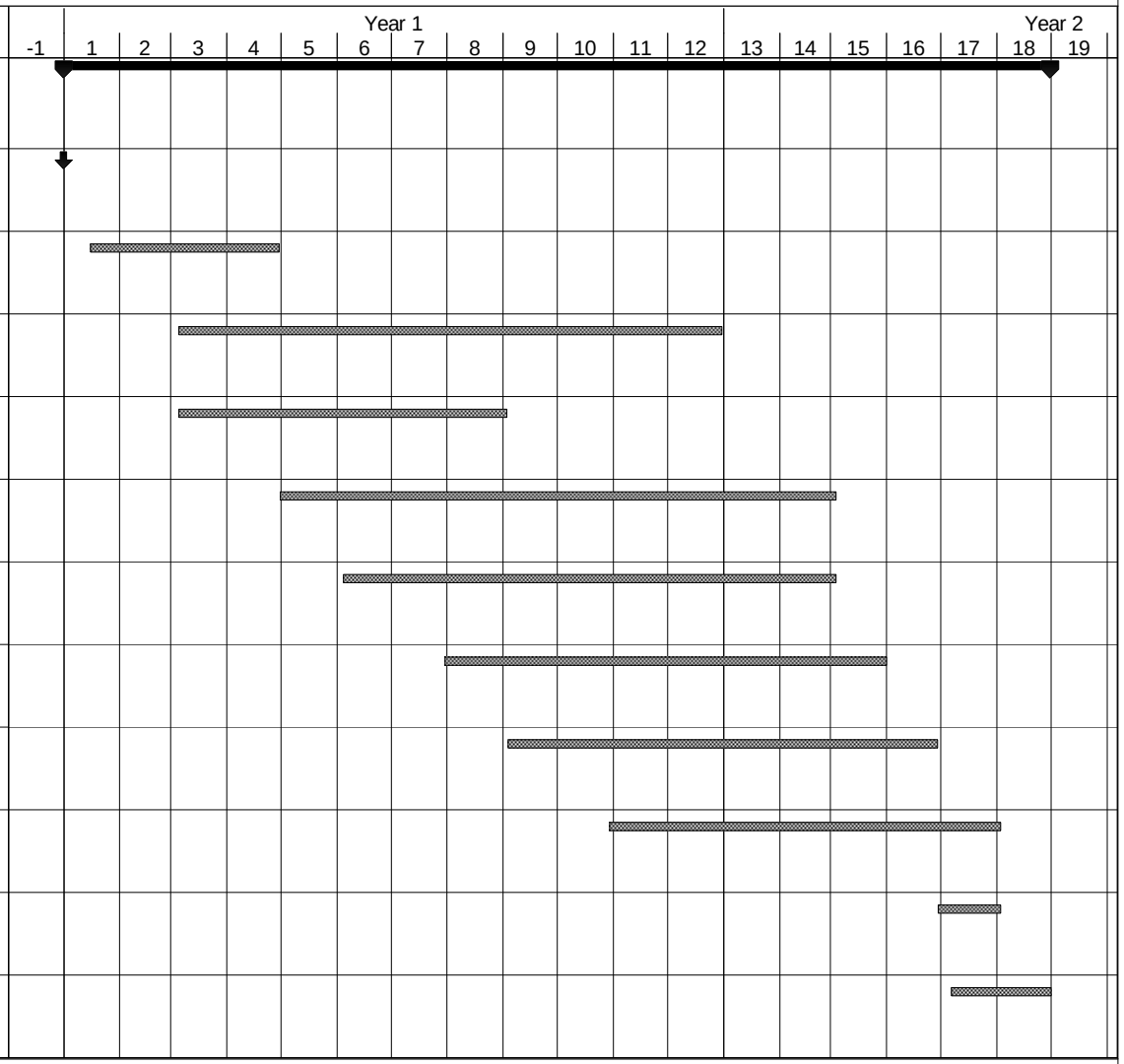
INDRADHANUSH GAS GRID LIMITED(IGGL)
North East Gas Grid (NEGG) Pipeline Project (Phase -I & Phase-II)
Natural Gas Compressor Station

Project Implementation Schedule

ID	Activity	Dur (wks)
1	**M/s IGGL - Natural Gas Compressor Station for North East Gas Pipeline Project (PH-1)**	**78 w**
2	**Zero Date (Order placement on Turnkey Contractor)**	**0 w**
3	**Basic Engineering and Approval**	**15 w**
4	**Detailed Design & Engineering**	**43 w**
5	**Tendering and Ordering on subvendors**	**26 w**
6	**Civil Work**	**44 w**
7	**Fabrication & Delivery of Structures**	**39 w**
8	**Erection of Structures**	**35 w**
9	**Delivery of Equipment**	**34 w**
10	**Erection of Equipment incl. Technological Structures**	**31 w**
11	**Testing, Trial-run & Commissioning - Auxillaries**	**5 w**
12	**Testing, Trial-run & Commissioning - Natural Gas CompressorStation**	**8 w**



23UU_NEGG_TS_Imp Sch_18 M

Task Milestone Summary Zerodate

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DRG NO: MEC/11/PY/23UU/TS/0001/R-0

Prepared By : R.Roobikala I Checked & Approved By : M.K.Tigga

10.00 ERECTION, TESTING, COMMISSIONING AND HANDING OVER

The Tenderer shall be fully responsible for erection, testing and commissioning of the facilities as per scope of work. Unless otherwise specified, during commissioning of the plant, necessary spares, consumable and tools/ tackles required are deemed included in Tenderer's scope of work.

During all testing and commissioning activities, the Tenderer shall involve Purchaser and impart necessary techniques and know-how required for operation and maintenance of the facilities provided under the scope.

10.01 Erection

a) The Tenderer shall perform the following with respect to the erection of the Plant and equipment supplied.

b) The scope of work of the Tenderer shall be complete erection of the Plant and Equipment as given in the Scope of work. The Tenderer shall make all arrangements to deliver the equipment at site by wagons / trucks / trailers, build his own stores (covered, uncovered, air-conditioned, if necessary) for the proper storage of equipment, maintain the stores and all related documents and records, transport the equipment to site for erection purpose. All security (watch & ward) arrangements also shall be made by the Tenderer.

c) The Tenderer shall unpack and do visual checking against physical damages to the equipment / cases, clean equipment before start of erection. Damage shortage, if any, shall be reported to the Purchaser / Consultant and shall be rectified / replaced expeditiously, so as not to upset the erection and commissioning shall not be considered an excuse for delay in completion of the work.

d) The Tenderer shall provide all necessary erection equipment and tools & tackles including material handling equipment, cranes, compressors and other equipment and instruments and consumables, all commissioning equipment and theodolite, etc. which may be required for carrying out the erection and commissioning work efficiently. All instruments shall be properly calibrated before use. Unless otherwise specified, the above erection equipment / material shall be the property of the Tenderer. However, Purchaser's prior permission shall be required for removal of these erection equipment / materials from the site. The tenderer shall ensure that proper procedure and documentation maintained at entry gate of

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Purchaser's premises for such items as may be carried back by the Tenderer after completion of work.

e) The Tenderer shall provide all temporary ladders; scaffolding materials; platforms, supports and other necessary facilities required for handling, erection, testing and visual inspection of suppliers at the point of installation and shall also provide necessary packing plates, wedges, shims, leveling screws etc. required for erection of equipment and structures.

f) The Tenderer shall provide erection consumable like oxygen and acetylene gas, welding rods, solder lugs, oil, grease, kerosene, cotton waste, etc. required for erection of equipment and related steel structures and minor civil work.

g) The Tenderer shall erect and maintain his own site offices and stores as required for the work and arrange for maintaining in neat manner of the area placed at the Tenderer's disposal. The site office shall be handed over to Purchaser free of cost after completion of the project or dismantled and handover vacant land as directed by Purchaser.

h) The Tenderer shall provide sufficient fencing, notice boards and lights to protect and warn others as may be considered necessary by the Purchaser / Consultant. All materials used for providing these facilities shall be properties of the Tenderer.

i) The Tenderer shall organize the work in a manner that other work being carried out simultaneously at site is not affected and the workmen not endangered and shall arrange all temporary access as required for the erection work.

j) The Tenderer shall carry out base / primer and final painting of all Plant & Equipment, Structures, Pipe lines, Tanks & Vessels etc. supplied. The painting including its process shall be carried out as per the requirement as have been laid down in the detailed technical specification. Where not specified, the same shall be as per the standard codes & practices normally applicable and adopted internationally for the type of Plant & Equipment offered.

k) All civil work including chipping, grouting of the equipment and steel structures foundations with approved non-shrink-grouting compound shall be the responsibility of the Tenderer. The materials required shall be supplied by the Tenderer.

