

08 CHAPTER
INSTRUMENTATION SPECIFICATIONS

APPLICABLE NATIONAL/ INTERNATIONAL STANDARDS

AGA	: American Gas Association, Gas Measurement Committee
ANSI/ASME	: American National Standards Institute/American Society of Mech. Engineers
B 1.20.1	Pipe Threads
B 16.5	Steel Pipe Flanges and Flanged Fittings
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
ANSI/FCI	: American National Standards Institute/Fluid Controls Institute
70.2	: Control Valve Seat Leakage Classification
API	: American Petroleum Institute
RP 520	: Sizing, selection and installation of pressure relieving systems in refineries. Part-I - Sizing and selection Part-II - Installation
RP 521	: Guide for pressure relieving and depressurising systems
RP 526	: Flanged steel safety relief valves
RP 527	: Seat tightness of pressure relief valves
MPMS	: Manual of Petroleum measurement standards
RP 551	: Process measurement instrumentation Part - I Process Control and Instrumentation
RP 552	: Transmission Systems
S 2000	: Venting atmospheric and low pressure storage tanks
S 670	Vibration, Axial-Position and Bearing Temperature Monitoring Systems
ASTM	: American Society for Tests and Materials
BS	: British Standards
BS-1042	: Measurement of Fluid Flow in Closed Conduits
BS-5308	: Specification for PVC insulated cables Part-II
BS-7244	: Breather Valves
DIN	:Deutsches Institut für Normung
DIN-43760	: Temperature Vs. Resistance curves for RTDs
DIN-19234	: Electrical Distance Sensors; DC interface for distance sensors and signal converter
DIN-50049	: Document on Material Testing
IEC	: International Electro technical Commission

IEC 79 : Electrical apparatus for Explosive Gas atmosphere
 IEC 85 : Thermal evaluation and classification for electrical insulation
 IEC 332 : Test on bunched wires or cables
 Part III Cat. A
 IEC 529 : Classification of degree of protection provided by enclosures
 IEC 534-2 : Industrial Process Control Valves - Flow capacity
 IEC 584-2 : Thermocouples - Tolerances
 IEC 751 : Industrial Platinum Resistance Thermometer Sensors
 IEC 801 : Electromagnetic compatibility for industrial process measurement and control equipment

IS : Indian Standard

IS-5 : Colours for ready mixed paints
 IS-319 : Specification for free cutting brass bars, rods and sections
 IS-1239 : Mild Steel tubes, tubulars and other wrought steel fittings
 IS-1271 : Specification of Thermal Evaluation and Classification of Electrical Insulation
 IS-1554 Part-I : PVC insulated (heavy duty) electrical cables – working Voltage upto and including 1100V
 IS-2074 : Ready mixed paints, air drying, red oxide - zinc chrome
 IS-2147 : Degree of protection provided by enclosures for low Voltage switch gear and control gear
 IS-2148 : Flame proof enclosures for electrical apparatus
 IS-3624 : Specification for Pressure and Vacuum gauges
 IS-5831 : PVC insulation and sheath of electric cables
 IS-7358 : Specification for Thermocouples
 IS-8784 : Thermocouple compensating cables

ISA : Instrument Society of America

S-5.2 : Binary logic diagrams for process operations
 S-7.3 : Quality standard for instrument air
 S-75.01 : Flow equations for sizing control valves

ISO 5167 : Measurement of fluid flow by means of orifice plates, nozzles and venture tubes inserted in circular cross-section conduits

NACE : National Association of Corrosion Engineers - MR-01-75

NEC : National Electric Code

NEMA : National Electrical Manufacturer's Association

ICS-6 : Enclosures for industrial control and systems

NFPA : National Fire Protection Association

NFPA-496 : Purged and pressurised enclosures for electrical equipment

OSHA : Occupational Safety and Health Authority

GENERAL PRINCIPLES

The contractor shall carryout all works wholly in accordance with the terms and conditions of the contract to fulfill the requirement of the project. All the material used, and the equipment installed shall be as per the specifications defined in the contract and the work shall be executed with good engineering practices.

Bidder shall adopt / adhere to below general engineering specifications and practice while designing / supplying the proposed system. The requirements mentioned below in this general engineering specifications, required for proper functioning of the instruments / equipment, shall be provided / fulfilled by the bidder at no extra cost, irrespective of whether separately mentioned or not with individual instrument / equipment specifications. Further bidder shall note that in case of any discrepancy or conflict in specifications or requirements or meaning, the provisions of below general engineering specifications shall be considered governing and shall override the requirements mentioned in the detailed specifications of any particular instrument / equipment, as applicable. The general engineering specifications and practice to be followed are as under:

- a) PLC / SCADA Station shall be located at Plant Control Room or as directed by engineer-in-charge providing monitoring and control facilities for entire proposed work under scope of this tender. The control room layout shall be planned after taking into consideration the space requirement of various PLC/SCADA panels, HMI, etc. It shall be properly air conditioned. Control room shall be aesthetically appealing. **PLC/SCADA system shall have spare Ethernet port with GSM/GPRS (4G/5G) or such suitable modem for connectivity with existing Central SCADA of Client for monitoring the proposed Entire WTP from Central SCADA of client. All required register data mapping address details and other details as required for client Central SCADA shall be provided by bidder at no extra cost.**
- b) The material procured under this contract shall be offered for required factory / site inspection of client / consultant's representatives as specified elsewhere in this tender.

Factory inspection and clearance by client shall in no case relieve the bidder of his responsibilities for the correctness of operation of the offered system / equipment as per application / logic requirement.

The contractor shall submit quality / inspection plan for all major equipment including stage/final inspection as specified above for the approval in engineer-in-charge and shall follow the same.

The drawings, if any accompanying the tender documents, are indicative of scope of work and issued for tendering purposes only. These drawings indicate the general scheme for the treatment as well as the location map to enable the contractor to make an offer in line with the requirement of the Owner. Final construction shall be as per approved drawings / documents furnished by the contractor and approved by engineer-in-charge / consultant.

- c) The specifications / scope of work for each item within this tender covers the design, manufacture, inspection, & testing at the manufacturer's works, proper packing for transportation for delivery at site, supply at site including transportation, loading & unloading, erection (including upgradation work where applicable), testing, commissioning, labour etc. and also including requirement of any

structural steel, fittings, piping, cables, cable trays, accessories, utilities, associated civil or mechanical works, etc., complete in all respects for proper trouble free and reliable working of instrument / item, and as required for proper operation of plant as described / intended in this tender, whether specifically mentioned or not.

- d) Applicable Codes and Standards - All the equipment/item specified herein shall comply with the requirements of the latest issue of the relevant Indian & International standards. The equipment / item shall meet the requirements of requirements of Indian Standards, where available and only in cases where Indian Standards are not available, relevant International Standards shall be followed.
- e) Inbuilt PID controller of instrument shall not be used for process control. Process control shall be through PLC only and necessary I/Os shall be considered for the same.
- f) In outdoor unpaved areas cables shall be directly buried in ground or suitably laid as per site conditions. The cable trenches shall be sized depending upon the number and voltage grade of cables. Where underground cables cross roadways, pipe sleepers at grade, etc., they shall be protected by being drawn through PVC sleeves/ducts or suitable RCC Pipes to provide a permanent crossing. Pipes laid for mechanical protection shall be sealed at both ends.

Cables shall be laid over cable trays within the pump house and in paved areas and for cables to be laid on outdoor units.

- g) Instrument installation hardware shall be supplied with each instrument whether specified or not. Generally it shall be as specified in the detailed / general specifications of instrument and as per clause "specifications of installation hardware" in this specifications, if specified or not specified elsewhere.
- h) Contractor shall make provision for a separate feeder in the Plant MCC of suitable current rating to provide 230V AC $\pm 10\%$, 50 Hz $\pm 3\text{Hz}$ supply to Instrument Panel(s).

1. **GENERAL:**

The Contractor shall obtain all instruments from manufacturers of international standing.

The design and quality of all instruments shall be fully suited to the conditions which will be met in service. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-801.

The instrumentation and control system shall be designed, manufactured and installed to ensure highest standard of operational reliability. Major instrumentation shall be electronic type. Panel mounted receiving instruments shall be electrically operated miniature flush mounting type unless otherwise specified. All instruments shall be installed in accordance with the recommendations or instructions of the instrument manufacturer for particular application.

All instruments shall be capable of carrying their full load currents without undue heating. They shall not be damaged by the passage of fault currents within the rating of the associated MCB or through the primaries of their corresponding instrument transformers. All instruments shall be back connected and the cases shall be earthed. Approved means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protect by DPMCB's in each unearthed phase of the circuit placed as close as practicable to the main connection.

Analogue signals shall be 4-20 mA according to BS 5862:Part I 1986 or its latest edition. They shall operate over two wires and be isolated from earth. 1-5V DC signals shall only be permitted within the main instrument enclosure.

Analogue signals shall be so connected that the failure of a remotely transmitted signal to another panel cannot affect other readings on instruments operated by the same signal.

The contractor shall furnish technical details / catalogues / drawings for the instruments and panels offered for monitoring and control of the entire plant to client/consultant for their approval prior to procurement of the same. Contractor shall offer inspection for the instruments/panel offered by him and in case of waiver of inspection by the client / consultant, necessary test certificates shall be submitted for approval of client / consultant before clearing the material for despatch. Contractor shall submit their inspection plan to client/consultant for their approval for this purpose.

All instruments procured by the contractor as per the Engineer's approval, and those which perform similar duties shall be of uniform type and manufacture throughout the scheme in order to facilitate maintenance and the stocking of spare parts. Moving parts and contacts shall be adequately protected from the ingress of dust, and all instruments shall be protected by moisture and dust-proof cases including those mounted in panels. All equipment shall be suitable for its environment.

Panel mounted receiving instruments shall be of the electrically operated miniature flush mounting type unless otherwise stated.

Scales shall be clearly marked with black lettering and graduations on a white background. Instruments of the same type and range shall have identical scales.

Instrumentation System shall be designed as per good engineering practice.

ENCLOSURE:

All instruments enclosure mounted in the field shall be weatherproof to IP-65 / NEMA4 as a minimum.

FIELD MOUNTED INSTRUMENTS

Field mounted instruments shall, where possible, be hermetically sealed. If this is not possible, they shall be of weatherproof construction with heavy cast iron. Transmitters and similar equipment shall be further enclosed in purpose made weatherproof, glass reinforced fire-retardant polyester resin cabinets.

Particular regard shall be paid to the ease of access to all instruments. Serial number/calibration plates shall be visible when the instrument is in its cabinet.

Locally mounted indicating instruments shall be mounted in viewable positions.

Field mounted instruments shall be complete with all mounting brackets, pillars, fittings and fixings to complete the installation.

FIELD TRANSMITTERS :

DP Type Flow Transmitter if used for congealing, corrosive and highly viscous services shall have Diaphragm Seal element with Capillary.

Transmitter shall be capable of delivering rated current into external load of at least 600 ohms when powered with 24V DC nominal voltage.

PUSHBUTTONS AND SWITCHES

Pushbuttons for operational circuits shall be provided with a shroud, guard or other suitable means to prevent inadvertent operation. They shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

Illuminated pushbuttons where used shall be of a design that allows easy replacement of the lamps from the front of the panel.

If legends are engraved on the pushbuttons they shall be clear and concise and shall be approved by the Engineer-In-Charge before manufacture.

Control switches shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

INSTRUMENT CONNECTIONS:

Electrical cable entry shall be ½" NPT (F). Suitable cable gland shall be used.

End connections shall meet the following unless, otherwise specified:

Threaded end connection shall be NPT as per ANSI / ASME B.1.20.1

Flanged end connection shall be as per ANSI / ASME B16.5

INSTRUMENTS:

Instruments as per following details and specifications shall be provided by vendor as a minimum. Quantities mentioned, if any, are indicative only and contractor shall provide all necessary instruments described in this section or as required for proper operation of the plant as described elsewhere in this tender or found necessary during detailed engineering in addition to below mentioned instruments and their locations. Bidder choosing to supply instrument with communication port suitable for process / diagnostic data transfer with PLC/SCADA need not consider analog signal and alarm contacts inputs to PLC.

