VALSAD NAGARPALIKA

Providing, Laying, Jointing, Testing of Rising mains from Abhrama Headwork to Kalyanbaug Sump and from Kalyanbaug Sump to ESR at Tithal Road including connection pipeline from Tithal Road ESR to existing network. Designing, Constructing, Testing & Commissioning of Elevated Service Reservoir (ESR). Design, Supply, Installation, Testing and Commissioning of Instrumentation & SCADA system for all the head works and House Service Connections for Valsad including all allied works complete and post completion operation & maintenance for five years

PROJECT FUNDED UNDER AMRUT SCHEME

VOLUME – III

EXTENT OF WORKS, TECHNICAL SPECIFICATIONS AND DATASHEET

Milestone Dates	
Online Downloading of Technical Bid & Price Bid	As Per Volume I
Pre – Bid Conference	As Per Volume I
Last Date of Online Submission of Technical Bid & Price Bid	As Per Volume I
Last Date for Physical Submission of Tender Fee, EMD and other Documents	As Per Volume I
Online Opening of the Technical Bid	As Per Volume I

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EXTENT OF WORK

1.0 GENERAL:

The scope of Valsad city under Gujarat Urban development Mission & AMRUT. Water Supply Scheme for this package is as given below but not limited to:

This is a single point responsibility contract. The Scope of Work under this Contract includes the **"Providing, Laying, Jointing, Testing of Rising mains from Abhrama Headwork to Kalyanbaug Sump and from Kalyanbaug Sump to ESR at Tithal Road including connection pipeline from Tithal Road ESR to existing network. Designing, Constructing, Testing & Commissioning of Elevated Service Reservoir (ESR). Design, Supply, Installation, Testing and Commissioning of Instrumentation & SCADA system for all the head works and House Service Connections for Valsad including all allied works complete and post completion operation & maintenance for five years "**

Any item of work, for erection of material / equipment which have not been specifically mentioned in the specification but are necessary for safe and trouble free operation and guaranteed performance of the entire system, plant and equipment offered shall be deemed to be included within scope of this specifications and shall be provided by the bidder without any extra price and time implication to the employer.

The successful bidder shall have to undertake site surveys, route surveys for ascertaining the terrain for planning and designing of the schemes in consultation with Engineer, as well as to conduct geotechnical investigations for designing of foundation system of various structures if required.

Civil, Mechanical, and electrical shall include design, manufacture, performance testing at manufacturer's works, painting, supply, delivery at site, storage at site, installation/ erection, testing and commissioning at site, final painting and handing over.

The scope of work shall also include obtaining necessary statutory approvals for the components as required. The statutory approvals may include but not limited to Load Sanction from GEB / Load Release from GEB / No Objection Certificates from Gujarat Electricity Board (GEB) / Railways/ Roads and Building Department/ Electrical Inspector / relevant government agencies / any other statutory authority as applicable.

In the work of construction of structures, if the following condition like ground situation, natural rainfall drain patterns, and unexpected type of strata encountered in foundation and the engineer in charge feels the necessity, the contractor should do the structural designing considering of that structure/component water uplift pressure of that structure. The decision of Engineer-in-charge shall be binding to the bidder. Bidders are advised to quote the rate keeping in view this point as no extra payment shall be given for this. In case of any ambiguity, the decision of Engineer-In-Charge shall be final and binding to the bidder.

Before starting the actual work, the contractor has to provide and fix necessary Display Boards at all works site as per design (attached Drawing), details, including writing with paints necessary details as directed by Engineer-in-charge at Contractor's own cost. No extra payment shall be made for this work. These boards shall be property of Valsad Nagarpalika after completion of works.

1.1 DETAILS OF PROPOSED SCHEME

1.2 GENERAL:

Valsad Nagar Palika is on a mission to provide adequate and qualitative water supply to its citizens. It is thus very necessary to modernize present installations with latest technology and automation so that the growth can be handled effectively. Also the present cost performance ratio of water supply needs to be improved. This also demands for high level of technology to be implemented and SCADA is very useful tool to carry out this huge task.

Valsad water supply system network is sub divided into three following zones

1. Head Works – Abrama,
2. Abrama Valiya
3. Kalyan Baug.

The source of raw water for the system is the check dam on Auranga River. Raw water is pumped from two Intake well cum pump houses to three nos. of existing Water Treatment Plants (Old 11 MLD WTP, New 11MLD WTP & Old 6.5 MLD WTP) & two nos. of proposed Water Treatment Plants (11MLD WTP & 15 MLD WTP).