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l) All safety, health and pollution control measures as required to be adopted as per the Statutory Regulations and the Safety Codes for projects issued along with the tender or otherwise required or implied by statutory regulations or the Technical specification. The Tenderer shall set up a suitable safety organization of his own at site in this regard.

m) The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the working drawings, specification, and instructions etc. duly approved by the Purchaser. The Tenderer shall carry out the work in the presence of / as per the instructions of the site engineer / supervisory personnel deputed by the Purchaser. The erection shall be carried out by highly skilled work men.

n) The Tenderer shall supply all required consumables, construction and erection materials such as grouting material, welding materials, flushing & initial fills of lube oils (as per manufacturers / suppliers recommendation), petrol, diesel, Kerosene, bolts, nuts, packing sheets, gaskets, jute, cotton waste, emery papers etc. as required for the satisfactory completion of work. Welding electrodes shall conform to the latest revision of the standards / codes.

o) The Tenderer shall provide adequate nos. of skilled, semi-skilled and unskilled labours including riggers, welders, filters, mechanics, supervisory staff; tools & tackles etc for completion of all equipment and piping systems within scheduled time.

p) The Tenderer shall take care of positioning, leveling and plumbing of all equipment & pipelines within required accuracy and tolerance limit as specified by codes, manufacturer, purchaser and consultant. It shall be deemed as a contractual obligation that equipment are not thrown out of alignment or lifted off during commissioning and subsequent operation.

q) The Tenderer shall be responsible for paying strict attention to statutory regulations for prevention of accidents and other safety rules.

r) The Tenderer shall be responsible for safe handling of all equipment. If any damage takes place during erection and testing work, the same shall be repaired / replaced by the Tenderer to the satisfaction of purchaser without any financial implication.

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s) Before erection all parts of equipment, pipes, valves, fittings etc. shall be cleaned, checked, lubricated and inspected for ease of operation and any possible damage during transportation.

t) After installation of equipment on the foundations, they shall be leveled and aligned by means of sensitive sprit level, screw jack, dial and feeler gauges etc. as per tolerances specified by equipment manufacturer / supplier. Number of packing plates / shims shall be as minimum as possible.

u) After alignment and leveling, equipment foundations shall be chipped to remove any traces of oil & grease. The base frames shall be grouted with the help of quick setting, non shrink cement. Sufficient time shall be given for proper setting / curing before tightening the nuts of the foundation bolts. Tightening of the foundation bolts shall also be done uniformly and diagonally.

v) After complete installation of equipment on foundations, alignment shall have to be checked again to ensure tolerances. The equipment shall be first rotated manually.

w) All the pipelines shall be provided with suitable slopes. Suitable vent with valve at the highest points and drains/ trap with by pass arrangement at the lowest points shall be provided in the pipelines by the Tenderer. Welded joints shall be located at a distance equal to pipe diameter but not less than 100mm from the beginning of the curve or pipe support locations. Radius of smooth bends of pipe shall be at least 3 times the pipe diameter unless otherwise specified.

x) Hooking up of all pipelines / services including supply of all fittings as required for the same for all pipelines / services with existing pipelines / services at battery limits shall be the responsibility of the Tenderer.

y) The Tenderer shall intimate the purchaser at least one month in advance for requirement of any shutdown of the existing services for hooking up purpose. The Tenderer shall also prepare shutdown plan indicating time required, manpower and equipment planning, availability of all fittings etc. well in advance to purchaser for approval.

z) Access platforms & ladders are to be provided for the equipment, instruments, valves etc. which are not approachable from ground for operation & maintenance purpose.

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aa) The Tenderer shall return to the purchaser all crates, packing boxes, packing materials and all surplus material brought to the site after completion erection, testing & commissioning of the plant & equipment. All these materials shall be kept at place and manner designated by the purchaser.

bb) The Tenderer shall clean and remove all surplus material, debris scraps, foreign material, metal chips etc. from the plant area after completion of erection & testing and before commissioning.

10.02 **Construction Water and Construction Power**

Construction water and power shall be arranged by Tenderer.

10.03 **Allotment of land**

Land shall be allotted for the purpose of Site Office, Stores and fabrication yard. The allotment shall remain valid till the period of contract and shall automatically cease after expiry of the guarantee period of the contract. The validity shall also automatically cease on termination of contract due to any reason whatsoever.

The Tenderer may build only temporary structures on the land allotted to him.

On completion of the work and expiry of the guarantee period, the Tenderer shall remove all temporary structures built by him and restore the land to its original condition unless otherwise advised by the Purchaser.

10.04 Testing

Tenderer shall ensure, either directly or through his sub-Tenderer, that all the tests / inspection specified in specifications, codes, data sheets etc. are carried out in full.

Purchaser / Consultant or its authorized agents may, at their option witness performance test of equipment at the works and erection and testing at site.

In case Tenderer is not able to meet any specific test / inspection requirement it shall be clearly brought out in the deviation list in his offer.

After completion of erection the following test shall be conducted at site.

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Site Tests

The Tenderer shall prepare and submit detailed quality plans for each equipment under this specification from the receipt of material at site, during storage, erection, pre-commissioning to final commissioning of the plant. These procedures shall necessarily include all check/tests conducted at site for preservation, assembly, alignment, positioning of the equipment, foundation preparation, welding/bolting, heat treatment, non-destructive examination, hydraulic test, running test, performance test etc. The above shall be discussed and finalized with the Purchaser/ Consultant. The Tenderer shall also furnish detailed quality procedures proposed by him for storage, preservation, painting, hydraulic test, air / gas tightness test, performance test etc. to the Purchaser/ Consultant. The same shall be discussed, finalized and approved by the Purchaser/Consultant before the commencement of respective site tests and such approved copies shall be submitted in six copies.

Hydraulic Tests of Pressure Parts

a) On completion of erection of pressure parts, the unit with its fittings and mountings in position and pipelines shall be subjected to hydrostatic pressure test in accordance with requirements of Indian Boiler Regulations.

b) Water used for hydraulic test shall be made alkaline by addition of suitable chemicals.

c) Hydrostatic test of all pipelines shall be done at 1.5 times the max. working pressure. However, pneumatic test of gas pipelines, as applicable shall be done at a pressure not less than 0.2 kg/cm2g.

System Checking / Reliability Trials

Tenderer shall carry out tests at site to prove to the Purchaser that each equipment of the plant complies with requirements stipulated and is erected in accordance with requirements. Before the plant is put into trial operation the Tenderer shall be required to conduct tests to demonstrate to the Purchaser that each item of the plant is capable of correctly performing the functions for which it was specified.

These tests may be conducted concurrently with those required under commissioning sequence.