All instruments, gauges and control equipment shall be strictly procured as per the list of approved vendors enclosed herewith as part of the tender documents

❖ ON-LINE pH MEASUREMENT SYSTEM:

The specifications in general shall be as under:

SPECIFICATIONS FOR PH ANALYZER			
A.	GENERAL		

1	Service		Raw / Clarified / Treated Water Application
2	Function		To measure & indicate the pH / Transmit
3	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	40 °C Max.
4	Operating Pressure		Atm., Max. 1 Bar
5	Installation		Indoor / Outdoor under Shed
B.	Electrodes & Electrode Holder		
1	Type of Sensor		Combination Sensor, Self-cleaning ,Digital / Smart Type
2	Measurement (Calibration) Range		As per process requirement
3	Temperature Compensation		Required, Automatic, In-built
4	Pre-amplifier		Integral or Remote as per mfr. Std.
5	Measuring Elements:		
a	Measuring Electrode	Material	Glass
b	Reference System	Type	Double Junction
		Electrolyte Material	Ag/AgCl with saturated KCL (Gelled Electrolyte)
		Ref. Junction / Diaphragm	Porous PTFE / Kynar / Equi. as per mfr. Std.
c	Soln. Ground Electrode		Required
		Material	Platinum / Titanium / Equi. as per Mfr. Std.
d	Sensor (Shaft) Body	MOC	Ryton (PPS) / PP as per mfr. Std.
		Type	Refillable or Completely Sealed, Non-Refillable Type as per Mfr. Std.
6	Sensitivity		± 0.01 pH
7	Protection Class		IP-68
8	Cable Length	Integral / after connector	Min. 10m length or higher up to 100m or more as per site conditions.
9	Process Connection (Mounting)	Type	Suitable for pipe or immersion (open tank / sump) type mounting with mounting as under for both this applications:
		- For measurement on Pipe	Measurement of pH on pipe line shall be with flow through (Tee) assembly in SS304. Shall be with isolation valve & required piping up to disposal/drain
		- For measurement on Open Tank / Sump	Measurement of pH at Open Tank / Sump shall be through suitable immersion mounting assembly. Immersion assembly shall be Swivel / Pivot / Pipe Clamp Assembly suitable for hand rail mounting in SS316 or of non-corrosive material.
10	Calibration Certificate		Required
11	Buffer Solution / Powder for Sensor Calibration		Buffer Solution / Powder of near about pH 4, pH 7 and pH 9 with NIST / DIN Std. traceability or equi. standards shall be

			provided in required quantity for periodic calibration of Sensor.
C.	TRANSMITTER		
1	Function		Transmit and Indicate
2	No. of Inputs		Single / Dual / Multiple (up to 8 channel)
3	Transmitter Type		Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
4	Location		Field Mounting
5	pH Measurement:		
a	pH Measurement Range		0-14 pH, programmable
b	Accuracy		$\pm 0.25\%$ of Measuring Value or better
c	Resolution		0.01pH
d	Repeatability		$\pm 0.2\%$ of Measuring Range or better
6	Temp. Compensation		Automatic & Manual
7	Output Signal		4 Modbus RS-485 with diagnostic feature and facility
		Relay	Min. 2 potential free changeover contacts
8	Instrument Power Supply		100 to 240 VAC $\pm 10\%$, 50 Hz $\pm 5\%$ or 24V DC as per mfr. Std.
9	Cable / Conduit Entry		1/2" NPT or M20 or equi. As per mfr. Std.
10	Local Indicator / Display		Backlit LCD Display
11	Security Access Code		Required, password protected
12	Protection:		
a	Elec. Area Classification		Safe
b	Enclosure	Type & Prot. Class	Weather Proof to IP-65 as a minimum
		MOC	Cast Alu. / Polycarbonate or equi. as per mfr. Std. suitable for withstanding harsh environment
13	Mounting		Wall mounting / Pipe mounting
14	Operating Temperature		0 to 55 °C
D.	Options / Accessories:		
1	Mounting Accessories		Required, Universal 2" Pipe and / or Wall Mounting Kit
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick

pH readings shall be continuously displayed locally as well as at PLC HMI at control room. Low / High pH level shall be annunciated at HMI in main control room.

❖ **ON-LINE TURBIDITY METER:**

The specifications in general shall be as under:

a.	GENERAL		
1	Service		Raw / Clarified / Treated Water Application
2	Function		To measure & indicate the Turbidity
3	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	40 °C Max.
4	Operating Pressure		Atm., Max. 1 Bar
5	Installation		Indoor / Outdoor under Shed
b.	Electrodes & Electrode Holder		
1	Type of Sensor		Nephelometric measurement, as per ISO 7027 NIR scattered light method Digital/Smart type
2a	Calibration Range		Raw Water: 0-100 NTU Normal & max. upto 1000NTU Clarified Water: 0-20 NTU Treated Water: 0-2 NTU Normal and max. upto 5 NTU
2b	Measurement Range		As per mfr. Std. suitable to measure normal turbidity range of 0-100 NTU & max. upto 1000NTU for raw water, 0-20 NTU for clarified water and 0-2 NTU)
3	Sensor Cable		Integral Cable or with water tight (IP-68) connector assembly with necessary cable
4	Measuring Elements:		
a	Measuring Electrode	Probe / Shaft MOC	SS 304 / PVC equi. suitable as per mfr. Std.
		Optical Window	Scratch proof / resistant Glass or Sapphire or equiv. as per mfr. Std.
5	Protection Class		IP-68
6	Cable Length	Integral / after connector	Min. 10m length or higher up to 100m or more as per site conditions.
7	Process Connection (Mounting)	Type	Suitable for pipe or immersion (open tank / sump) type mounting with mounting as under for both this applications:
		- For measurement on Pipe	Measurement of Turbidity on pipe line shall be with Flow through assembly / sensor mounting assembly Sampling pump and pipe of required size and length upto instrument / sensor and sample drain pipe back up to sump. Assembly shall be in Black color only.

		- For measurement on Open Tank / Sump	Measurement of Turbidity at Open Tank / Sump shall be through suitable immersion mounting assembly. Immersion assembly shall be Swivel / Pivot / Pipe Clamp Assembly suitable for hand rail mounting in SS316 or of non-corrosive material.
8	Mounting Accessories		Required
9	Calibration Certificate		Required
10	Sensor Calibration Kit		Required for on-site during O&M period for periodic calibration of Sensor as per manufacturer's recommendation.
c.	TRANSMITTER		
1	Function		Transmit and Indicate
2	No. of Inputs		Single
3	Transmitter Type		Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
4	Location		Field Mounting
5	Turbidity Measurement:		
a	Turbidity Measurement Range		As specified above for sensor
b	Accuracy		$\pm 2\%$ of Measuring Value or better
c	Repeatability		$\pm 1\%$ of measured value
6	Turbidity Calibration		Semi-Automatic, 1 or 2-point calibration or as per mfr. Std. using reference / Manual adjustment to grab sample
7	Output Signal		Modbus RS-485 with diagnostic feature and facility
8	Instrument Power Supply		100 to 240 VAC $\pm 10\%$, 50 Hz $\pm 5\%$ or 24V DC as per mfr. Std.
9	Cable / Conduit Entry		1/2" NPT or M20 or equi. As per mfr. Std.
10	Local Indicator / Display		Backlit LCD Display
11	Security Access Code		Password protected
12	Protection:		
a	Elec. Area Classification		Safe
b	Enclosure	Type & Protection Class	Weather Proof to IP-66/67 as a minimum
		MOC	Cast Alu. / Polycarbonate or equi. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
13	Mounting		Wall mounting / Pipe mounting
d.	Options / Accessories:		
1	Mounting Accessories		Mounting plate (min. 3 mm thick MSEP) for complete instrument,
2	Tag Plate		Required, SS 304

3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick

Turbidity readings shall be continuously displayed locally as well as at PLC HMI at control room. High Turbidity level alarm shall be annunciated at HMI in main control room.

❖ **ON-LINE RESIDUAL (FREE) CHLORINE MEASUREMENT SYSTEM:**

The specifications in general shall be as under:

SPECIFICATIONS FOR FREE CHLORINE ANALYZER			
A.	GENERAL		
1	Service		Raw / Clarified / Treated Water Application
2	Function		To measure & indicate the Free Chlorine / Transmit
3	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	40 °C Max.
4	Operating Pressure		Atm., Max. 1 Bar
5	Installation		Indoor / Outdoor under Shed
B.	Electrodes & Electrode Holder		
1	Type of Measurement		Amperometric / Potentiostatic with pH compensation as per application, Digital/Smart Type
2	Measurement (Calibration) Range	Free Chlorine	0 - 5 mg/l free residual chlorine
3	Sample Withdrawal	As per application requirement	Peristaltic pump or suitable arrangement with necessary tubing / piping, Sample Inlet / Drain connection size as per mfr. Std.
			The withdrawn sample shall be suitably transferred back to immediate downstream or upstream process - shall not be drained / discharged in open. Pipe / Fitting associated or grouted with civil unit / structure shall be in GI / SS only.
4	pH sensor for compensation		Required (Refer pH analyzer specifications for sensor)
C.	TRANSMITTER		
1	Transmitter Type		Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.

2	Location		Indoor Mounting / Outdoor mounting with canopy
3	Free Chlorine Measurement:		
a	Free Chlorine Measurement Range		0-5 mg/l, programmable (Normal measurement range shall be 0 - 2 mg/l)
b	Accuracy		+ 2 % of Measuring Value or better
c	Resolution		0.01 mg/l
4	Output Signal		Modbus RS-485 with diagnostic feature and facility
5	Instrument Power Supply		100 to 240 VAC \pm 10%, 50 Hz \pm 5% or 24V DC as per mfr. Std.
6	Cable / Conduit Entry		1/2" NPT or M20 or equi. As per mfr. Std.
7	Local Indicator / Display		Backlit LCD Display
8	Security Access Code		Required, password protected
9	Protection:		
A	Elec. Area Classification		Safe
B	Enclosure	Type & Protection Class	Weather Proof to IP-55 / 56 as a minimum
		MOC	ABS with Clear Polycarbonate Windows or equi. as per mfr. Std. suitable for withstanding harsh environment
10	Mounting		Wall mounting
D.	Options / Accessories:		
1	Mounting Accessories		Required, Universal 2" Pipe and / or Wall Mounting Kit
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick
6	Strainer Kit		Required, strainer kit with required tubing & fittings for continuous operation without clogging, where applicable

Residual Chlorine readings shall be continuously displayed locally as well as at PLC HMI at control room. Low / High residual chlorine level shall be annunciated at ICP in main control room.

❖ **ULTRASONIC TX. – LEVEL / DIFF. LEVEL / FLUME FLOW**

Ultrasonic level measurement shall be accomplished by the use of non-contact, echo-time measuring equipment operating at ultra-sonic frequency. The equipment shall transmit pulses which are reflected back to the sensor from the surface of the liquid whose level is being measured.

The equipment shall consist of a sensor incorporating both transmitter and receiver, together with an integral or separate control unit. The control unit shall be microprocessor based and user programmable. Control unit shall have IP-65 protection as a minimum.

The equipment shall be provided with automatic temperature compensation, shall be suitable for operation in the designated application under the specified climatic conditions.

The sensor shall be suitable for mounting in the open, or within an enclosed tank, and shall with environmental protection to IP-67 as minimum. The sensor / transducer range shall be as required to cover Liquid Depth + Free Board + Blanking Distance as a minimum. The sensor shall be able to monitor the overflow condition of the unit and shall not get submerged in case if the unit overflows.

The control units shall incorporate:

Facilities for independently adjusting both zero and span, and shall have an output of 4-20mADC with HART proportional to selected measurement parameter of level / diff. level / flow as per user selection / program.

LCD read out of selected measurement parameter in suitable engineering units.

Secure access for parameters via a removable keypad or in-built programmer.

The overall accuracy of the level measurements shall be within 0.5 % or better of the instrument span.

The Contractor shall ensure that each part of the equipment is suitable for the application, particularly with regard to the blocking distance and transmitted beam angle or cone.

Each ultra-sonic level sensor shall be installed on a robust and rigid structure provided for the purpose under this contract. The structure shall include a means of levelling the sensor so that the transmitted beam is perpendicular to the liquid surface and shall provide a safe and easy access to the sensor for servicing and maintenance.

The contractor shall, where applicable, provide a cover / canopy around and/or above the sensor and / or the control unit them to provide a protection from direct sunlight.