It has been proposed that, once the proposed 15 MLD WTP successfully commissioned, the existing old 11MLD WTP will be demolished.

The scope of work is for only four (4) nos. of WTPs (two existing having capacity of New 11 MLD & old 6.5 MLD and two proposed WTPs which are under construction having capacity of 15 MLD & 11 MLD).

The treated Clear water from old 6.5 MLD WTP & proposed 11MLD WTP which are located at Head works – Abrama will be distributed to the Sumps & ESRs of Abrama North, Mograwadi & Abrama South.

Treated pure water from new 11MLD & old 11MLD/ 15 MLD proposed WTPS will be distributed to Sumps & ESRs of Abrama head works, Kalyan baug, Halar, Ramwadi and Madanvad.

Valsad Municipality intends to implement the Instruments, SCADA and Automation for water supply system in order to provide quality and required quantity of water to the

residents. Automation, Instrumentation and SCADA works are proposed for the following locations where monitoring, automation and remote control can be provided:

1. Head Works – Abrama (Centralized SCADA)
2. Abrama Valiya (Local SCADA & Integration with Centralized SCADA)
3. Kalyan Baug Tank (Local SCADA & Integration with Centralized SCADA)

The Above three locations are having following Pump Houses, Overhead Tanks & Underground Sumps which are listed in Table -1&2. The required monitoring information will be transferred to local & centralized SCADA system through field instruments of respective location and accordingly pumps can be controlled & operated remotely.

Sr. No	Location	Set No.	H.P	Remarks
HEAD WORKS				
1	Old Intake Well	Set No-01	100 H.P submersible type	Old Intake Well
		Set No-02	100 H.P submersible type	
2	Old Intake Well	Set No-03	100 H.P submersible type	
3	New Intake Well (6.5 Polder Raw Water Pump House)	Set No-01	75 H.P submersible type	New Intake Well
		Set No-02	75 H.P submersible type	
4	11 MLD Old Pure Water Pump house	Set No-01	75 H.P submersible type	Clear water Pump house -01
		Set No-02	75 H.P submersible type	
		Set No-03	120 H.P Horizontal type	
5	11 MLD New Pure Water Pump house	Set No-01	75 H.P submersible type	Clear water Pump house -02
		Set No-02	75 H.P submersible type	
		Set No-03	100 H.P Horizontal type	
6	6.5 MLD Polder Pure water pump house	Set No-01	75 + 75 H.P submersible type	Clear water Pump house -03

		Set No-02	60 + 60 H.P submersible type	Clear water Pump house -04
Abrama Valiya				
1	Pump Hose for Mogravadi	Set No-01	75 H.P submersible type	Clear water Pump house -05
		Set No-02	75 H.P submersible type	
2	Pump Hose for Abrama	Set No-01	60 H.P submersible type	Clear water Pump house -06
		Set No-02	60 H.P submersible type	
Kalyan Baug Tanki				
1	Pump House for Other E.S.R	Set No-01	75 H.P submersible type	Clear water Pump house -08
		Set No-02	100 H.P submersible type	
		Set No-03	75 + 75 H.P submersible type	Clear water Pump house -07
		Set No-04	100 H.P Horizontal type	Clear water Pump house -08

Table 1: Pumps & Pump House details for both Raw water & Pure water

Details of Overhead Tanks within limits of valsad municipality			
Sr. No.	**Overhead Tanks**	**Litres**	**Remark**
1	Kalyan baug Tank	12.50 Lakh	450mm Dia Rising main from U/G Sump Kalyanbaug to Kalyanbaug E.S.R.
2	Halar Tank	09 Lakh	250mm Dia Rising main from U/G Sump Kalyanbaug to Halar E.S.R.
3	Ramwadi Tank	13.62 Lakh	450mm Dia Rising main from U/G Sump Kalyanbaug to Ramwadi E.S.R.
4	Madanvad Tank	09 Lakh	250mm Dia Rising main from U/G Sump Kalyanbaug to Madanvad E.S.R.
5	Mogravadi Tank	4.50 Lakh	400mm Dia Rising main from U/G Sump to Mograwadi E.S.R.
6	Abrama Valiya (North)	1.50 Lakh	250mm Dia Rising main from U/G Sump to Abrama (North) E.S.R.