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10.05 Acceptance Tests

After erection of the equipment at site acceptance test shall be conducted in accordance with latest codes or any other approved equal international standards. A detailed test procedure shall be prepared and submitted to the Purchaser / his Consultant for approval at least one month prior to testing. All instrument and accessories for the test shall be arranged by the Tenderer.

10.06 Definitions

a) Mechanical Completion

When all the design and engineering is completed, all factory inspection tests have been completed, all the building work has been completed, all equipment and machinery are installed and aligned all piping and instrumentation work is completed, all hydrostatic / pneumatic testing is done, speed and direction of rotation of all prime movers is checked, relays are set and all scales, meters, measuring devices and recorders are calibrated, all operating procedures and maintenance procedures have been forwarded to the purchaser for review, all items for which Contractor is responsible for obtaining third party, regulatory or purchaser's approval have been obtained and confirmation documentation has been provided to the purchaser, the Tenderer shall notify purchaser in writing that the plant is ready for occupation in all respect and is ready to start.

b) Preliminary Acceptance

Preliminary Acceptance of the Facilities means that the Facilities have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of Pre-commissioning of the Facilities have been completed.

c) Pre-commissioning Activities

Pre-commissioning means the checking, testing including conducting of integrated trial runs (cold integrated trial runs in case of Facilities involving operation at high temperature) and meeting other requirements specified in the Technical Specifications that are to be carried out by the Tenderer in preparation for Commissioning.

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Pre-commissioning activities are required to be performed after erection / installation, hydro testing, etc. of an equipment / system to make them ready for commissioning. This shall include but not limited to the activities like system checking as per P & I drawings, site modification, inspection of equipment, calibration of instruments, loop checking, checking of the electrical equipment for proper earthing, continuity, insulation resistance, primary and secondary injection test of relays after insulation resistance, conducting operability test on individual equipment / systems, supply and charging of lube oil and other chemicals, complete checking of the safety system, removal of all debris and construction equipment from site, etc. Fabrication and supply of such temporary facilities as for example, temporary bypasses, spools, blinds, jump over, vents, etc., which shall be required to carryout pre-commissioning activities are to be provided by the tenderer.

d) Ready for Commissioning

The plant shall be considered "Ready for Commissioning" when all the facilities have been completed along with its auxiliaries and support facilities in every respect including charging of lube oil, any last minute modifications as recommended by the Purchaser / Consultant, all temporary structures, scaffolding, etc. used for carrying out pre-commissioning works have been removed, all the blinds / blanks have been put in position as required by process, all systems as recommended have been purged and pressurized, and the plant has reached to a stage of ready for commissioning and acceptable to the Purchaser / Consultation.

The Tenderer shall issue a certificate of "Ready for Commissioning" of plant, for acceptance by Purchaser.

e) **Commissioning** means operation of the facilities by the Tenderer to a level of output not less than 66% of the Guaranteed Production Capacity.

f) **"Taking Over"** means, on commissioning, the Purchaser shall be responsible for the care & custody of the Facilities together with the risk of loss or damage thereto, and shall thereafter take-over the Facilities.

g) **"Performance Guarantee Test"** means the test(s) specified in the Technical Specifications to be carried out to ascertain whether the Facilities are able to attain the Performance Guarantees specified in Clause no. 11.02.01.

h) **"Final Acceptance"** shall occur in respect of the Facilities when:

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i) The performance guarantee tests have been successfully completed or the amount of Liquidated Damages, if recoverable, has been recovered by the Purchaser from the Tenderer.
ii) The Tenderer has submitted all final drawings & documents for the respective Facilities including As-Built.
iii) The Tenderer has fulfilled all the obligations under the Tender.

10.07 Pre-commissioning & Commissioning

Tenderer shall be responsible to carry out pre-commissioning and commissioning of complete Plant and equipment supplied. Tenderer shall document elaborating different activities with schedule for pre-commissioning and commissioning. The document shall cover the following as minimum.

i) Description of facilities / Equipment layout drawings with clear legends
ii) Start up procedures
iii) Normal operation procedures
iv) Shut down procedures (normal / emergency)
v) Operating parameters and set points of different alarms and trips.
vi) Summary of utilities consumption (normal & maximum)
vii) Lubrication schedules and identification of equivalent available in India.
viii) Fire and safety system.

The manual shall have the following attachments as a minimum :

i) Reduced size copies of line lists and valve schedules
ii) Equipment and instrument data sheets
iii) Electrical single line diagram
iv) Area classification drawings
v) Pump characteristics curves
vi) Piping and instrumentation diagrams
vii) All shut down schemes
viii) Safety logic diagrams
ix) Recommended proforma of log books for major equipment

10.08 Commissioning

It shall be the responsibility of the Tenderer to carry out the commissioning activities of the plant (after successful mechanical completion and pre-commissioning activities duly witnessed by the Purchaser / Consultant), under

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necessary guidance and overseeing of Licensor, if any.

One month in advance of starting the commissioning, the Tenderer shall submit proposal to the Purchaser giving details of the programme to be followed during commissioning. This shall be checked by Purchaser / Consultant. Tenderer shall depute trained operation team to carry out plant start up and commissioning and process operations and maintenance under the overall guidance of the Purchaser / Consultant. Tenderer also be required to associate Purchaser's operation and maintenance personnel in all the day to day pre-commissioning, commissioning, maintenance activities and process operations. However, responsibility for adequate manning and commissioning of the plant shall be that of the Tenderer.

The plant shall be considered to be commissioned successfully when all the systems, with instrumentation / control systems, process utilities and support systems have been on uninterrupted stable operation at rated parameters, under specified conditions for not less than 72 hours. Whether the 72 hours operation has been successful or not, shall be decided by Purchaser based on observations recorded during the 72 hours. The count down for the 72 hours operation shall start only after the plant has been on stable operation with all controls and safety system in normal operation for a period of not less than 24 hours.

10.09 Acceptance & Handing over

a) The Tenderer shall supervise the Acceptance Tests to ensure that the plant and equipment supplied by them meet Purchaser's system requirement.

b) Acceptance Test for system, equipment and pipelines covered in this specification shall be conducted unit wise or group wise within a reasonable period after the completion of erection work which shall be mutually agreed upon.

c) Commissioning certificate of the plant as a whole shall be issued only after complete facilities have been commissioned and satisfactory operated for a period of 72 hours continuously at required parameters at rated output.

d) Any defects found in the supplied plant & equipment during commissioning shall be rectified by the Tenderer at his own cost failing which the Purchaser reserves the rights to take remedial measures at the Tenderer's cost or reject the plant and equipment as deemed necessary.

After successful commissioning of the plant and equipment, there shall be formal handling over and taking over of the plant between Tenderer and the Purchaser. Final

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taking over certificate shall not be issued unless Purchaser is fully satisfied with the supply work in every respect as per requirement and all documents, drawings, manuals, etc. are furnished by the Tenderer as per the terms of the technical specification.

10.10. **Deputation of experts for Erection, Commissioning and Performance Guarantee Tests**

The Tenderer shall depute site Engineers / Specialists from various disciplines for erection, commissioning, testing and performance guarantee tests of the Plant and equipment with their auxiliaries in addition to the complete team of personnel posted for carrying out site activities.

If some of the experts deputed for erection, commissioning and Performance Guarantee Tests are required by the Purchaser beyond the contract period, the Tenderer shall provide such services in accordance with the terms and rates to be agreed upon between the Purchaser and the Tenderer.

10.11. **Manufacturer**

It shall be the responsibility of the Tenderer to arrange to get service of Manufacturer's installation / commissioning engineer at site during mechanical completion / commissioning of all the major equipment and systems for the plant.

The Tenderer shall plan availability of personnel / experts indicated above, well in advance to match with the requirement. Also the Tenderer shall ensure the continuity for concerned experts / personnel till completion of the work. Short time deputations of different persons shall be avoided.