❖ **Ultrasonic Transmitter for Level Measurement:**

Ultrasonic transmitter shall be provided to measure liquid level for all tanks/sumps. The purpose is to monitor tanks/sump levels as well as provide low level trip for safety of pumps against dry running, start/stop of pumps in auto mode through suitable logic to be decided during detailed engineering, low/high level alarm annunciation on HMI at control room, etc. The brief specifications in addition to above specifications shall be as under:

a.	GENERAL		
1	Application		Raw / Clarified / Treated Water Application
2	Service		Clear Water

3	Function		To measure & indicate Level / Transmit
4	Operating Temperature		Ambient 0 to 50 °C
5	Operating Pressure		Atm.
6	Installation		Indoor/ Outdoor
b.	LEVEL TRANSMITTER / SENSOR		
1	Measuring Principle		Ultrasonic Non-Contact type Level Measurement, Time of Flight method
2	Type		Microprocessor based, User Programmable, 4-Wire type, Remote Transmitter
3	Measurement Range		As per Process Requirement
	- Blanking Distance	Max.	0-3-0.4m max.
	- Sensor Meas. Range Selection		Sensor Range shall be Actual Meas. Range + Unit Free Board + Blanking Distance. Sensor shall be mounted above the top of sump by at least the blanking distance i.e. entire unit depth shall be measurable.
4	Temperature Compensation		Built-in, Automatic
5	Output Signal	Level	4 -20 mADC analog HART
6	Accuracy		± 0.5 % of measuring range
7	Resolution		± 3 mm or suitable as per mfr. Std.
8	Protection:		
a	Elec. Area Classification		Safe
b	Enclosure	Type & Protection Class	Weather Proof to IP-66/68 minimum for transmitter
		MOC	Aluminium / PBT or equi. as per mfr. std.
		Paint	Chemical Resistant / Epoxy Coating
c	Sensor	MOC	PVDF or equi. as per mfr. std.
		Prot. Class	IP-68
9	Cable Length - Sensor	Remote Transmitter	Min 5 meter or higher as per site requirement
10	Process Connection (Mounting)		1.5" / 2" NPT threaded or 3" or 4" Flanged or as per mfr. Std.
11	Programmer		Built-in or Hand held type
12	Instrument Power Supply		100 to 240 VAC $\pm 10\%$, 50 Hz $\pm 5\%$ or 24V DC as per mfr. Std.
13	Cable / Conduit Entry		1/2" NPT or M20 or equi. as per mfr. Std.

14	Local Indicator / Display	Level, in mm or m	LCD Display
15	Scale Graduation / Measuring Units		Engg. Units
c.	Options / Accessories:		
1	Tag Plate		Required, SS 304
2	Cable Glands	Protection	Required, IP-65/66 as a min.
		MOC	Ni plated Brass or Polyamide (IP-67/68 only)
3	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, SS316 / Polyamide / Equi.
4	Cabinet for Transmitter	To prevent from direct sun & rain	Required. Lockable with transparent protection cover

Level readings shall be continuously displayed locally as well as at PLC HMI at control room. Associated pumps/MOVs shall be turned on and off in automatic mode depending on the level reached using these measured levels. Low / High level shall be annunciated at HMI in control room.

❖ **Ultrasonic Transmitter for Parshall Flume / Open Channel Flow Measurement:**

Ultrasonic transmitter shall be provided to measure flow over parshall flume, weir, etc. The brief specifications in addition to above specifications shall be as under:

a.	GENERAL		
1	Application		Water Application
2	Function		To measure & indicate Flow / Transmit
3	Operating Temperature		Ambient 0 to 50 °C
4	Operating Pressure		Atm.
5	Installation		Indoor/ Outdoor
b.	FLOW TRANSMITTER / SENSOR		
1	Measuring Principle		Ultrasonic Non-Contact type Level Measurement, Time of Flight method
2	Type		Microprocessor based, User Programmable, 4-Wire type, Remote Transmitter
3	Measurement Range		As per Process Requirement
	- Blanking Distance	Max.	0-3-0.4m max.

	- Sensor Meas. Range Selection		Sensor Range shall be Actual Meas. Range + Unit Free Board + Blanking Distance. Sensor shall be mounted above the top of sump by at least the blanking distance i.e. entire unit depth shall be measurable.
4	Temperature Compensation		Built-in, Automatic
5	Output Signal	Level	4 -20 mADC analog HART Proportional to flow
6	Accuracy		± 0.5 % of measuring range
7	Resolution		± 3 mm or suitable as per mfr. Std.
8	Programming Device		In-Built in controller or Hand-held
9	Protection:		
a	Elec. Area Classification		Safe
b	Enclosure	Type & Protection Class	Weather Proof to IP-66/68 minimum for transmitter
		MOC	Aluminium / PBT or equi. as per mfr. std.
		Paint	Chemical Resistant / Epoxy Coating
c	Sensor	MOC	PVDF or equi. as per mfr. std.
		Prot. Class	IP-68
10	Cable Length - Sensor	Remote Transmitter	Min 5 meter or higher as per site requirement
11	Process Connection (Mounting)		1.5" / 2" NPT threaded or 3" or 4" Flanged or as per mfr. Std.
12	Programmer		Built-in or Hand held type
13	Instrument Power Supply		100 to 240 VAC $\pm 10\%$, 50 Hz $\pm 5\%$ or 24V DC as per mfr. Std.
14	Cable / Conduit Entry		1/2" NPT or M20 or equi. as per mfr. Std.
15	Local Indicator / Display	Level, in mm or m	LCD Display
16	Scale Graduation / Measuring Units		Engg. Units
c.	Options / Accessories:		
1	Tag Plate		Required, SS 304
2	Cable Glands	Protection	Required, IP-65/66 as a min.
		MOC	Ni plated Brass or Polyamide (IP-67/68 only)
3	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, SS316 / Polyamide / Equi.
4	Cabinet for Transmitter	To prevent from direct sun & rain	Required. Lockable with transparent protection cover

Flume Flow (Instantaneous and Totalized) readings shall be continuously displayed at PLC HMI.

❖ **Hydrostatic Type Level Transmitter for LOH/ROF Measurement:**

Hydrostatic type level transmitter shall be provided to monitor choking of filter bed by measuring differential water level across the filter (Loss of Head) and Flow Rate over weir at outlet of each Filter Bed (Rate of Flow) for alarm and auto / semi-auto backwash operation of filter bed as per the logic furnished by the bidder. Loss of Head and Rate of Flow shall be calculated in PLC/SCADA software and displayed at each filter console as well as at HMI at main control room.

The brief specifications in addition to above specifications shall be as under:

A.	General		
1	Function		To measure & transmit Level
2	Type		Hydrostatic Type
3	Service		Water
4	Max. Operating Temperature		Ambient, 50 °C Max.
5	Max. Operating Pressure		Atm./ Upto 1 Bar
6	Installation		Indoor
B.	Transmitter /Sensor		
1	Type		2 Wire type
2	Power Supply		24 V DC (2 wire)
3	Measurement Range, mtr		Suitable to Tank Height
4	No. of Measurement Channels		One
5	Accuracy		±0.5% of full scale
6	Output signal	Analog	4-20 mA
7	Measuring Principle		Hydro-static Pressure Measurement
8	MOC - Body		SS-316L
9	Measuring Cell		Ceramic / as per mfr. Std.
10	Seal MOC		Viton / as per mfr. Std.
11	Protection Class		IP 68
12	Process Connection/Mounting		Mounting clamp,MOC SS 316L
13	Cable Length		As per Process requirement
14	Terminal Box/Housing		Required (IP-65 as a min)
15	Guide Pipe/Mounting Assembly		Required
C.	Options / Accessories		
a.	Mounting Hardware		Required
b.	Tag Plate		Required, SS 304
c.	Cable Glands		Required
d.	Canopy		Required

Level readings shall be continuously displayed at PLC HMI at control room and filter console.

❖ **DISPLACER OR FLOAT/BUOYANCY SWITCHES:**

a.	GENERAL	
1	Type	Float Type
2	Operating Temperature	0 to 50 °C
3	Max. Pressure	Atm. + Liq Depth, Max. 1 Bar
4	Specific Gravity	1.0 to 1.1
b.	Float	
1	MOC of Float	Polypropylene
2	Construction	Circular / Tubular / Bioconical
3	No. of Float	1
4	Protection	Min IP-68
5	Switch Type	Micro Switch, SPDT
6	Contact Rating	8A @ 230V AC (1 NO + 1 NC)
7	Cable	Inbuilt cable from Float up to Terminal Box
8	Cable Material	Suitable for Fluid application
9	Cable Length	As per SOQ
10	Process Connection	Flanged 4" NB
11	Counter Weight (Ballast)/	Required to ensure stable vertical position of the Float
	Support pipe for Clamping cable	
12	Adj. Stopper	As Applicable
13	Stopper / Ballast MOC	Rubber
c.	Junction Box	
1	Mounting	On Top of tank & sump, Flanged
2	Junction Box - MOC	Cast Alu.
	Prot. Class	IP-55
3	Connection Size	1/2" NPT / 3/4" ET or to suit cable dia.
4	Electrical Area Classification	Safe
5	Process Connection	Through Flange
d.	Accessories	
1	Cable gland	Required
2	Mounting accessories	Required
e	Locations / Service	Dry Run Protection of Pump (relay based logic to stop pump in any mode, auto or manual, of operation with necessary alarms.

❖ **FLOAT & BOARD TYPE LEVEL GAUGES:**

Sump shall be provided with local level indication gauge as specified. Gauges shall be mounted in a manner that it is easily visible to the operator with gauge preferably facing towards the pump house control / operator room and preferably visible to the operator from these rooms and the nearby access road.

Meas. Range : As per Sump Height
 Float Size / MOC : 300 mm dia. / SS316
 Float Wire Size / MOC : 1.5-1.6 mm / SS316
 Guide Wire Size / MOC: 3 mm / SS316
 Bottom Anchor Bar : SS316
 Guide Pipe : G.I., Class B

90° Sheave Elbow	:	Cast aluminum
Roller Pulley	:	2 nos.
Top Anchor	:	Cast aluminum
Tension Spring	:	Cd Plated Steel
Pipe Support & U Bolts	:	MS (Epoxy coated)
Scale	:	MS (epoxy painted), 125 mm wide, White background, Minor marking at every 50 mm in Black, Major marking at every 1000 mm in Red.
Pointer	:	MS (Cd Plated), painted in red

❖ **ELECTRO MAGNETIC FLOW MEASURING SYSTEM**

Generally, the flowmeter shall be as follows:

Flow metering System

Each flow metering system shall consist of the primary transducer (Sealed to IP-67 for above ground / non-submerged application and IP-68 for below ground within chamber for submerged application), earthing rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit. Flowmeter in general shall be sized considering maximum design line velocity as specified in this tender specifications (2.5m/sec for pumped flow) except for all sludge flowmeters which shall be of minimum 80mm size or higher as required as per sizing calculations.

Each of the signal converts / power supply units shall be supplied for remote mounting, unless otherwise specified.

The signal converts / power supply units shall be provided with a 4-20 mA output signal, linear with flow and suitable for retransmission to remote instrumentation. The above units shall operate from a 240V 50 Hz supply.. The supply voltage may vary by $\pm 15\%$ and frequency between 47 and 53 Hz.

The contractor shall provide sufficient suitable cable to allow for the primary transducers to be situated up to 10 meters from their signal converters, unless a longer length is specified.

The Contractor shall provide full details of the cable, he proposes to use.

The general specifications for electromagnetic flow meter shall be as under:

Service		Water / Sludge / Chemical Application
Function		To measure & indicate Instantaneous Flow and Totalized Flow / Transmit (Flow)
Fluid Conductivity		> 20 μ S/cm
Installation		Indoor or Outdoor, Below or Above Ground as per piping / site conditions
Flow Sensor / Tube / Element		
Type of Sensor		Full Bore type
Flange Materials		MS / CS Epoxy Painted or Better
Tube Material		SS304 or better

Liner Material		Clear Water Application: Hard Rubber / PU / Ebonite Rubber Chemicals/PAC Application: PTFE
Body Material / Coil Housing		MS Epoxy Painted or cast alu. with corrosion resistant paint of better as per mfr std.
Electrode Material		Clear Water Application : SS316L/Ha-C Chemicals/PAC Application: Ha-C
Power Supply		From Transmitter
Grounding	Type / Material	Metallic Line: Earth Electrode / Set of Earth Rings-SS316 or better Non Metallic Pipe: Set of Earth Rings Only / SS316 or better
Upstream/Downstream Length		As per mfr. Recommendation
Protection Class	Above GL or Indoor within Pump House / Bldg.	IP-67 for flowmeters installed above Ground Level or if installed indoor within pump house / building above ground level.
	Below GL / outdoor	IP-68 for flowmeters installed outdoor / below Ground Level (shall be mounted within RCC Chamber with water proof plaster)
Cable Entry (for separated / remote version) & Glands		Shall be as per mfr. Std. and suitable to maintain the specified protection class at site
Cable Length	Sensor to Transmitter	Min. 10m, dual shielded cable
Painting, where applicable	CS / other	Chemical Resistant, Epoxy Painted
TRANSMITTER		
Function		Transmit and Indicate
Type		For Outdoor / Below ground Sensor, Tx. shall be Remote (Non-Integral) type, Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
		For Within Building or Pump House above ground level Sensor , Tx. shall be Remote / Integral type Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std
Flow / Velocity Measurement Range	Max. Flow Velocity	Flowmeter shall be capable to measure flow with velocity up to max. 10 m/sec.
	Velocity for Sizing	Flowmeters for clear water shall be sized to measure flow with max. flow velocity up to 2.5m/sec. or as per specified size in scope of work / specifications
	Minimum Flow Velocity	up to 0.3 m/sec. (shall measure flow without loss of accuracy up to 0.5 m/sec and below that)

Accuracy	Flow Vel. \geq 0.5 m/s	$\pm 0.5\%$ of Flow Rate / Measured Value or better
	Flow Vel. $<$ 0.5 m/s	as per mfr. Std. for flow velocity up to 0.5 m/s
Output Signal	For Flow	Modbus RS-485 with diagnostic feature and facility
Instrument Power Supply		100 to 240 VAC $\pm 10\%$, 50 Hz $\pm 5\%$ or 24V DC as per mfr. Std.
Cable / Conduit Entry		1/2" NPT.
Local Indicator / Display	Inst. & Total Flow	Backlit LCD Display for Inst. & Tot. Flow readings
Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum or better
	MOC	Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment with chemical resistant / epoxy coating
	Type	Wall mounting / Pipe mounting
Vibration Conditions		Conformity with IEC 60068-2-6 or equi., shall be able to endure vibration, when in service, without any degradation in performance
Pipe not Full Detection / Empty Pipe Detection		Required
Canopy for Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick
Expansion Bellows	SS 304	Required at suitable location to enable ease of removal / insertion of flow meter for maintenance

Flow (Instantaneous and Totalized) readings shall be continuously displayed at PLC HMI.

Flow meter shall be mounted above ground level / HFL as far as possible. In case of flowmeter mounted below ground level / HFL shall be provided with suitable water proof chamber constructed in RCC elevated sufficiently above GL of sufficient size for ease of operation and maintenance as decided during detailed engineering.

Flowmeter shall be mounted as per manufacturer's recommendation and good engineering practices and each flow meter shall be provided with a bellows at suitable location to enable ease of removal / insertion of flowmeter for maintenance. For flowmeter mounted below ground level, chamber shall be sized suitably to accommodate flowmeter and bellows in the same chamber.

❖ PRESSURE GAUGES:

All pumps, compressors and air blowers shall have PG at their discharge lines. Pressure Gauges for process fluids containing sludge/solids and corrosive chemicals shall be of diaphragm type.

PG dial face shall be marked with pressure element material. Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall confirm to IS-3624 standard dials, wherever possible.

Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of clean out type with flushing connection.

Pressure Gauge Dial Size shall be of minimum 150mm and of white with black engraving, shall be provided with blow out disc, toughened/safety glass window, bayonet type bezel ring, case material of SS304, Bourdon Element / Socket of SS316, movement parts of SS, weather proof to IP-65, offering accuracy of $\pm 1\%$ of FSD. Micro-zero adjustment at the pointer, bottom process connection shall be 1/2" NPT, over-range protection of 130% of FSD.

In case of Diaphragm type Pressure Gauge, Diaphragm / Lower Chamber Wetted Parts shall be SS316, Upper Chamber of SS304 / SS316, with silicon oil sealing fluid, 2" ANSI B16.5 flanged process connection

Following accessories shall be supplied as a standard with all pressure gauges:

Syphon / MOC	:	Required, SS316, for process temp. range exceeding 60°C
Snubber / MOC	:	Required, SS316, for pulsating flow/output application (blower/compressor/dosing pump delivery, etc.)
Glycerin Filled	:	All pump delivery
Isolation Valve	:	Required, Gate / Ball Valve, SS 316
2-Valve/3-Way Manifold	:	Required, SS 316

❖ PRESSURE TRANSMITTER

Pressure readings shall be continuously displayed at PLC HMI with low and high pressure alarm annunciation at HMI. The transmitter specifications shall be as under:

Transmitters shall be manufactured from material suitable for use with the process medium and for the site ambient conditions.

a.	GENERAL		
1	Type of Measurement		Gauge Pressure
2	Service		Raw / Clarified / Treated Water / Air Application
3	Function		Transmit & Indicate
4	Type		Smart
5	Mounting		Yoke
6	Zero elevation & suppression		Provided

7	Operating Temperature		Ambient, 0 to 50 °C
8	Installation		Indoor / Outdoor
b.	Measuring Unit		
1	Element Type		Diaphragm
2	Element Material		SS316L
3	Body Material	MOC	Cast Alu. or equi. as per mfr. Std.
4	Over range Protection		130% of maximum static pressure
5	Process Connection		1/2" NPTF through adaptor
6	Connection Location		Bottom
7	Calibration Certificate		Required
c.	Transmitter		
1	Type		Microprocessor based, User Programmable, 2-Wire, Smart
2	Measurement (Calibration) Range		As per Process Requirement:
3	Accuracy		± 0.1% of Span
4	Output		4-20 mADC , Two Wire, with HART protocol
	- Load Resistance		600 Ohms max.
5	Tx. Power Supply		24V DC
6	Cable Entry		1/2" NPT F
7	Local Indicator / Display		Digital Display
8	Scale Graduation / Measuring Units		Engg. Units
9	Protection:		
a	Elec. Area Classification		Safe
b	Intrinsically Safe		N.A.
c	Enclosure	Type & Protection Class	IP-66/68
		MOC	Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
		Requirement for Hazardous Area	N.A.
10	Mounting		2" Pipe Mounting / Field Enclosure Mounting
d.	Options / Accessories:		
1	Mounting Accessories		Required, 2" Pipe Mounting
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide

4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Isolation Valve		Required, ½” Ball Valve
6	3-Way Manifold (2 Valve)		Required (With SS-316 Tubing/fitting as required)

❖ PROGRAMMABLE LOGIC CONTROLLERS (PLC) PANEL

PLC & AUTOMATION REQUIREMENT FOR WTP (INCLUDING CLEAR WATER PUMPING STATIONS & ZLD):

The vendor shall provide main Instrument Control Panel (ICP) located at control room at administration building and Local Control Panel / Filter Consoles (LCP) at Filter House Gallery for local monitoring and control of filter beds. Local Control Panels shall also be provided at PMCC/MCC Rooms, and other locations if necessary as per contractor's design. The PLC systems shall be centralized configuration or with Distributed I/O or remote PLC configuration integrated over suitable communication network.

All filter beds shall be possible to be backwashed automatically through PLC with complete back wash cycle programmed in the PLC as per process requirement. Auto backwash shall be started with suitable interlocks of LOH/ROF controller or through Selector Switch at filter console or through soft PB at HMI, as per the mode selection.

It should be possible to operate/control and monitor status of all electric drives, electrically / pneumatically operated valves, process parameters (level, diff/ level / flow / LOH & ROF / water quality analyzers, etc.) of plant at main control room PLC HMI. Valves shall be monitored for full open, intermediate and full close position and electrical drives for motor on, off and trip status. Separate indication at HMI, Red indication for Valve close / motor off status, Green indication for Valve open / motor on status and Amber indication for Trip shall be provided.

Filter console panel (FCP/LCP) shall be provided one no. between two beds. Filter Console Panel shall be provided with min. 10” color touch screen HMI and it shall be possible to operate/monitor electrically operated valves for filter beds associated to that particular panel and also operate/monitor any of the air blowers & backwash pumps for backwash operation. Operation and monitoring of valve/blower/back wash pump shall be provided at LCP. Valves shall be monitored for full open and full close position and electrical drives for motor on, off and trip status. Backwash tank / sump level and LOH/ROF indication of associated bed shall be displayed at each Filter Console. It shall be possible to operate the electrically operated valves, air blowers & backwash pumps both, from control room (through HMI/SCADA) as well as locally at filter beds from filter consoles (through local HMI) as well as in full auto mode without any manual intervention in LOH/ROF initiated auto backwash cycle and as per operator selection of each mode at SCADA. It is to be noted that all the I/Os of a particular bed (especially valves and LOH/ROF) be wired in the FCP associated to that bed only. Necessary operation mode selector switches shall also be provided at HMI/SCADA to enable operator select the mode of operation i.e. in full auto mode or to operate from filter console (default mode) or from SCADA/HMI or in manual mode, separate for each type of equipment / set of filter bed valves and shall have required interlocks and level / timer / LOH-ROF or such process interlock based auto operation when selected in full auto mode. All electric

drives shall be possible to operate manually from MCC/LCP and actuator through actuator mounted push buttons in manual mode.

1. **POWER SUPPLY TO PACKAGE:**

A) Power Supply shall be made available by the bidder at the following voltage levels, **unless otherwise specified**.

- For Instruments, Control Systems, Analyzers : 230V AC \pm 10%, 50 Hz \pm 3 Hz/ 24 V DC
- Solenoid Valves, Relays, Lamps : 24V DC
- Input Interrogation Voltage : 24V DC
- Panel/Cabinets Lighting : 230V AC \pm 10%

24V DC required for Input Interrogation, relays and lamps etc., same shall be generated by the bidder using **dual redundant power supply**. Power shall be suitably conditioned by providing on-line type UPS (with in-built AVR) to prevent damage to instruments against power fluctuation / disturbances.

B) Instrument power circuits shall be individually protected from fault with the help of Dual pole Miniature circuit breakers (DPMCB's). Power supply to the individual instrument shall be disconnected with the help of (DPMCB's).

2. **EARTHING:**

Vendor shall provide separate earth bus bar connections for shield and panel electrical earthing.

Any special earthing requirements, if required, shall be provided by vendor during detailed engineering.

Necessary earth pits shall be provided for the same by the vendor.

3. **INTERLOCKS / LOOPS:**

All plant interlocks shall be carried out using PLC to be supplied by vendor for fail safe and reliable operation. Vendor to indicate all process interlock requirements on the P&IDs.

Loop integrity must be maintained for each loop. No component of any loop shall be shared by other loop.

The system shall be designed fail safe and shall meet the following requirements, as a minimum:-

- a) All initiating contacts shall be close under normal conditions and shall open under abnormal conditions.
- b) All relays and solenoid valves shall be energised under normal conditions and shall de-energise under abnormal conditions.

The system shall be designed using PLC unless specified otherwise and shall be located locally or remotely as per the operational requirements. The system shall meet the following requirements as a minimum:

- a) The electromagnetic relays shall be low power continuously rated type and shall have LED for status indication.
- b) The relays shall be plug-in type and their plug-in bases shall have screwed terminals for interconnection. Lug type soldered connection shall not be acceptable.
- c) Each relay shall have two numbers of 'NO' and two numbers of 'NC' contacts as a minimum each suitable to drive the connected. Out of these, one 'NO' and one 'NC' contacts shall not be used.

4. **CONTROL PANEL:**

Control panels shall be prefabricated type, Sourced from Approved Vendors.

Control Panel shall be CNC machine prefabricated out of CRCA sheet steel of thickness not less than 1.5 mm, modular in construction, properly reinforced, powder coated and having rigid frame structure. Internal mounting plate including the gland plate shall be 3 mm thick. Anti vibration pad, Predrilled base channel ISMC – 100 or equivalent for all sides. The instrument panel shall have dimensions as per system requirement.

The exterior corners and edges shall be rounded to give a smooth overall appearance with projections kept to a minimum.

Lifting lugs shall be provided for installation purposes and shall be replaced with corrosion resistant bolts after installation.

Control Panel shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than IP 52 in accordance with IS: 13947 Part-I.

Control Panel shall be freestanding type. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.

Metal sills in the form of metal channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting the Instrument panels. These shall be dispatched in advance so that they may be installed and leveled when concrete foundations are poured.

Cable entries to the panels shall be from the bottom with fire retardant spray compound sealing. Instrument panels shall be provided with louvers along with washable micron filters AIRIN – AIROUT fans will be provided.

No process fluid of any kind, except instrument air, shall enter the instrument cubicle. All cable entry shall be from the bottom of the panel. Also power supplies greater than 230 V shall not enter the ICP/LCP.

The internal layout of the panel/cabinets shall be designed considering proper approach for each item for maintenance. Following point must be taken into consideration while deciding the internal layout:

- a.) All wiring inside the panels shall be housed in covered non-flammable plastic raceways arranged to permit easy accessibility to various instruments for maintenance adjustment, repair and removal. No raceway shall be more than 70% full.
- b.) Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring.

- c.) Distance between terminal strips and side of the panel parallel to the strips up to 50 terminals: Min. 50 mm.
- d.) Distance between terminal strip and top and bottom of cabinet: Min. 75 mm.
- e.) Distance between two adjacent terminal strips: Min. 100 mm.
- f.) Distance between cable gland plate and the bottom of strips: Min. 300 mm.
- g.) 20% spare terminals shall be provided as a minimum.

Overall height of Control Panel shall not exceed 2100 mm. Panel mounted instruments and controls shall be such mounted that they are accommodated between 800 mm and 1300 mm from floor level.

Control Panel shall be provided with fluorescent type lighting fixtures controlled from totally enclosed door operated switches for internal illumination of the panel cabinets.

Contractor shall provide with necessary cooling fans and cut-outs covered with appropriate filters for necessary air changes to limit temperature rise within panel to 5 deg. C over ambient temperature.

For cases where PLC is to be mounted, panel shall be designed suitably as per PLC manufacturer's recommendation. Necessary marshalling boxes may be considered if required as per design.

Control rooms (PLC/SCADA Control room at Plant) shall be provided with air conditioners of sufficient numbers/quantities as recommended by Air conditioner manufacturer based on room size, heat load, etc. However, a minimum of 2 nos. 1.5Ton capacity air conditioner shall be provided.