10.12. **Spares and Consumables**

The Tenderer shall be responsible for the supply of all spares till the plant is handed over to the Purchaser. In addition to this, itemized price list for two years **spares** for operation of plant shall be supplied by the Tenderer to the Purchaser.

The Tenderer shall be responsible for supply of all the consumables for startup and commissioning till the plant is handed over to the purchaser.

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11.00 PERFORMANCE GUARANTEE & LIQUIDATED DAMAGE

11.01 Performance Tests

The successful Tenderer shall conduct Performance Guarantee Tests (PGT) of the compressors in unit wise manner. Duration of tests shall be as mentioned below:

i) Duration of test run of Individual compressor shall be 72 hours.

The objective of performance test of the Natural Gas Compressors shall be to establish:

Natural Gas delivery capacity, discharge pressure and temperature, power consumption of each compressor. Each compressor shall be run and be tested for all the interlocks, audio-visual alarms & trips etc. All the test for compressors shall be carried out as per relevant codes.

11.02 Guarantee

11.02.01 Guarantee Parameters

Table – 11.01

Performance Guarantee under Demonstration

Sl. No.	Description	Parameter (Guaranteed)	Tolerance
1.	Rated Capacity	1.25MMSCMD	**No negative tolerance Acceptable**
2.	Rated discharge pressure at the outlet of after cooler	55 kg/cm^2(g)	**No negative tolerance Acceptable**
3.	Discharge temperature after after-cooler at rated capacity and pressure	55^0 C	**No positive tolerance Acceptable**
4.	Power consumption of each compressor at the above rated conditions of compressor as measured at PLC/DCS in the control room.	To be indicated by the Tenderer	**Acceptable upto 2% above the guaranteed value for each compressor with LD as per clause no. 11.02.02**

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In case of non achievement of the above guaranteed parameters, the successful Tenderer shall carry out all rectification works at his own cost. Even after two such consecutive rectification works, particular equipment fails to achieve the guaranteed parameters, it will be assumed that the plant and equipment supplied is defective in its design and the Purchaser may reject the Facility and recover the entire cost paid to the Tenderer or alternatively the Purchaser may proceed for commercial settlement with the Tenderer for acceptance of the Facilities at the negotiated Price.

11.02.02 Liquidated Damages (LD)

The power consumption of running compressors shall be measured at PLC/DCS in the control room.

For each kWh or part thereof increase in power consumption above the guaranteed value of all the running compressors, penalties will be applicable at the rate of Rs. 5,51,660 per kWh.

LD shall be applicable for worst performance of running compressors.

In case of power consumption increases above 2% of the guaranteed value for each of the running compressor, the Tenderer shall be advised for necessary rectification works at his own cost. Even after two such consecutive rectification works, particular equipment fails to achieve the guaranteed power consumption, it will be assumed that the plant and equipment supplied is defective in its design and the Purchaser may reject the Facility and recover the entire cost paid to the Tenderer or alternatively the Purchaser may proceed for commercial settlement with the Tenderer for acceptance of the Facilities at the negotiated Price.

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12.00 DRAWINGS / DOCUMENTS / INFORMATION TO BE SUBMITTED ALONG WITH THE TENDER

i) Layout showing locations of all the equipment/ system/ facilities and cross sectional view of each major equipment/ system including dimensions.

ii) System scheme, Process Flow Diagrams and P & I diagrams

iii) Descriptive information, catalogues, drawings etc. of all equipment offered under these specification and pertinent engineering data as per Technical particulars so that Purchaser/ Consultant may have full and complete knowledge/assessment of equipment offered.

iv) A detailed experience list about supply and execution of similar type of plant by the Tenderer.

v) A comprehensive write up or brochures on details of manufacture and testing facilities and quality control procedures in the shops of the manufacturer/supplier.

vi) Layout of various services including pipelines, cabling, power supply distribution, etc. indicating terminal points.

vii) Technical particulars as per Chapter-15**.**

viii) List of O&M spare parts for two years of operation.

ix) List of commissioning spares.

x) List of tools and tackles for repair and maintenance.

xi) Schedule of submission of drawings for Purchaser's/ Consultant's approval.

xii) Schedule of design, manufacture, shop testing and delivery at site.

xiii) Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment.

xiv) Any limitations of vendor’s test facilities to carry out the specified tests.

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13.00 DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER PLACEMENT OF ORDER

13.01 General

13.01.01 The Tenderer shall furnish a comprehensive programme of submission of drawings for Purchaser's approval. Submission of drawings shall commence within two weeks after placement of order and shall be completed keeping in view the overall completion schedule of the project.

13.01.02 The Tenderer shall submit requisite number of sets of all the drawings, documents, performance curves and manuals for Purchaser's approval, records and use. After erection of equipment the Tenderer shall submit all final and as-built drawings.

13.01.03 The Tenderer shall observe strict logical sequence in submission of drawings for Purchaser's approval. The drawings shall be fully dimensioned and complete to the extent that may facilitate Purchaser's approval in conjunction with other drawings submitted earlier by the Tenderer. Each set of drawings submitted for approval shall be accompanied by detailed bill of materials giving quantity, material specification, unit and total weights and applicable standard code in respect of each item.

13.01.04 Shop test certificates, test reports and curves for various pumps, motors and equipment shall be submitted for approval before clearance for despatch of equipment.

13.02 Submission of Drawings

Following drawings/documents shall be submitted in soft copy within four weeks from the date of placement of order for Purchaser's approval/information/further working.

13.02.01 Technological

Drawings / documents for approval

1. List of drawings with schedule of submission (Technological, Mechanical, Electrical, Instrument & Control, etc.) within four weeks from the date of placement of order.

2. QC & QA plan.

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3. Equipment layout drawing showing the location of Plant & equipment & its auxiliaries, pipelines, ducts, trenches, etc. (plan and cross section) within four weeks from the date of placement of order.

4. G.A. and Cross Sectional drawings indicating the following:-

- Outline dimensions (minimum three views) (all principal dimensions).
- Location (in all three planes), size, type, rating and identification of all hook-up / interface connections including those of vents, drains, fuel, cooling water & electrical / instrumentation.
- Direction of rotation viewing from the driving end.
- Weight of each assembly / component.
- The weight & location of centre of gravity of the heaviest assembly / components that must be handled for erection.
- Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance.
- Maintenance clearance and dismantling clearances.
- Speed
- Layout of auxiliary equipment and operating platform.
- Make Type and Size of couplings and the location of guards.
- A list of reference drawings, if any.
- Material of construction
- Bill of material
- Specification
- A list of any special weather – protection and climatic features.

5. Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design including the following:

i) Foundation bolt sizes, pocket sizes and locations.
ii) Grouting thickness and other necessary technical details.
iii) Static weight of each skid / independently grouted item and location of center of gravity of each of such skid / items in all three planes.
iii) Weight distribution for each bolt / sub-sole plate location and total static weight.
iv) Dynamic loading caused due to various items grouted independently.
v) Maximum permissible amplitude of vibration of the foundation at base level.

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vi) Suggested dynamic factor and ratio of foundation weight to weight of skid / equipment as per vendor experience.

6. Field Alignment Diagram

The diagram shall indicate the relative displacement to be kept between the centerlines of various equipment at the time of installation, so that under normal running conditions the equipment get fully aligned.

This relative displacement should be decided on the basis of centerline temperature rise data of drive, gear box / transmission system, driven equipment.

7. Flexibility analysis of pipelines with isometric drawings as applicable.

8. Schedule and Specification of pipes, valves, pipe fittings, thermal insulation, etc.

9. Final design calculations and assumptions.

10. Actual performance data based on the testing at site.

11. Technical specifications of major Plant & equipment and all other accessories.

12. System scheme, Process Flow Diagrams and P & I diagrams indicating battery limits.

13. Characteristics curves of all the equipment.

14. Final list of drawings.

15. As built drawings.

Technical document for Reference / Information

1. Civil foundation drawings with static & dynamic load data of all equipment indicating cable trench, pipe trench, conduits, inserts, cable entries to motors, field devices etc.

2. Technical literature and catalogue of bought out items.

3. Drive list.

4. List of special tools & tackles to be supplied

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5. Test certificates.

- Material test certificates of all equipment & their components
- Hydrostatic test certificate of valves, pipes, shells, fittings, etc.
- Static and dynamic balancing of all rotor parts / equipment as applicable.
- Shop test performance data of Plant & Equipment, etc.

6. Part number and description of all spare parts.

7. Installation, operation & maintenance manual.

8. Reproducible of all final drawings.

10. Total list of all equipment with dispatch schedule.

11. All other relevant drawings / documents / certificates not specifically mentioned above but deemed essential for successful functioning of the equipment.

13.02.02 **Electrical**

As per Electrical specification**. (Chapter –05)**

13.02.03 **Instrumentation**

As per C&I specification**. (Chapter – 06)**

13.02.04 Please refer to the chapters on various facilities/systems for the list of drawings to be submitted after award of the contract and submit these drawings accordingly.

13.03 **Submission of Operation & Maintenance Instruction Manuals**

The Tenderer shall furnish 12 sets of operation and maintenance instruction manuals meeting the following requirements :-

a) Instruction manuals shall present the following basic categories of information in practical, complete and comprehensive manner prepared for use by operating and/or maintenance personnel.

- Instruction for initial installation

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- Instructions for operation, maintenance, repair and safety regulations.
  - Ordering information for all replaceable parts.
  - Lubrication chart.
- Recommended inspection points/ areas and period of inspection.

b) Information shall be organised in a logical and orderly sequence. A general description of all systems and equipment including detailed drawings identifying parts / items and significant technical characteristics shall be included to familiarise operating and maintenance personnel with the equipment.

c) A parts list shall be included showing nomenclature, manufacturer's part numbers and/ identification and ordering of replaceable parts.

d) Instruction and parts list shall be clearly legible and prepared on good quality paper. Instruction manuals shall be securely bound in durable folder.

e) If a standard manual is furnished covering more than the specific equipment purchased, the applicable model(or other identification) number, parts number and other information for the specific equipment purchased shall be clearly identified.

f) Instruction manuals shall include list of all special tools and tackles furnished with complete drawings and instructions for use of such tools and tackles.

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14.00 LIST OF PREFERRED MAKES

The makes of various equipment and supplies in respect of imported or indigenous equipment/components/materials are listed out in this document. It is essential that the equipment/component/materials to be supplied from imported or indigenous sources by the Tenderer will be of any one of the makes listed against that particular equipment/ component/material in this document.

In case the Tenderer intends to substitute any particular make of equipment / components/ materials by a make other than that listed in this document, the Tenderer shall clearly bring out the same in his offer along with justification and indicate the alternative makes offered by him. It will be prerogative of the Purchaser to accept or reject the alternative makes so offered.

If any items are not mentioned in the list provided herein but the same are required to complete the system, the said make of that item should have been already used in Oil & Gas Industrial Installations (Refinery/Gas Compressor Complex/POL Terminals of PSUs). Only in such cases the same makes of that item shall be acceptable subject to approval of Purchaser after submission of Performance Certificate of End User especially for equipment to be located in Hazardous Area.

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14.01 Valves for Natural Gas, Nitrogen, Instrument Air

Item Description		Manufacturers
CS, FS, SS Valves (Gate, Globe, NRV)	:	L&T (Audco Div), Fouress, BHEL, KSB, GM Dalui, Leader, BDK, NECO, Associated Tooling, Hawa Egr., Vass Ind, Advance Valves, Kalpana Valves.
CI, CS, SS & FS Plug Valves	:	Vass Ind., Xomox, Virgo, BDK, Leader, Steam and Mining, GM Dalui, H.Sarkar, Audco
Ball Valves	:	Audco, Vass Ind, KSB, BDK, Microfinish, Niton,AL Saunders, Xomox, Virgo, United Engineers, Steam & Mining, Hi-Tech B.Valves
GM Valves	:	Bombay Metals, GM Dalui, Leader, NECO, Kalpana Valves
Butterfly Valves	:	Audco, Fouress, Kirloskar Brothers, IVPL, Inter Valve, Virgo, AL Saunders, Keystone, BDK, Leader, AVC Engg., Crowley & Ray, Xomox, Tyco, Hi-Tech.
Diaphragm Valves	:	AL Saunders, Fluid System, Leader, BDK, Xomox, Steam & Mining
Pressure Control Valve/Pressure Reducing Valve	:	JNM, Fouress, Bestobell, IL, Mazda, Nirmal Ind., Vanaz, Kosan Metal, Vass Ind., RK Control, Fluid Line, Forbes Marshal, Leader.
Large Diameter Goggle Valve	:	Audco, Fouress, Cimmco, L&T

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Fabricated Gate Valves	:	Fouress, Cimmco, BECO, Beekay, L&T, Kalpana Valves
Safety Relief Valve (Pressure relief Valves)	:	BHEL, Keystone, Bliss Anand, L&T (Audco Div.), Sempell, Fainger, Leser Valves (P) Ltd., IL, Anderson, Kosan.

14.02 Natural Gas Facility & Compressed Air Equipment

Item Description		**Manufacturers**
SS Bellows Expansion Joints	:	Flexican, Flexatherm, SURR Ind., Pressel (Cuttack), BD Engr., Eludyne Engr., SPB, SEPL, PEBI, Lonestar, GBM Mfg., TI Flexible Tube.
Air Compressors	:	Ingersoll Rand, Atlas Copco, KG Khosla, Kirloskar Pneumatic, Chicago Pneumatic, Mannesman Demag, Eliat, Cooper, Sulzor, Corken (USA)
Hoses	:	Flexican, Gaytri Industrial Corpn., Inalsa, Teksons, Sudeep Industries, Markwell
Air Drying Uuit	:	Chemech, Cleanair, Delair, Indcon, Mellcon, Mirch Mirex, Gasoenergy System Pune.
Trap & Strainer for Compressed Air	:	Uniklinger, ESCO, JNM, Dryton Greaves, Forbes Marshall, Hawa Engrs., Mazda
Electrical Actuators		AUMA India, Beacon Rotork Controls, Continental Profiles, Emtork Actuators, Limitorque
Pneumatic Actuators		Marsh Engg., Keystone, IL, Massoneilan, EL-O-MATIC, Virgo, AL Saunder, L&T, Flocan

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Heat Exchanger (Shell & Tube Type)		BHPV, Kaveri, Texmaco, Thermax, Babcock & Wicox, Parkair Engg., Rhine, Universal Heat Exchanger, Godrej, L&T, GEI Godavari, Patel Air Temp., Hindustan Radiaton
Control Valves	:	Blue Star, Fouress Engg., IL, JNM, Mazda, Forbes Marshall
Pressure Vessel & Tanks	:	Beekay Engg., BHPV, ISGEC, Kaveri Engg., TSL, Lloyds Steel, Mukand, Parkair Engg., Grasim Industries, Anup Thermal System, Texmaco, SV Tank, Grasim Industries, Hyderfuel Industries.
Thermal Insulation	:	Hyderapad Industries, Lloyds Insulation, Rockwool, Thermax Heat Tracers, U.P. Twiga Fibreglass.