Windows in control room shall be provided with suitable louvers to prevent direct heat / glare.

Mounting

All equipment's on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front.

Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.

Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

Earthing for Instruments

The panel shall be equipped with an earth bus securely fixed along the inside base of panel.

Minimum two numbers of Dedicated Earth Stations to be provided each for Instruments / Panel Earthing and for Signal (Electronic) earthing. The earth station shall be of cu plate type electrode (Size Min. 600 X 600 X 3.15 mm thick) or maintenance free pipe in pipe technology having earth electrode of 50 mm dia. and length of 3000 mm.

All metallic cases of instruments and other panel mounted equipment shall be connected to the instrument earth bus. The minimum section of the earth bar shall be 25 mm x 3 mm.

Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to create alternative paths to earth bus shall be provided.

A separate instrument earth bus will be created which will be floating and all the cable shields will be terminated onto this bus. This bus will be connected to an electronic earth pit as specified above.

Space Heater

Strip type space heaters of adequate capacity shall be provided inside control panels to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. The heaters shall operate on 230 V AC. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. The operation of heaters shall be controlled by thermostats.

Interior Lighting and Receptacles

Each panel shall be provided with either a LED lighting fixture rated for 5 watt, 230V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. The illumination lamp shall be operated by door switch or manual switch. Each panel section shall be provided with separate lighting.

Each panel shall be provided with 230V, 1 phase, 50 Hz, combined 5 amps and 15 amps, 3 pin receptacle with a switch and neon indication. The receptacle with switch shall be mounted inside the panel at a convenient location. If the panel has front and rear doors then maintenance socket shall be provided at both locations.

Labels

All the equipment mounted on the front facia of Instrument panel as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Also the panel shall be provided at the top with a label engraved with panel designation.

Switches and Miniature Circuit Breakers (MCBs)

Each instrument panel shall be provided with necessary arrangement for receiving, distributing, isolating and protecting of DC and AC supplies for various controls, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with DP Miniature Circuit Breakers (MCBs).

Intra-panel (i.e. Panel Internal) Wiring

Connections within a panel, between panel mounted devices and terminal blocks or between two panels mounted devices will be made by 600 volt grade, multi stranded copper flexible conductor insulated with FRLS Grade PVC and designed for a minimum conductor temperature of 70 degrees centigrade. The wires shall be shielded, where necessary.

Panels shall be supplied completely wired internally, with a colour coding scheme decided mutually between the Purchaser and the Contractor, to equipment and terminal blocks and ready for external cable connections at the terminal blocks.

Wires within the panel shall be continuous i.e. without splicing and shall comprise stranded copper conductors. Internal wiring or wiring between the two assemblies shall be commensurate with mechanical safety.

Terminal Blocks

Terminal blocks for power connection shall be 600V grade, 20 amps rated, one-piece moulded. All control output terminals will be fused type and all other input signal terminals will be clip on shrouded type.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

Panel internal wiring shall not be looped directly from instrument to instrument. The same shall be looped through the panel terminal block only.

If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker, these wires shall not be terminated on adjacent terminal blocks.

Cable Supports

All external cables shall present a neat appearance and shall be suitably braced, placed in troughing clipped or laced to prevent effects of vibration.

Terminal / Identification

Every terminal plug shall be uniquely identified within the terminal cabinet by means of a terminal number. Appropriate labels shall be used to permit quick and unambiguous identification of each terminal and test plug.

Painting of System Cabinet/ Control Desk

All sheet steelwork shall be painted using seven tank processe in accordance with the following procedure:

- i. The pretreatment shall be hot process with running water for rinsing.
- ii. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- iii. Rust and scale shall be removed by trickling with clean water followed by final rinsing with dilute dichromate solution.
- iv. The control panel shall be powder coated. Thickness of coating shall be around 60 microns. QA test certificate shall be furnished for thickness adhesion and hardening of powder coating.

5. ALARM ANNUNCIATOR:

- (i) Microprocessor based alarm annunciators shall be provided, **if specified in detailed specifications for instruments**, for generating audiovisual alarms for each abnormal condition. Alarms shall be initiated by the opening and closing of volt-free contacts which shall remain unchanged throughout the periods in which the alarm conditions exist. Alarm circuits shall be capable of conversion from open-healthy to open-alarm or vice versa by a simple modification after installation requiring no additional parts or special equipment. Each alarm shall initiate the operation of both visual and audible devices. The sound intensity of each audible device shall be suitable for the maximum sound level of its environment. The sequence of alarm should be user selectable by dip switch.
- (ii) The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a future alarm condition occurs.

(iii) Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds do not initiate any action.

(iv) Isolation facilities shall be provided for the hooter using an MCB

(v) Alarm annunciator/indicator legends or labels shall be arranged with three lines of text as follows :

i.	top line	:	location
ii,	middle line	:	parameter
iii.	bottom line	:	status

e.g. RESERVOIR
 LEVEL
 HIGH

The annunciator will be split / integral architecture type and the facia will have Super Bright LEDs.

Alarm annunciator shall be provided on instrument control panel for annunciation of alarms in control room. A minimum of 20% spare windows with alarm modules shall be provided in alarm annunciator.

The technical particulars of alarm annunciator are as follows:

(a) Technical Particulars

i.	Type	:	Microprocessor based, split type / integral type with alarm windows mounted on the front door and electronic modules inside the panel
ii.	Mounting	:	Flush with panel
iii.	Construction	:	Modular
iv.	Inputs	:	Potential free, NO/NC contacts
v.	Size of windows	:	60 mm X 26 mm
vi.	Operating sequences	:	First up (user selectable dip switch)
vii.	Bulbs per channel	:	2 (Cluster LEDs)
viii.	Push Buttons	:	For Reset, Accept and Test
ix	Hooter	:	Required, electronic type
x	Power supply	:	24 V DC/240 V AC
xi.	Power supply status	:	Required indication
xii	Weather protection	:	IP-52 of IS 13947

xiii No. of Windows : as per requirement + 20% spare windows

In case if hard wired annunciator is not specified in detailed specifications for instruments, then visual alarm at HMI and audio alarm through panel mounted hooter along with rest push button shall be provided for all the required alarms as per specifications / approved P&ID / process requirement.

6. RECEIVING INDICATORS MOUNTED AT ICP/LCP:

All indicators/controllers shall be electronic (microprocessor based) type programmable indicator and shall be mounted on the control panel located in the control room. Multiplying factors, shall be specified on manufacturer's nameplate, if applicable. Specifications, as applicable are as follows:

Process Indicator:

Type	:	Microprocessor based, programmable
Input	:	4-20 mA
Display	:	4 ½ Digit, 7 Segment LED display
Display Units	:	% or Engg. Units, user programmable at site
Alarm Set point	:	Two nos., pot. free relay contact rated at 5A @230V AC resistive load, adj. over entire range
Transmitter Supply	:	Required, 24V DC @30mA
Retransmission Output	:	Required, 4-20 mA in 600 ohm load
Accuracy	:	± 0.25% of FSD
Terminals	:	suitable for up to 2.5 sq.mm. wires
Mounting	:	panel flush mounting
Power	:	110/230 V AC, 50 Hz

Flow Indicator cum totaliser shall also have following in addition to above:

Totalizing Counts/Hr	:	User Programmable at site
Totaliser Display	:	6/8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

Notes :

Indicating instruments shall indicate various process parameters as per following measuring units, in general :

Flow	M ³ /Hr or MLD or LPS	as per process requirement
Level	m	Meters
Pressure	Mt. head of water or Kg/Cm ²	as pr process req.
Temperature	C	Degree Celsius
Concentration	ppm or mg/l	Parts per million or Milligram per litre.
Current	A	Amperes
Voltage	V	Volts
Power	W	Watts
Electrical Energy	Whr	Watt-hours
Frequency	Hz	Hertz
Speed	r.p.m.	Revolutions per minute.

7. **PROGRAMMABLE LOGIC CONTROLLERS**

These specifications shall be read in conjunction with control panels (ICP & LCPs / filter consoles) and other PLC/Panel/Automation/Major Logic requirements specified above of these instrument specifications and other requirements specified in scope of work, process description & specifications and elsewhere in tender specifications.

Codes and Standards

PLC shall comply with International standards such as NEMA, IEC, ANSI, ISA, IEEE, DIN and VDE

DESIGN AND CONSTRUCTION REQUIREMENTS

PLC H/W & S/W shall be from the same family and should be sourced from approved Vendors only.

Programmable logic controller (PLC) shall be microprocessor based with 32 bit processor and be fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking.

The PLC shall be high performance processors suitable for real time process application. High inherent reliability, self-checking, error-recovery and trouble-shooting features shall be some of the features of PLC.

The PLC shall have a modular / modular chassis design which allows for ease of future expansion. The processor module shall be easily removed from the I/O chassis for service or repair. The I/O chassis shall have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules shall be capable of being installed in any open slot in the chassis or DIN rail mounted. Module and channel level diagnostics should be standard feature.

The PLC shall have a suitable power supply and can be easily serviced or replaceable. The system shall be capable of being powered on 120VAC / 230VAC / 24V DC as per mfr. Std.

The PLC shall be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards shall be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel or other objects.

Bidder to note the location specific requirements specified as under to be provided/included in scope of work irrespective of whether mentioned in following general specifications or not:

PLC Based Instrument control Panel at **WTP** with Local SCADA system comprising of min. 2 nos. 24" LED PC console one for EWS and other for OWS, 1 no. A4 size Laser Jet Printer cum scanner cum xerox for report generation and alarm, Online UPS with min. 60 min backup, 50" wall mounted TV, PC and Printer console, Min. 2 Nos. Revolving chair, Remote data transmission facility 4G GPRS connectivity shall be provided to transmit data of entire WTP Site to be monitored at central SCADA / Office of Client.

Note: The cost of acquiring SIM card and its renewal / operating cost up to completion of O&M period shall also be in bidder's scope.

The SCADA system at WTP site shall comprise of following as a minimum:

- 2 Nos. Desktop PC (One for EWS and Other for OWS) with 24" Full HD LED,
- 1 No. min. 50" TFT / LED Display for large screen viewing of EWS/OWS.
- SCADA software license for both PC with min 100 display / Equivalent Screen Runtime + Development License for EWS and Runtime License for OWS
- 1 No. A4 Laser printer cum scanner cum Xerox for report & alarm printing respectively.
- VPN Router with suitable number of ports if required
- Reporting Software
- Online UPS with minimum 60 minute backup
- Required Licensed OS (Operating System), Anti-Virus & other software
- 4G/5G GPRS Modem with SIM CARD for Remote Data transmission to Central SCADA of client
- Console furniture for PC and Printer, Revolving Chair, etc,
- Any other as required to complete the work in all respects

For GSM/ GPRS connectivity the bidder shall select service provider after checking the feasibility and signal strength in the area of coverage of this contract and obtain prior approval from Client Engineer.

Basic Processor Functions

Real-time control of output points for turning on and off digital devices such as motor starters and solenoids.

Read the status of real world digital inputs from limit switches, float switches, and other field devices.

Real-time control of analog process control variables.

Read the status of real world analog set points and feedback values.

Perform timing, counting, sequencing, and interlocking functions for pump/equipment control.

Process local alarm handling functions

Math and Advanced Functions

Four function math in floating point or signed integer format

Convert to/from BCD

Data comparison and manipulation

Scaling from integer data into engineering units such as flow, level and pressure

Full PID Instructions for control of process control variables such as flow, level and pressure.

ASCII instruction set for interfacing to ASCII devices

Compute Instruction which executes a mathematical expression and can be used for totalizing functions

Trigonometric and Exponential math functions

Real-Time Calendar Clock for time stamping alarms and events.

Automatic restart of the system on resumption of power shall be provided.

The processor shall have solid state RAM memory to store the application program, process data, and alarm status. This memory shall have both capacitor and battery backup in the event that input power to the processor is lost. It shall also have the capability of EEPROM backup which automatically reloads the memory on a power cycle. The processor shall have the ability to automatically control the process on a power cycle, provided there are no major or unrecoverable processor faults.

Processor RAM memory shall be adequate and selected with at least 25-30% spare capacity for application program storage over the actual requirement, and also should be expandable for future expansions. Bidder shall demonstrate the spare capacity at the time of commissioning and after completion of entire logic development for the plant controls and monitoring as per the logic write-up to be furnished by client / consultant to the successful bidder after award of work.

Sufficient program memory and data memory space shall be provided. System initialization and application software shall be stored in EEPROM or EPROM with necessary hardware. Running data shall be stored in a RAM with internal battery back-up

All process parameters and electrical parameters shall be monitored at HMI and necessary controls actions shall be initiated.

All PLC/HMI products shall be fully supported and available for purchase for up to ten (10) years from the date of the original system purchase and shall be upgraded or maintained as required till completion period of O & M contract, at no extra cost and accordingly any software or hardware getting obsolete shall be upgraded or replaced by contractor at no extra cost with prevailing latest version during this period.

The PLC & SCADA System shall be provided either by PLC OEM or Authorized System integrator of PLC OEM only. In case of system integrator, required valid certificate from OEM shall be provided in this regards along with drawing / document submission.

Specific Requirements for PLC

- | | | | |
|-----|---|---|--|
| (a) | Expandability in future | : | 30% of installed I/O capacity as per present requirement at each location |
| (b) | Weather Protection | : | IP-20 for PLC hardware and shall be IP-54 of IS 13947 when mounted in ICP |
| (c) | Power Supply | : | 230V AC / 24V DC |
| (d) | Interrogation Voltage | : | 24V DC |
| (e) | CPU, communication module and power supply module | : | Required, high performance 32 bit CPU Module having modular configuration suitable for real time process application. CPU shall be preferably of same family if provided at different locations. For filter consoles 16 bit CPU / micro PLC is acceptable. |
| (f) | Scan time | : | 0.5 Milliseconds or better for 1K instructions |
| (g) | Key Switch for Processor | : | Shall be as per mfr. Std. |
| (h) | Mounting | : | Inside the main instrument/local instrument control panel |
| (i) | I/O Capacity of CPU | : | 30% expandability in future over present I/O requirement (actual + spare I/O) |
| (j) | Inputs and Outputs | : | As required for process operation with an intention to maximize the automatic operation of equipment/plant and ease of operation and maintenance of the plant. |
| (k) | System Loading | : | Max. 60% under worst loading conditions |
| (m) | Power supply to sensor / transmitters | : | Required |

- (n) Type of input : NO/NC – Contacts field selectable from programmer
- (o) Outputs : Relay outputs for driving MCC starter coils, driving motorized valves etc.
- (p) Spare I/O (Wired) : Min. 2 nos. or 10% of each type of I/O, whichever is higher, at each panel/location, wired to terminal block
- (q) Accessories : Required sets of SCADA software and report printing
- (r) Interposing Relays : Shall be provided for all the Digital Output (DO) including spare DO & for Digital Input where ever required
- (s) Interface (Hardware and Software) to SCADA : Required (plug and play) ready to use type
- (t) Printers for alarm, status, report generation : 1 No. A4 size Laser Jet Printer cum scanner cum xerox required at control room
- (u) Computer –The system shall have two operator consoles, with one console designated at operations – cum – engineering console (Primary Console), and the second console shall be an operation console, : Desktop / Workstation grade PC with min. 24” Full HD LED monitor having following specifications as a min.:
Intel core i7 CPU or better, / 8 GB DDR4 RAM / 1TB SSD / PS/2 Keyboard / Wireless Keyboard and Mouse / Audio: inbuilt speakers, Camera Vision 1080p FHD camera with integrated dual array digital microphone and Network Interface / Required External I/O Port viz. Headphone, microphone, and 2 USB, etc. / Licensed OS (Windows 10 or latest version) and supported by SCADA software / licensed version of anti-virus software package.
- (v) Type of Protocol on communication port : Standard Min. 10/100 MBPS speed for SCADA and 12MBPS speed or suitable for Distributed I/O. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G/5G network of selected service provider.
- (w) Tests : Functional test (simulated) for complete system
Test for monitoring function Voltage variation test (at $\pm 10\%$ of rated voltage).
Factory acceptance test (to be witnessed by Purchaser / purchaser’s representative)
Simulation test for all logic / loops (to be witnessed by Purchasers / purchaser’s representative)
Vendor to submit all Test Certificates for purchaser / consultant’s review.

Input / Output Modules

- (a) Standard DIN Rail / rack mounted I/O modules with plug-in cards shall be provided. Field wiring shall be terminated in screwed terminal blocks and interconnected to the processor I/O system with preferably pre-fabricated cables and plug in card type connectors.
- (b) Min. 2 nos. or 10% of each type of I/O, whichever is higher, extra I/O's of installed capacity for each type at each location shall be provided as spares and shall be wired to the terminal block of the control panel. Provision shall be made for future expansion of extra I/O modules of the installed capacity.
- (c) Discrete Input Cards: Solid-state input circuits rated for 10-30VDC operation. Cards must be available in 8 or 16 or 32 point configurations and shall source current to the field device. Each input point shall have a status LED which indicates the ON or CLOSED condition for that field sensor or switch.
- (d) Discrete Output Cards: Solid-state output circuits rated for 24VDC operation. Cards must be available in 8 or 16 or 32 point configurations and shall be able to operate a control relay. Each output point shall have a status LED which indicates the ON condition of the output. Cards must have removable terminal strips so that module can be easily replaced without disturbing the field wiring. The control Relay-contact shall be rated for 5A @240VAC or 5A @125VDC. The control relay shall have a LED indication to show the status of the control relay.
- (e) Analog Input Cards: Analog inputs shall capable of reading in 0 to 20mA or 4 to 20mA signal. The A/D converter shall provide a minimum 12 bit resolution over the full range from module minimum to module maximum.
- (f). Analog Output Cards: Analog Outputs shall be capable of outputting 0 to 20mA or 4 to 20mA signals. The A/D converter shall provide a minimum 12 bit resolution over the full range from module minimum to module maximum.
- (g) All cards shall have optical isolation between digital and field side circuitry.
- (h) Some of the common features of the I/O modules shall be as follows:
 - 1) Filters for noise rejection.
 - 2) Surges withstand facility as per standards.
 - 3) All the modules shall be of addressable type.

Communications

- (a) PLC shall be with Minimum one port for High performance Ethernet communication at 10/100 Mbps network for program upload / download, on-line editing, peer- to –peer messaging, data acquisition and man machine interface.

Shall be open protocol for connectivity and communicaiton with third party hardware/PLC/SCADA in future (for monitoring at central control room of client in future). The PLC/SCADA system shall provide connectivity (through Ethernet/equi. Communication port) for remote connectivity and data transmission requirement by client as required. Ethernet switch or such required hardware/software shall be provided for this purpose for ready to use connectivity in future. Required register data shall also be provided

by contractor / vendor for remote data transmission & acquisition, storage and display of parameters at remote site.

- (b) PLC shall be with minimum One RS 232C/RS485 port (with Modbus protocol) for connecting devices over network for data acquisition from Energy analyzers/soft starters /VFDs /temp. scanners/instruments/Modbus based equipment & valves/gates, etc.
- (c) Any other communication ports / modules (Profibus-DP, HART, Modbus, etc.) as necessary for remote/distributed I/O communication to communicate with distributed I/O's @ Min. 12 MBPS or suitable other as per manufacturer standard or for connecting devices over network for communication / data acquisition from field instruments as per specifications / bidder's selection of communication facility with field instruments, variable AC drives, energy analyzers, etc. required to be monitored as per this tender scope / specifications.
- (d) The data communication based on GPRS will be with required communication port and modem suitable for GPRS data communication on 4G/5G network of selected service provider for third party integration and remote data transfer data to central SCADA / Monitoring station of Client as required during detailed engineering for communication facility to transfer data from WTP to remote central control room of client for which bidder shall consider to provide required RTU / modem, GPRS modem, SIM Card, and other required communication facilities and include the same in their price. The required charges for procuring SIM Card / Broadband connection and it's renewal / operation charges during entire period of O&M shall be borne by bidder.

Engineering Station / Operator Work Station (at Control Room / Client Office)

The engineering station / operator station shall consist of branded Personal Computer / Work Station as per specifications described above in requirement of PLC.

General specifications for HMI shall be as under:

1	HMI shall be with 10" Wide Size TFT Color LCD Touch Screen Display with 800 x 400 dots resolution as a minimum
2	HMI shall have LED Backlight
3	HMI shall have FRAM/ROM of 10MB and SRAM of 128KB as a minimum
4	HMI shall have 1 nos. 485 Port and 1 no. RS-232 port as a minimum. Ethernet port shall be available as an option
5	HMI shall be with 1 no USB Port to permit insertion of pen drive for Data Backup and 1 no. Mini USB port (for programming/printing, as required) as a min.
6	HMI shall have Built in RTC with Lithium Primary Battery
7	HMI shall be suitable to operate for ambient temperature of 50 deg C and 95% RH
8	HMI shall be provided with Built in Software for Viewing HMI Screen on LAN (with Ethernet Port)

9	HMI shall be provided with 32 GB Removable Pen Drive for Recording Historical Data & Streaming
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Specifications for GPRS Modem shall be as under:

1	Modem shall support SIM900 Quad Band GSM/GPRS engine suitable to transfer data over GPRS for any 4G or latest network
2	Modem shall have Built In RS232 Serial Interface Port/ Ethernet /Suitable port/SIM
3	Modem shall have Built In Network Status LED
4	Modem shall have Built In Sim Card Holder
5	Modem shall have configurable Baud Rate
6	Modem shall operate with Input Voltage of 24VDC
7	Modem must have auto reset facility when network resume

Contractor shall provide minimum of 3 sets of as-built control panel wiring drawings, PLC logic write-up, I/O Schedule/assignment, ladder diagram and other relevant documents in hard copy format and 3 sets in soft copy form on CDs. Soft copy format shall be in editable form to enable incorporating any changes in future. 3 sets of application program as back-up shall also be provided in soft form on CDs. All application programs shall be without password protection and as per final approved scheme ready to install and use by client and same shall be demonstrated by bidder prior to acceptance of system at site.

Bidder to note that the operation philosophy / logic specified anywhere in tender specifications is indicative only and same shall be submitted by successful bidder as per requirement and to ensure smooth and trouble free operation with minimum manual intervention during detailed engineering for review and approval and shall carry out all software development as per approved philosophy only.

Programming Software

The programming software should help in maximizing performance, save on project development time and improve productivity.

The programming software should be able to operate on Windows-10 or latest version at the time of supply.

The programming software shall have Online editing features which is used to modify the application program while the process is still operating.

Make system backup copies while the system is online.

Upload and down load programs to the PLC

Human Machine Interface (SCADA) Software

HMI shall display process scheme of entire treatment plant including Pumping Station showing status of all electrical drives, electrically operated valves and instrumentation (level, flow, dif. Level, process analyzers, field transmitters, LOH/ROF, etc.). Screens depicting entire pumping station / treatment plant and also for individual process units as well as each filter bed shall be developed and displayed at HMI with necessary process parameters / equipment status and operation buttons. It shall be easily possible to navigate through various screens.

The operator interface software, herein described as the HMI (Human Machine Interface) shall be common for engineering and as operator works station. - an integrated package for developing and running automation applications and also to be just running the automation application.

The HMI shall be designed for use in latest version of Microsoft Windows and shall use OLE, ODBC, DDE, OPC and ActiveX technologies for optimal performance and integration with other software systems.

The HMI shall have several Methods (relying on DDE server / OPC server / etc.) for collecting data from programmable controllers.

The tag database shall be organized in a hierarchy, each level represented by a folder that can be expanded or collapsed.

The HMI shall have the ability for the current value of a tag to be updated from the device it is connect to and stored in RAM so it is immediately accessible to all parts of the HMI.

The HMI shall have the ability to create a tag whose value is the result of an expression. The expression can be made up of mathematical operations, tag values, if-then-else logic and other special functions. The current value of the derived tag shall be stored in an analog, digital or string tag in a value table.

The HMI shall provide a Macro capability that will execute system commands, user defined commands and other macros.

The alarm system shall have the ability to define up to eight different severity classes to visually and audibly distinguish alarms.

The alarm system shall have the ability to use system default messages or create unique messages to describe an alarm log messages to a file, to a printer or to both suppress alarms for maintenance and tuning purposes and set up global alarm monitoring.

The alarm system shall provide a means of displaying up to 1000 tags that are in alarm. This alarm summary display shall be fully configurable.

The alarm system shall have the ability to create alarm log files periodically, at specified times and on event. This alarm log system shall have the ability to automatically purge old files after a specified time.

The HMI shall have the ability to trigger actions based on an event that has an expression applied to it. An expression is an equation containing tag values, mathematical operations, if-then-else logic, or other functions. An action shall have the ability to produce a variety of functions including, but not limited to, initiating a snapshot of tag values, displaying an error screen and changing a tag value.

The HMI shall have the ability to allow certain users or groups of users to access only certain parts of the system. The security shall be based on a series of codes. Each code shall allow the users, or groups of users, with security privileges for that code to access the HMI commands allowed by that code. Users shall be allowed to be assigned combinations of security codes, allowing for each user to access a different set of features.

The security system shall assign each person a user account with a login name, password, and any desired macros. The HMI shall have a minimum of 2-3 different security codes.

The HMI shall provide a graphics display editor for creating displays using graphic objects. The graphics display editor shall have the ability to drag and drop objects from a pre-configured graphics library, paste objects that are copied to the clipboard from another Windows application, and insert objects created by another Windows application using OLE. The graphic display editor shall allow the user to create libraries of graphic objects.