14.03 **Pipes & Fittings for Natural Gas Facilities and Instrument Air Facilities**

Item Description		**Manufacturers**
SW/SAW, ERW/EFW MS Pipes	:	SAIL, BHEL, TISCO, Jindal, Ajanta, Zenith, Saw Pipes, Welspun, Man Industries, Surindra Engg., Maharastra Seamless, Indian Seamless, BST, Advance Steel, Good Luck, Indus Tubes, Mukat, Lloyds, Poonam Enterprises, Soor Neogi Koumar.
SS Pipes / SS Fittings	:	Heavy Metal Tubes, Nobel Tubes, Rajendra Mech. Ind., Sterling Supply Agency, Vitrag, SAIL, Poonam Enterprises, N.L.Hazra, M.S.Fittings
Seamless, Stainless Steel Pipes/Tubes	:	Amardeep Steel, Choksy Tubes, MJ Patel, Nagardas Kanji, Poonam Enterprises, Sandulk Asia, MEC Tubes, Nagardas & Kusai, Noble Tubes, Allied Steel, Kamlesh Tube, Menilal & Bro, Uday Tubes, SAIL, Maharastra Seamless (P) Ltd, Imperial Steel, Soor Neogi Koumar.

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Fittings for the above Pipes/Tubes	:	EBY Ind., High-Tech, Hydro technic, Hydro-Air Engg., Project Toolings, Shivananda, M.J.Patel, Nagardas & Kusai, MEC Tubes, Nobles Tubes, Amardeep Steel, Allied Steel, Kamlesh Tube, Menilal & Bros, Poonam Enterprises, N.L.Hazra, M.S.Fittings
RCC Pipes & Fittings	:	SUR Industrial Pipes, Hind Ceramics, Indian Hume Pipes, Daya Cuncrching.
HDPE Pipes & Fittings	:	EMCO, KWH Heliplastic Polyolefins, Oriplast
PVC Pipes & Fittings	:	Oriplast, Finolex, Bharat Pipe & Fittings, Supreme Industries.

14.04 Diesel Generating Set

Diesel Engine : Mitsubishi, MTU, Germany, Caterpillar, Wartsilla, Rolls Royce (Bergen), Man Diesel, Perkins Cummins, Ashok Leyland, Ruston, Kirloskar, Crompton Greaves

Alternator: Stamford, AVK-SEG, ABB, BHEL, Leroy-Somer, Toyo Denki Power System (TDPS), KIRLOSKAR ELECTRIC, JYOTI, AWK, JAKSON

14.05 Water System

Sl. No.	Item Description	Manufactures
1.	Submersible pump-motor set for bore-well	KSB, SU Motors, Kirloskar Brothers, WILO (M&P), Grundfoss, Darling
2.	Horizontal centrifugal Pumps	Kirloskar Brothers, KSB, Beacon Weir, WPIL, WILO (M&P), Sam Turbo, Grundfoss
3.	Vertical centrifugal pumps	Kirloskar Brothers, WILO (M&P), KSB, Su Motors, Grundfoss
4.	Diesel engine for pumps/fire	Cummins, Kirloskar, Ashok Leyland, Caterpillar, Greaves

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Sl. No.	Item Description	Manufactures
	water pumps	
5.	CS valves (gate, NRV)	L&T Valves, Kirloskar Bothers, Intervalve, S&M industrial valves pvt. Ltd, Advance, Del val, BDK, Microfinish
6.	Ball valves	L&T Valves, Kirloskar Bothers, Intervalve, S&M industrial valves pvt. Ltd, Advance, Del val, BDK, Microfinish
7.	Butterfly valves	L&T Valves, Kirloskar Bothers, Intervalve, S&M industrial valves pvt. Ltd, Advance, Del val, BDK, Microfinish, Valve Tech Industries (VTI)
8.	Air release valve	Leader valve, Kalpana Valves, Kirloskar Bothers
9.	Pipe- MS/GI	SAIL, TATA, Jindal, MAN, SAW, Welspun, Prakash, PSL Limited, MSL
10.	MS/GI pipe fittings	Tube bends, Engineering service enterprises, MS fittings manufacturing pvt. Ltd., NL Hazra & sons
11.	Rubber expansion joints	Cori Engineers, BDX, Aphrodite polyprene pvt. Ltd.,
12.	Cooling Tower	Paharpur Cooling Towers Ltd Paharpur House, Southern Cooling Towers Pvt. Ltd., Hamon Cooling Systems Pvt. Ltd.,
13.	Chemical Dosing System	M/s Thermax, M/s Nalco Chemical India Ltd.,M/s Ion Exchange

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14.06 ELECTRICAL

A) Power Distribution Equipment

SL. NO.	EQUIPMENT	PREFERRED MAKES
1.	TRANSFORMERS	
a)	POWER TRANSFORMER (OIL TYPE) (33/6.6 kV)	ABB / SCHNIEDER / CGL / BHEL / BHARAT BIJLEE / VOLT AMP/TRANSFORMER RECTIFIER
b)	ONLOAD TAPCHANGER	EASUN MR/ MR GERMANY/ BHEL/ CTR
C)	DRY TYPE TRANSFORMER	ESSENAR / VOLTAMP / ABB/RAYCHEM RPG
2.	ACSR	HINDUSTAN/LUMINO/OMEGA CABLES/CABCON
3	INSULATORS	ALSTOM/ BHEL/ / WS INDUSTERIES/ JAYSHREE INSULATORS(BIRLA)/ ASSOCIATED PORCELEIN
4.	HT SWITCHBOARD (33 kV &6.6 kV)	SIEMENS/ABB/SEIL/BHEL
6.	NEUTRAL GROUNDING RESISTOR	RSI/ PEFFCO/RESITECH/NARKHEDE
7.	HT SOFT STARTER(REACTOR BASED)	JAYSHREE/ELTECH/INNOVATIVE
8	HT CAPACITORS	ABB(HITACHI)/ UNISTAR (UNIVERSAL CABLES)/ BHEL/ /EPCOS
9	REACTOR (AIR CORE)	QUALITY POWER ELECTRICALS EQUIPMENTS LTD./ SHRIHANS ELECTRICALS/ CGL/ BHEL
10	33 kV/6.6 kV ISOLATOR/ DISCONNECTING SWITCHES R	HIVELM-INDUSTRIES/SIEMENS /CGL/ ALLIENCE/PANIKKAR/A BOND STAND
11	OUTDOOR CTS/PTS	ABB/BHEL/CGL/MEHRU/TELK/PRAGATI

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SL. NO.	EQUIPMENT	PREFERRED MAKES
12.	OUTDOOR LIGHTNING ARRESTORS	ELPRO(SIEMENS)/JAYSHREE/LAMCO/OBLAM/ WSI
13.	SAS /POWER SCADA	SIEMENS/ABB/SCHNIDER
14.	BATTERY	
a)	NICKEL - CADMIUM	AMCO / HBL NIFE
b)	VALVE REGULATED LEAD ACID MAINTENANCE FREE BATTERY (VRLA)/ SMF	HBL NIFE / AMARARAJA / EXIDE
c)	BATTERY (PLANTE)	EXIDE
15.	BATTERY CHARGER/ DCDB	CHHABI / HBL NIFE/ CALDYNE / AMARA RAJA / CHLORIDE
16.	PROTECTIVE RELAYS	ALSTOM/SEIL / ABB / SIEMENS
17.	AUXILIARY RELAYS	ABB / ER / SIEMENS / ALSTOM/SEIL
18.	HEAT SRINKABLE & COLD SRINKABLE CABLE JOINTING KITS/ STRAIGHT THROUGH JOINTS (H.T)	RAYCHEM / 3M
19.	METER (ANALOGUE TYPE)	IMP / AE / MECO / L&T / RISHAVH
20.	CURRENT TRANSFORMERS & POTENTIAL TRANSFORMER (INDOOR)	ABB / PRAGATI / SEIL/SIEMENS/ECS
21.	DIGITAL TYPE MULTIFUNCTION METER	SCHNIDER / L&T / SECURE / ER / RISHAVH
22.	SOLAR MODULES	TATA BP SOLAR (I) LTD. , REIL JAIPUR, CEIL SAHIBABAD, HBL POWER
23.	SOLAR CHARGE CONTROLLER	HBL POWER SYSTEMS LTD. , UNIVERSAL INSTRUMENT MGF CO PVT LTD BANGALORE, SIGNOTRON (INDIA) PVT LTD KOLKATA
24.	SOLAR PCU / INVERTER	DELTA ELECTRONICS, ABB LTD, KACO, SMA, SCHNEIDER