The graphic display editor shall have the ability to attach, as a minimum, the following control to objects: blinking colors, visibility, rotation, horizontal and vertical movement, resizing (width and height), fill and touch.

Additional requirements

The HMI package shall provide the following features:

Display status of Plant in a graphical and tabular format (i.e. running, stopped, fault etc.)

Display Analog values on the appropriate graphic screen.

Annunciator alarms associated with the area of the plant concerned including details of the time the alarm occurred

The HMI package shall also provide following facilities for the operator Station

- Adjust process set points

- Select process modes

- Acknowledge alarms

- View a journal of unacknowledged alarms

- View a journal of the last 200 alarms acknowledged and unacknowledged.

- Display process set points

- Provide real time and historic trending of local analogue values

- Provide data archiving of all local analogue values

- Prepare daily and weekly reports (providing details of daily and weekly throughputs against numbers of pump running hours, power usage, etc.)

- Display a total running hour's log of local transmission pump drives.

- Display preventive / planned maintenance schedules

Power monitoring/management using various analogue / digital inputs provided from the HT switchgear / PCC / MCC / VFDs / etc. for Plant.

Power monitoring/management – data communication with MFM using communication port as well as using various analogue / digital inputs provided from the HT switchgear / PCC / MCC / SS / VFDs / etc. for entire Plant / scope of this tender for various power parameters as specified in tender including required trends / bar graphs and for reporting. Display / report for power consumption for m3 of pumping machinery. Power consumption per day for today (till time), for previous day and for previous month for all major electro-mech equipment provided with MFM of power monitoring tool as part of starter and for all HT/ PMCC/MCC and for entire plant .

Preventive Maintenance Schedule based on operating hours and duration basis as recommended by vendor for all major electro-mechanical equipment.

For provided flow meter on inlet and outlet of treatment plant and for other as required, totalized flow data shall be displayed at HMI/SCADA as total flow today till time, total flow pumped for previous day and total flow pumped in current month till today and total flow pumped in previous month. Also the flow data of each day shall be presented in bar chart for last 90 days / 3 months and shall form part of reporting.

Operating hours shall be logged for all electrical drives irrespective of auto or manual mode of operation. In auto mode, the equipment if available, shall be selected for operation based on operating hours so as to achieve uniform utilization of all equipment. OH shall be displayed on HMI/SCADA along with status of respective equipment. In case of more than one working pump

in a set, no two pumps shall start or stop simultaneously. The start & stop shall be having user programmable delay to be finalized during detailed engineering.

Report generation shall be done on daily, weekly and monthly basis from SCADA for submission to client including all parameters and analysis data specified in tender and in the format and any other periodicity as required by client (owner's) engineer.

Display & report for power consumption per m3 for Power consumption per day for today (till time), for previous day & for previous month for total plant Discharge to be provided.

Time stamped data shall be available for operation of all pump / equipment drives including daily and total working hours of each pump / equipment drives and provided as part of report generation as required by client..

Any additional features required to assist in the effective and efficient operation of the WTP. Power monitoring/management using various analogue / digital inputs provided from the HT switchgear / PCC / MCC / VFDs / Soft Starters, etc. for WTP / CWPS.

Graphic screens shall be provided as follows but not limited to this:

Main and subsystem menus

Plant / Process overview (i.e. providing details of Nos. of pumps / blowers / equipment running, Flow, totalized flow, levels, process parameters / power supply status, etc.) for WTP.

Overview of power system

Overview of control system

Screens to permit viewing of process set points

Tabular screen of Pumping / Treatment Plant status and values

Running hours log for Pumping Station and treatment plant process pumps, etc.

Trends for important process parameters

Trends for important power parameters

The screens shall display data commensurate with their size and the area of and number of Plant items covered. In addition to the specific screen requirements stated above, any additional screens to ensure comprehensive coverage of the Works needs to be provided.

A comprehensive screen navigation system shall be provided giving access to all screens via a system of menus and short cuts (i.e. it shall be possible to follow the process from one screen to another by clicking the mouse cursor on screen 'hotspots' to effect the move from one screen to another).

The sample rates required for the displaying of trends shall typically be one sample every 15 seconds for flow values and one sample every 30 seconds for levels. The system shall be capable of storing real time data for one day and historic data for 90 days.

The sample rates for archiving shall be the same as for trending. The archives shall be stored in daily files. The system shall provide capacity to store archives for 90 days. A warning alarm shall be provided to the operator to advise that archiving to disk should take place or archived data will be overwritten.

The data derived from archiving to the MMI and the archived data viewed using the trend facility.

The HMI shall have the ability to record specific tag values under certain conditions. Several models shall define these conditions. This data that is collected shall be stored in MS SQL format for displaying in trends, archiving for future processing or analysis, and/or using with third-party software, such as FoxPro, Crystal Reports, and Microsoft Excel, for display or analysis. It shall be possible to log historical data directly to an ODBC compliant database.

The Contractor shall provide a disc drive with the MMI in order to download archive data or to upload previously stored archive data onto electronic storage media.

❖ **Uninterruptible power Supply (UPS)**

UPS of suitable capacity as per following specifications for 60 minutes back-up shall be supplied for entire load of instrument control panel including PLC and essential / critical instrument supply for necessary shut-down in case of power failure.

- (a) The UPS shall be floor mounted, self-contained and metal clad and shall be suitable for supplying a nonlinear load.
- (b) It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact touch.
- (c) The UPS shall be on-line type incorporating a six-pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch that shall operate in event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.
- (d) The UPS shall incorporate a DC under voltage trip circuit to Electro-mechanically trip the UPS output in order to protect the batteries.
- (e) The noise level of the unit shall not exceed 60 dB (A) at 1 m from the UPS cabinet.
- (f) The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% nonlinear loads. It shall be suitable for load power factors 0.7 lag to 0.9 lead.
- (g) The unit shall have a dynamic response such that 100 % step load causes an output voltage transient of less than $\pm 4\%$ with a recovery of less than 4ms. The load crest factor shall not be less than 3:1.
- (h) Indicators shall be provided for the following
 - i. UPS status
 - ii. PS alarm conditions
- (i) The UPS shall provide volt free contact outputs for the following purpose:
 - i. Warning, (viz., low battery voltage)
- (j) The UPS shall have an overloaded capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.
- (k) The batteries shall be housed, within a separate matching battery cubicle suitable for location adjacent to the UPS. The batteries shall be of the rechargeable, sealed maintenance free lead acid type. The battery supply to the UPS shall be via a fused load break switch disconnecter circuit.

breaker. The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.

- (l) Terminals shall be shrouded to prevent accidental contact
The Uninterruptible Power Supply (UPS) System with SMF Lead Acid battery shall conform to the minimum following specifications:

i. Input

Input Voltage	:	230 V, $\pm 5\%$
Frequency	:	50 Hz $\pm 5\%$
Nominal DC input (Battery)	:	Bidder to design and submit calculations

ii. Output

Output	:	230 V AC, applicable KVA with 25 % margin as per Load Calculation
Regulation mode	:	$\pm 1\%$
Load power factor	:	0.8 to unity
Duty	:	Continuous
Ripple on DC	:	$< 2\%$

iii. General

Principal of operation	:	Shall be solid state, pulse with Modulation (PWM)
Cable entry	:	Bottom
Cooling method	:	Forced air
Type of Battery	:	Sealed Maintenance free

Additionally CVT (Single phase Constant Voltage Transformer)/ Stabilizer as per following specifications shall be supplied along with UPS (to be considered as part of Item of UPS) for entire load of instrument control panel including PLC/UPS/PC & instrument for protection in case of any higher jerk/spike in incoming power for each ICP.

Capacity: as per capacity of UPS

Input: 180-270 VAC,

Output: 230 V $\pm 1\%$.

Efficiency: 85 % (with Full Load)

UPS sizing calculation shall be submitted by bidder for approval for entire panel / Instrument system load and UPS shall be selected with min. 25 % spare margin.

❖ **INSTALLATION MATERIALS:**

Vendor shall supply all erection hardware required for the installation of complete instrumentation forming part of this tender.

This includes items like cables, cable glands, junction boxes, instrument valves and manifolds, mounting accessories, impulse piping / tubing, pipe/tube fittings, pneumatic signal tubes, air line pipes and fittings, filter regulator, insulation material, cable duct and trays, conduits, identification tags, structural material required for instrument supports and trays etc.

A) CABLES:

Vendor is fully responsible for the sizing of all cables in their scope of supply considering factors like maximum distance between Control Room and the Unit. Specifications for cables for analog signals, digital signals and instrument power cables shall be as follows:

Cables For Analog Signals:

Cables shall be of 660V/1100V grade, single or multi-pair cables, annealed, tinned, high conductivity 1.0 sq.mm stranded copper conductor, PVC insulated two cores twisted into pair, laid up collectively, individual pair shielded and overall shielded with aluminium mylar tape, ATC drain wire running continuously in contact with aluminium side of the tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for analog signals. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. For multiplier cable, Pair identification as per BS 5308 Part-II marking pair no. for each pair shall be provided at maximum 50mm between two consecutive numbers.

Cables For Digital Signals:

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity annealed 1.0 sq.mm stranded, tinned copper conductor, PVC insulated, overall shielded with aluminium mylar tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for digital signals. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing/engraving shall be legible and indelible. Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50mm between two consecutive numbers. Colour coding for cables upto 5 cores shall be as per IS.

Cables For Instrument Power Supply:

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity annealed 1.5 sq.mm, stranded, tinned copper conductor, PVC insulated, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part I & II shall be used for instrument power supply. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter

Fiber-Optic Cable:

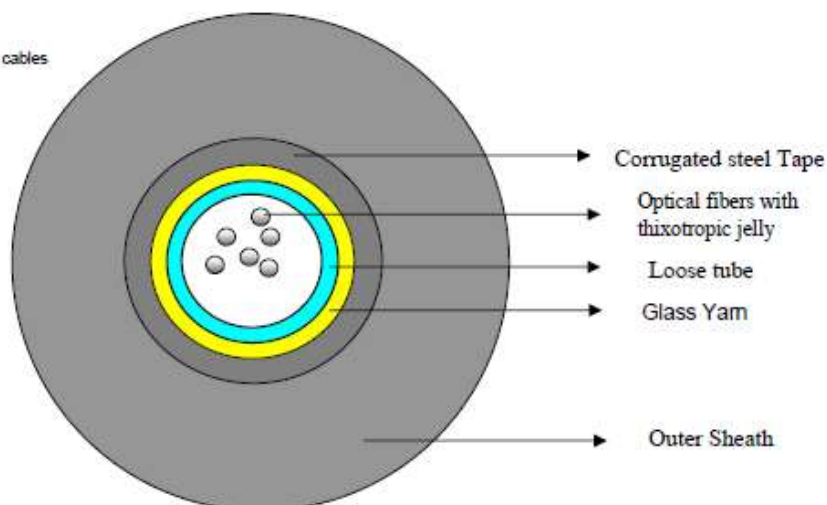
- 1) Optical fiber cable shall be Single mode multiple cores (6), galvanized corrugated steel taped armored, fully water blocked with dielectric central member for outdoor application so as to prevent physical damage.

- 2) The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively.
- 3) The outer sheath shall have flame retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacture, progressive sequential on-line marking of length in meters at every meter on outer sheath.
- 4) The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. steel central member, loose buffer tube design, 4 fibers per buffer tube, interstices and buffer tubes etc.,
- 5) The central fiber optic unit shall be designed to house and protect the fibers from damage due to forces such as crushing, bending, twisting, tensile stress and moisture, wide temperature variations, hydrogen evolution etc.
- 6) All fiber optic cable shall have a minimum service life span of 25 years
- 7) The offered cable shall meet requirement of mechanical characteristic & tests specified in latest TEC specifications
- 8) The cable shall conform to the following standards.
 - i) ITU-T Recommendations G.652
 - ii) Electronic Industries Association, EIA/TIA 455-78A, 455-3A, 455-62A, 455-164A/167A/174, 455-168A/169A/175A, 455-176, 455-59, EIA/TIA 598, EIA 455-104.
 - iii) International Electro technical Commission standards, IEC60304, IEC60794-1-2, IEC60811-5-1.
 - iv) Bellcore GR-20
 - v) Telecom Engineering Centre (TEC), Department of Telecom, Govt. of India (TEC-spec no-GR/OFC-17/01, June 2007)
- 9) All testing of the fiber optic cable shall be as per relevant IEC, EIA and other international standards. The Contractor shall submit the type test reports along with test reports.
- 10) Cables shall be suitable for laying in conduits and underground buried installation.