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B. LV EQUIPMENT

SL. NO.	EQUIPMENT	PREFERRED MAKES
1	LT AIR CIRCUIT BREAKERS	L&T/ SIEMENS/ SCHNEIDER/ ABB/ GE POWER CONTROL/
2	MOULDED CASE CIRCUIT BREAKER (MCCB)	SCHNEIDER (MG)/ L&T/ ABB/ SIEMENS/ GE POWER CONTROL / BCH
3	MOTOR PROTECTION CIRCUIT BREAKERS. (MPCB)	SCHNEIDER/ L&T/ ABB/ SIEMENS/ GE POWER CONTROL
4	MINIATURE CIRCUIT BREAKER. (MCB)	SIEMENS/ L&T/ GE POWER CONTROL/ SCHNEIDER (PROTEC / MG)/ STANDARD/ INDOASIAN/ HAVELLS/ MDS (LEGRAND)/ ABB
5	EARTH LEAKAGE CIRCUIT BREAKER / RCCB	GE POWER CONTROL/ STANDARD/ HAVELLS/ ABB/ SIEMENS/ SCHNEIDER/ MDS (LEGRAND)/L&T/INDOASIAN
6	HRC FUSE FOR LT APPLICATION	GE POWERCONTROL/ L&T/ SIEMENS/ INDO ASIAN/ HAVELLS/ STANDARD/ BUSSMAN/ CONTROL & SWITCH GEAR/ ABB/ AREVA
7	POWER CONTACTOR / AUX. CONTACTORS	ABB/ SIEMENS/ SCHNEIDER (TELEMECANIQUE)/ L&T/ GE POWER CONTROL/ CONTROL & SWITCHGEAR/ BCH
8	VACUUM CONTACTOR	SIEMENS/ L&T/ ABB/ SCHNEIDER
9	ELECTRONIC OVER LOAD RELAYS	SIEMENS/ L&T/ BCH/ SCHNEIDER-SAMWHA/ LG
10	THERMAL (BIMETALLIC) OVER LOAD RELAYS	BCH/ L&T/ SEIMENS/ SCHNEIDER(TELEMECANIQUE)/ ROCKWELL AUTOMATION/ ABB/ CONTROL & SWITCHGEAR/ GE POWER CONTROL
11	MASTER CONTROLLER (STEP CONTROL TYPE)	EPCC/ INDUSTRIAL SYNDICATE/ STROM KRAFT/ SCHNEIDER (SQUARE D)/ SCHNEIDER (TELEMECANIQUE)/ ELECTROMAG/ SPEED O CONTROL

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SL. NO.	EQUIPMENT	PREFERRED MAKES
12	RESISTANCE BOXES (FECHRAL EDGE WOUND)	EPCC/ ELECTROMAG/ BCH
13	ELECTROMAGNETIC DC BRAKE ASSEMBLY	EPCC/ BCH / INDUSTRIAL SYNDICATE
14	LT BUS-DUCT	STARDRIVE/ ECC/ GEPOWER / CONTROL & SWITCHGEAR/ UNITED ELECTRIC/ UNILEC ENGINEERS

Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
C. POWER CONTROL / ELECTRONICS & AUTOMATION ITEMS		
1	SOFT STARTERS	ABB/ ROCKWELL AUTOMATION/ BHEL/ SIEMENS/ INNOVATIVE TECHNOMICS/ SCHNEIDER (Only for LT motor)
2	VVVF DRIVES	
	1. FOR LT MOTORS	ABB/ BHEL/ SIEMENS/ NELCO (HITACHI)/ VACON/ SCHNEIDER/ L&T (YASKAWA)/ ROCKWELL AUTOMATION/ TMEIC/ AMTECH/EUROTHERM
	2. FOR HT MOTORS MV DRIVE/ HI- LO-HI DRIVE	ABB/ ROCKWELL AUTOMATION/ BHEL/ SIEMENS/ CONVERTEAM (UK)/ TMEIC.
3	ROLLING MILL MAIN DRIVE VFD	SIEMENS/ABB/CONVERTEAM/ALSTOM/TMEIC GE/H ITACHI/ROCKWELL
4	UPS	EMERSON/DB-ELECTRONICS/ NUMERIC/ GE/ LIFELINE/ FUJI/ HI-REL
5	DIGITAL TYPE MULTI-FUNCTION METER	CONSERVE/ L&T/ SECURE/ RISHABH/ SIEMENS/ ABB
D. PANELS & PANEL COMPONENTS (LOW VOLTAGE)		

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Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
1	POWER CONTROL CENTRES	SIEMENS / L&T / SCHNEIDER / GE POWER
2	INTELLIGENT MCC (Drawout / Non- drawout with intelligent controller of approved make) / CONVENTIONAL DRAW-OUT MCC	SIEMENS / L&T / SCHNEIDER ELECTRIC / ABB * / GE POWER CONTROL*
3	INTELLIGENT CONTROLLER FOR INTELLIGENT MCC	SIEMENS / SCHNEIDER/ L&T/ ROCKWELL AUTOMATION
4	CONVENTIONAL NON DRAW OUT TYPE MCC / POWER DISTRIBUTION BOARDS (PDB) / ROLL TABLE DISTRIBUTION BOARDS	VENUS/ ANDREW YULE/ BCH/ SCHNEIDER ELECTRIC/ HAVELLS/ STANDARD/ TRICOLITE/ ADVANCE POWER CONTROL/ HINDUSTAN CONTROL/ CONTROL & SWITCHGEAR/ L & T/ SIEMENS/ GE POWER CONTROL/ ABB/ SWITCHING CIRCUITS/ KMG A TO Z SYSTEMS/ SEN & SINGH ENGINEERS/ MEDITRON
5	MAIN LIGHTING DISTRIBUTION BOARD (MLDB)/ SUB LIGHTING DISTRIBUTION BOARDS (SLDB)/ LOCAL CONTROL STATIONS	VENUS/ ANDREW YULE/ BCH/ SCHNEIDER ELECTRIC/ HAVELLS/ STANDARD/ TRICOLITE/ ADVANCE POWER CONTROL/ HINDUSTAN CONTROL/ CONTROL & SWITCHGEAR/ L & T/ SIEMENS/ GE POWER CONTROL/ ABB/ NGEF/ SWITCHING CIRCUITS/ KMG A TO Z SYSTEMS/ SEN & SINGH ENGINEERS/ TECHNO-COMMERCE/ POWER & PROTECTION/ ADLAC SYSTEM/ ECC/ MEDITRON/ CONTROL DEVICES/ TECHNOCRAT ENTERPRISES/ MDS
6	MIMIC PANELS & ANNUNCIATION PANELS	L&T/ ADVANI OERLIKON/ GE POWER CONTROL/ BHEL/ BCH/ TRANSRECT/ MINLEC/ TIRUPATI ELECTRONICS/ ADVANCE POWER CONTOL/ CONTROL DEVICES