Specification (Indicative) of Fiber Optic Cable

CABLE DESCRIPTION

- 1 9/125 micron Single-mode Armored Optical Fiber cables
- 2 Designed with a Loose tube construction
- 3 Tubes are gel filled to ensure protection against moisture ingress
- 4 Designed for use in the following applications like Backbone cabling, Campus site cabling & Outdoor Ducts or Direct Burial applications
- 5 Cable contains upto 6 Fibers
- 6 Each loose tube contain 6 Optical Fibers
- 7 HDPE Sheath



Sr.No.	Parameter	Unit	Specifications
1	Type of Cable		6F Unitube Armoured Optical Fiber Cable
2	Fiber		Single Mode / Multimode Fiber
a)	Fibre size	um	9/125/250 (OS2)
b)	No. of Fibers / Loose Tube	No.	6F
c)	Fiber Identification		
	6F		BL, OR, GR, BR, SL & NT
3	Optical parameters		
	For Single Mode		
	Attenuation @1310nm	dB/Km	≤ 0.34 (MAX)
	Attenuation @1550nm	dB/Km	≤ 0.22 (MAX)
4	Loose Tube / Tight Buffer		Loose Tube
a)	Material		PBTP
b)	No. of Loose Tubes	No.	1
c)	Diameter (Nominal)	mm	2.8
d)	Colour of Loose Tube		Natural
e)	Sequence of elements in core		NA
f)	Loose Tube Gel		Thixotropic Gel
5	Jacketing		
a)	Material		HDPE
b)	Colour		Black
c)	Nominal Thickness	mm	2.0
d)	Overall Diameter (Nominal)	mm	10.0
6	Strength Members		Yes
a)	Type (Peripheral)		Water Swellable Glass Yarn
7	Armouring		
a)	Type		Corrugated Steel Tape
b)	MS Tape Thickness		> 0.15
8	Cable weight (Nominal)	Kg/Km	87
9	Standard Length	Mtrs	2KM+5%

10	Tensile Strength	N	1250
11	Type of Packing		Wooden Drum

Laying of Cables:

Cables shall be laid on trays, in trenches, conduits, ducts as necessary. Instrument cables shall not be buried in ground as far as possible. Cable joints in instruments signal and power supply cables shall not be permitted. In case if some of the instrument cables are to be buried in the ground, it shall be as per standard/good engineering practice and shall be subject to client's/consultant's approval.

The contractor shall also supply necessary materials such as junction boxes, glands, lugs etc. required for termination of cables. Each cable shall be terminated to individual panel/terminals box. Cable glands shall be of Nickel plated Brass and of Double Compression Weather proof type.

A distance of minimum 300 mm shall be maintained between the cables carrying low voltage AC & DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HT & LT cables.

Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by contractor. All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedule. Identification tags shall be securely fastened to the cables at both ends.

B) CABLE GLANDS:

Cable glands shall be nickel-plated brass and shall be of double compression type suitable for armoured cables.

Flame proof glands wherever required shall be with Ex (d) certification.

C) INSTRUMENT VALVES (MINIATURE TYPE) AND MANIFOLDS:

Body rating shall be as per piping class or better. Valve body and Trim material shall be SS316 as a minimum. Packing material in general shall be PTFE. Valves and Manifolds shall be of forged type only.

D) PIPE AND TUBE FITTINGS:

Tube fitting shall be flareless compression type and of three piece construction.

Ferrule shall be of SS in general.

Socket Weld type forged pipe fitting of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 3000 lbs. Weld neck fittings shall be used where socket weld is not allowed by piping class.

For air service instrument brass fittings suitable for use on copper tubes conforming to ASTM B 68 / B 68M shall be used. It shall be manufactured from Bar Stock or equi and shall be nickel plated.

E) CABLE TRAYS:

All branch cables/tubes, cables on various civil units/structures shall run on cable trays only.

Hot dip galvanized perforated type cable trays as per IS 2629/ FRP (GRP) cable tray as per NEMA FG1 specification with minimum factor of safety 1.5 or higher as specified elsewhere. Cable trays

shall be made out of galvanized mild steel sheets of 2.0 mm thickness. The width shall be so selected that 10-20% space is available for future use. All material shall be hot dip galvanized as per IS 2629.

Suitable cable clamps shall be supplied for binding cables / tubes at every 500mm.

F) JUNCTION BOX:

Junction Box material shall be Cast Aluminium (LM-6) only and shall be weather proof to IP-65. Flame proof Junction box wherever required shall be with Ex (d) certification

The boxes shall have terminals suitable for a minimum of 4 mm² cable termination mounted on rails. 20% spare terminals shall be supplied in junction boxes.

Each junction box shall have 10% or minimum 2nos., whichever is higher, spare entries of each size. Spare entries shall be provided with plugs.

Alternately junction boxes housing shall be of polycarbonate MOC and of reputed make.

G) CABINETS FOR FIELD INSTRUMENTS

A Cabinet shall be provided for enclosing instruments and associated accessories which are mounted outside the control panel such as transmitter, LPU, terminal blocks etc. at all measurement locations.

It shall be fabricated from cold rolled steel with powder coating sheet of standard gauge and shall be suitable for wall mounting or pedestal mounting as required.

The cabinet shall be properly painted from inside and outside by paint shade RAL 7032.

The cabinet shall conform to IP-65 protection and shall have built in locking facility. The cabinet shall be earthed properly. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and accessories.

❖ INSPECTION & TESTING

Inspection of offered equipment/items at manufacturers' works' shall be done by the Client/PMC/TPI as specified here in as per relevant inspection and testing standards and as per approved, quality assurance plans, technical data sheets, documents and drawings.

Inspection Criteria of Various Major Equipment/Items at Manufacturers' Works:

Major instrumentation system electrical equipment/items as specified below, shall be tested and inspected at vendor manufacturers' works as narrated, prior to dispatch to ensure compliance with the specifications, requirements and applicable codes and standards and approved quality assurance and testing plans by the Client/PMC/TPI.

➤ PLC-SCADA Panel

100% quantity of PLC-SCADA based Control panels, tests (FAT) shall be witnessed @ Manufacturers' works by the Client/PMC/TPI.

SCADA Screens, operation logic, report format and report generation, etc. shall be witnessed at site by the Client/PMC/TPI. Report format shall be finalized as per client requirement at site.

➤ **Electro-Magnetic Flow Meters**

Flow Meters \leq 500 mm dia. NB: Wet calibration tests carried out internally and test certificates shall be submitted for review and acceptance by the Client/PMC/TPI.

Flow Meters $>$ 500 mm dia. NB to \leq 900 mm Dia. NB: Wet calibration tests of **5% quantity or one number (whichever is higher)** of each class type and size shall be witnessed @ Manufacturers' works by the Client/PMC/TPI.

Flow Meters $>$ 900 mm dia. NB: Wet calibration tests of **10% quantity or one number (whichever is higher)** of each class, type and size shall be witnessed @ Manufacturers' works by the Client/PMC/TPI.

Wet calibration (3 point calibration, 3 separate point) test shall be conducted as per governing standards approved Quality Assurance Plan (QAP) by Client/PMC/TPI as applicable shall be as specified below.

All electro-magnetic flow meters shall be provided with manufacturers' calibration certificates.

Manufacturer shall test all the meters internally and shall provide their internal test records for hydrostatic test along with material test certificates, Dimensional check certificates etc. and as per approved QAP for review, record and dispatch clearance prior to dispatch of materials.

The flow calibration and testing should be as per ISO 8316 (Calibration by Volumetric Method) or ISO 4185 (Measurement of fluid flow in closed conduits - Weighing Method) and shall be calibrated for minimum 3 Point Calibration (3 Separate point). Performance Type Testing Certification (ISO 9104) is strictly not acceptable. The manufacturer shall also have a flow calibration and testing facility in India or abroad so that methodology and procedures can be verified and each meter shall be tested and wet calibrated before shipment by the manufacturer. The flow calibration and testing facility shall be duly accredited in accordance with ISO 17025 standards.

The manufacturer's flow calibration and testing facility if in India shall be preferably accredited by National Accreditation Board for Testing & Calibration Laboratories (NABL). If the manufacturer is outside India then their flow calibration and testing facility should be accredited by a reputed International authority.

Further, if manufacturer test bed in India is not accredited to NABL or for flow meters imported from outside India then,

- The flow meter shall be calibrated/witnessed for wet calibration at the facility of FCRI, Palakkad, Kerala or other FCRI facility in India.
OR ALTERNATIVELY,
- The flow meter shall be calibrated/witnessed for wet calibration at any NABL accredited laboratory / facility in India (laboratory to meet above mentioned requirements for conducting wet calibration test)
OR ALTERNATIVELY,

- For flow meters imported from outside India, contractor shall arrange to inspect/ witness for wet calibration by a reputed third party inspection agency (SGS/ Bureau Veritas/TUV) as per approved inspection plan at manufacturer works at no extra cost. The test/performance certificates and relevant supporting documents shall be submitted to Client/PMC/TPI for review and approval. The meter(s) shall be dispatched only after obtaining dispatch clearance from Client. Additionally if desired by Client a simultaneous inspection/witness for wet calibration shall be offered virtually to Client/Client representative.

**VENDOR DATA REQUIREMENT
(INSTRUMENTATION)**

Sr. No.	Description	Info. / Review	As-Built
1	Piping & Instrument Diagram	*	*
2	Instrument index	*	*
3	Vendor List for Instruments & accessories	*	
4	Sizing Calculations	*	
5	Utility requirements	*	
6	Instrument Specifications and data sheets	*	*
7	Detailed loop drawings	*	*
8	Panel front arrangement	*	*
9	Wiring diagram for panels	*	*
10	Cable Schedule	*	*
11	Instrument Installation drawings	*	*
12	Bill of Material for installation items	*	*
13	Inspection and Test procedures	*	
14	Test Certificates and certific. from statutory bodies	*	*
15	Complete catalogues with part list for all vendor supplied instruments, controls etc.	*	
16	Installation, Operation and maintenance manuals		*

NOTE :- This list indicates the minimum drawing and document list. However vendor shall also furnish any other drawing or document required to be furnished during the course of job execution.

LIST OF APPROVED VENDORS FOR INSTRUMENTATION SYSTEM

Item Description	Approved Vendors
Process Analyzers (pH, DO, Free/Residual Chlorine, Nitrate, Phosphate, ORP, Conductivity, TSS, Turbidity, MLSS, BOD/COD, Hardness, etc.)	E+H, Emerson, Hach, Yokogawa, Xylem / WTW, Krohne, Forbes Marshall (Forbes Marshall make for pH analyzer & Conductivity Analyzer; Optex, Japan make for Turbidity analyzer)
Laboratory Instrument (Portable / Handheld) - pH / Turbidity / TDS (conductivity meter), etc.	Hach, Orion, YSI, Radiometer, Denver, Hanna
Ultrasonic Type Level / Diff. Level / Open Channel Flow Transmitter/ Radar Type Level Tx.	Endress+Hauser, Siemens, Krohne, Vega, Emerson, ABB
Hydrostatic type level transmitter	ABB, E+H, Siemens, Krohne Marshall, Emerson
Electro Magnetic Flow Meter	ABB, E+H, Krohne Marshall, Yokogawa, Siemens Aarohi Embedded Systems,
Ultrasonic Flow Meter (Insertion / Clamp on type)	ABB, E+H, Krohne Marshall, Siemens
Differential Pressure / Pressure / Temperature Transmitter	ABB, Emerson, Fuji, Honeywell, Siemens, E+H Yokogawa
Pressure/Diff. Pressure Switch, DP Gauge	Dag Process Instruments, Danfoss, E+H, Indfoss, N.K. Instruments, Verma Trafog, Orion, Switzer
Pressure / Compound Pressure Gauges	Wika, General Instru. Consortium, Pricol, Manometer (I) P. Ltd., Baumer, Excel Instrument, Precision Mass, Forbes Marshall, H. Guru
Displacer / Float / Buoyancy Level Switch	ATMI, Baumer, E+H, Nivelco, P+F, Pune Techtrol, SBEM, Levcon, Nivo/Toshbro
Float & Board type Level Gauge/ Tubular type Level gauge	Nivo/Toshbro, Pune Techtrol, Revathi, SBEM , Levcon , Jayati Instrumentation, General Instrument Consortium
Programmable Logic Controller (PLC) System / HMI/SCADA Software	ABB, Rockwell (Allen Bradley), Schneider, Siemens, Honeywell, Mechatronicssystems
Panel Enclosures	BCH, Bartakke, Eldon (nVent Hoffman), Enklotek, Rittal, Pyrotech
DC Power Supplies (DIN Rail mounted)	Phoenix, Omron, Aplab, IFM, Schneider, Allen Bradley, Siemens, Intex, Microtex, Schneider, IFM, Meanwell
GSM/GPRS Modem	Maestro (Lantronix), Axitech, Netgear, D-link, Moxa, Robustel, Teltonika
Ethernet Switch	D-Link, Rockwell, Siemens, Schneider, Cisco, Phoenix Contact
Media Converter	Digisol, TP link, Microtek D-link, Moxa
Receiver Indicators (Panel Mounted)	Masibus, Nivam, Nishko, Selec , Yokogawa ,Multispan

The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, final selection will be done with the approval of Engineer in charge.