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Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
7	CURRENT TRANSFORMER (LV)	ABB/ JAYSHREE/ PRAGATI/ KAPPA/ INTRAVIDHYUT/ INDCOIL/ PRECISE
8	INDICATING LAMPS	BINAY/ SIEMENS/ L&T/ ESSEN/ BCH/ VAISHNO/TECNIC/OSRAM/ TELEMECANIQUE/ AREVA/ ESBEE
9	PUSH BUTTONS	SALZER/ BCH/ L&T/ SCHNEIDER/ SIEMENS/ GE POWER/ VAISHNO/ CONTROL DEVICES/ ESSEN/ TECNIC/ CONTROL & SWITCHGEAR
10	TERMINAL BLOCKS	EPCC/ ELMEX/ PHOENIX CONTACT/ CONNECT WELL/ ESSEN DEINKI/ WAGO/ LAPP/ S&S/ HANSEL
11	SELECTOR SWITCHES & CONTROL SWITCHES	ABB/ GE POWER CONTROL/ BCH/ EPCC/ KAYCEE/ SIEMENS/ TEKNIK/ L&T/ CONTROL & SWITCHGEAR/ AREVA/ VAISHNO/ JYOTI/ SALZER
12	CRANE CONTROL PANEL (ABOVE 50	SIEMENS / ABB / SCHEIDER / L&T
E. MOTORS		
1	LT AC CRANE DUTY MOTORS	MARATHON/ KEC/ CGL/ SIEMENS/ ABB
2	LT AC ROLL TABLE MOTORS	KEC/ CGL/ ALSTOM/ ABB/ SEW/ IC-BAUER/ NORD/ SIEMENS
3	LT AC GEARED MOTORS	LAXMI HYDRAULICS PVT LTD/ SEW/ NORD/ IC-BAUER/ POWER BUILD/ DEMAG/ ROSI/ KEB, GERMANY
4	LT FLAME PROOF / INCREASED SAFETY SQUIRREL CAGE MOTOR	MARATHON/ BHARAT BIJLEE/ CGL/ KEC/ LAXMI HYDRAULICS PVT LTD.
5	LT SQUIRREL CAGE MOTORS	ABB/ BHARAT BIJLEE/ CGL/ KEC/ LAXMI HYDRAULICS PVT LTD./ MARATHON/ SIEMENS/ ELGI/ JYOTI/ WEG

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Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
6	ROLLING MILL MAIN DRIVE AC MOTORS	SIEMENS/ ABB/ TOSHIBA/ ALSTOM/ HITACHI/ WEG, BRAZIL
7	HT AC MOTORS (SQUIRREL CAGE/ SLIPRING & SYNCHRONOUS MOTORS)	MARATHON/ CGL/ KEC/ ABB/ BHEL/ JYOTI/ SIEMENS/ WEG/ TMEIC
8	ACTUATOR MOTORS	AUMA/ ROTORK/ LIMITORQUE/ MARSH
F. <u>FIELD SWITCHES / SENSORS</u>		
1	PROXIMITY SWITCHES (INDUCTIVE/ CAPACITIVE AND MAGNETO)	IFM/ SIEMENS/ SICK/ ROCKWELL AUTOMATION/ PEPPERL + FUCHS/ SCHNEIDER/ DELTA/ LINE & LEINDE
2	ENCODER	IFM/ HUBNER/ HEIDENHAINE/ LEONARD/ ROCKWELL AUTOMATION (ALLEN BRADLEY) / SICK (GERMANY)/ LEIN & LEINDE
3	ZERO SPEED SWITCH	JAYSHREE/ SCHNEIDER-SAMWHA/ IFM/ ROCKWELL AUTOMATION/ SIEMENS/ PEPPERL+FUCHS/ PYROTECH/ PROTO-CONTROL
4	SENSORS / SWITCHES * LIGHT BARRIERS * DISTANCE * LEVEL	IFM/ SICK/ ROCKWELL AUTOMATION/ PEPPERL + FUCHS/ SIEMENS/ SCHNIEDER/ DIMETIX AG/ DELTA
5	SWITCH MODE POWER SUPPLY	SIEMENS/ IFM/ ROCKWELL AUTOMATION/ SCHNEIDER/ HONEYWELL.
6	PULL CORD SWITCHES/ BELT SWAY SWITCHES	JAYSHREE / EPCC(KAKKU) / AG-MECHANIC/ TELEMECHANIQUE / STROMKRAFT / PROTO-CONTROL/ PYROTECH
7	LIMIT SWITCHES	SIEMENS/ ESSEN/ GE-POWER/ SCHNEIDER/ BCH/ JAYSHREE / EPCC(KAKKU) / AG-MECHANIC/ INDUSTRIAL SYNDICATE/ L&T/ ELECTROMAG/ PROTOCONTROL

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Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
8	ROTARY LIMIT SWITCHES	EPCC(KAKKU)/AG-MECHANIC/ TELEMECHANIQUE
9	TIMERS & TIME DELAY RELAY	ABB/ BCH/ L&T/ GEPOWER/ SIEMENS/ ESSEN/ ELECTRONIC AUTOMATION/ TELEMECANIQUE/ OMRON
S.N.	**ITEM DESCRIPTION**	**PREFERRED MAKES**
G. TELECOM EQUIPMENT & FDA SYSTEM		
1	INTELLIGENT DETECTORS (PHOTO ELECTRIC, HEAT, THERMAL) UL /FM /ULC APPROVED	SIMPLEX / NOTIFIER / EDWARDS/ SIEMENS
2	INTELLIGENT FIRE ALARM CONTROL PANELS UL /FM /ULC APPROVED	-DO-
3	ADDRESSABLE MANUAL CALL POINTS INCLUDING HAND SETS . UL /FM /ULC APPROVED	-DO-
4	MONITOR MODULES , FAULT ISOLATION MODULES, CONTROL MODULES (UL /FM /ULC APPROVED)	-DO-
5	UV FLAME DETECTORS UL /FM /LPC APPROVED	PATOL / DETRONICS / SPECTREX
6	BEAM DETECTORS UL /FM /ULC APPROVED	EDWARDS / NOTIFIER / SIMPLEX

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Sl.No.	ITEM DESCRIPTION	PREFERRED MAKES
7	IR FLAME DETECTORS SOLAR BLIND EMBER, FIRE UL /FM /LPC APPROVED	ODTI / PATOL / DET-TRONIX / SPECTREX
8	ANALOG LINEAR HEAT SENSING CABLE WITH METAL BRAID STEEL/ BRONZE, COPPER WITH NYLON BRAID UL /FM /LPC APPROVED	KIDDE / L.G.M / PATOL.
9	DIGITAL LINEAR HEAT SENSING CABLE WITH NYLON BRAID WITH METAL BRAID STEEL, BRONZE, COPPER UL /FM /ULC /MIL /LPC APPROVED CONTROL UNIT	KIDDE / L.G.M / PATOL
10	VIDEO DISPLAY UNIT INCLUDING CPU, PC, MONITOR, PRINTER ETC FOR FDA.	DELL / HP / HCL / WIPRO / IBM
11	SIGNAL CABLE FOR FDA	USHA BELTRON / HCL / DELTON / VINDHYA TELELINK
12	F.D.A SYSTEM SUPPLIERS	AGNICE FIRE PROTECTION LIMITED / TECHNICO (INDIA) PVT. LIMITED. / FIRE PRO SYSTEMS LTD. / TYCO / SIEMENS
13	IP-PBX	AVAYA / ALCATEL / AASTRA
14	IP-PBX SYSTEM SUPPLIER	AGCL / WIPRO / ABS / ITI / HCL
15	CCTV CAMERA	BOSCH / PELCO /SANYO /SHARP /SONY
16	CCTV MONITOR	SHARP / HITACHI / PHILIPS / LG / SONY / SAMSUNG / SANYO
17	C.C.T.V SYSTEM SUPPLIERS	NELCO LIMITED / POWER SYSTEMS LTD, KOLKATA /TOSHNIWAL INDUSTRIES / PANORAMA ELECTRONICS PVT LTD

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