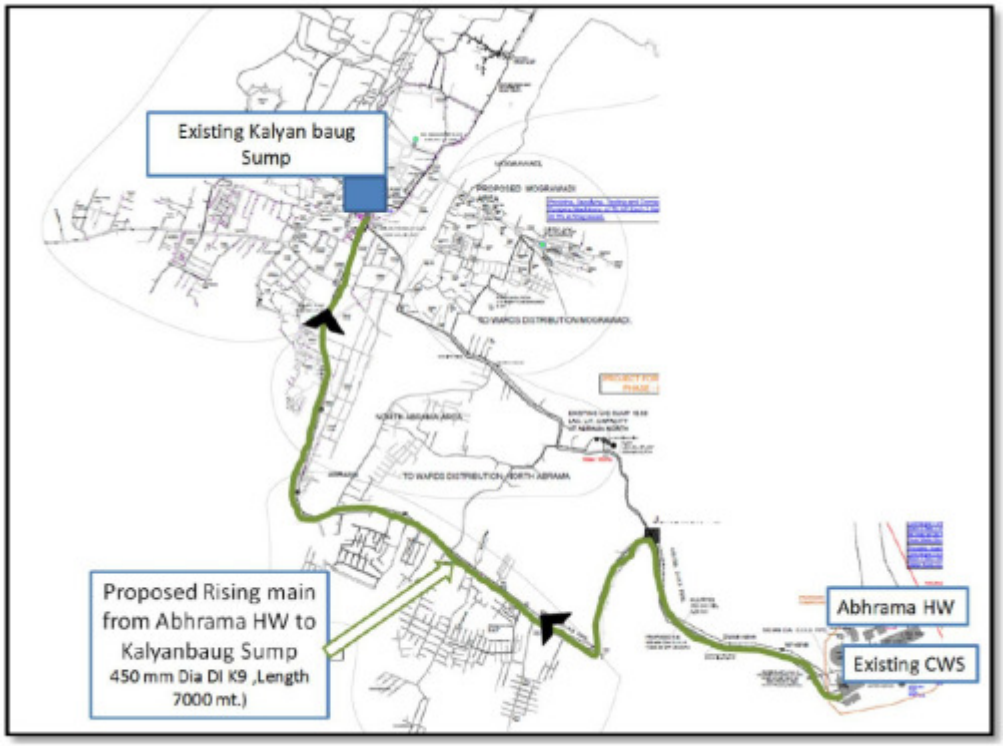
7	Abrama Head Works Tank	1.50 Lakh	450mm Dia Rising main from U/G SUMP to ABRAMA E.S.R (SOUTH)
8	Valsad Pardi	5 Lakh	250mm Dia Rising main from Kalyan Baug U/G sump to Valsad Pardi ESR
9	Tithal Road	5 Lakh	300mm Dia Rising main from Kalyan Baug U/G sump to Tithal Road ESR

Details of Underground Sump within limits of valsad municipality			
Sr. No.	**Underground Sump**	**Litres**	**Remark**
1	Kalyanbagh	20 Lakh	450mm Dia Rising main from Head works Abrama to Kalyanbagh
2	Abrama Valiya (North)	10 Lakh	Feed from 6.5 MLD WTP at Abrama Head works
3	Abrama Head Works (Old) (11MLD/ Proposed 15 MLD)	10 Lakh	Proposed 15 Lakh Litres U/G sump is under construction. After construction of the same, this sump will be demolished and all existing pumping machineries will be installed in new sump.
4	Abrama Head Works (New) (11MLD)	10 Lakh	Feed from New 11 MLD WTP at Abrama Head works
5	Abrama Head Works (Polder) (6.5MLD)	05 Lakh	Presently this sump is fed from 6.5 MLD WTP. Now this is proposed to disconnect from that line and will be internally connected with New 10 Lakh Litre sump. Water to new sump will be transmitted from proposed 11 MLD WTP
6	Proposed 10 Lakh Litre U/G sump at 5 Lakh Litre U/G sump area	10 Lakh	
7	Abrama Head Works (For South Abrama)	08 Lakh	Feed from 6.5 MLD WTP at Abrama Head works

Scope of work under this tender is mentioned below-

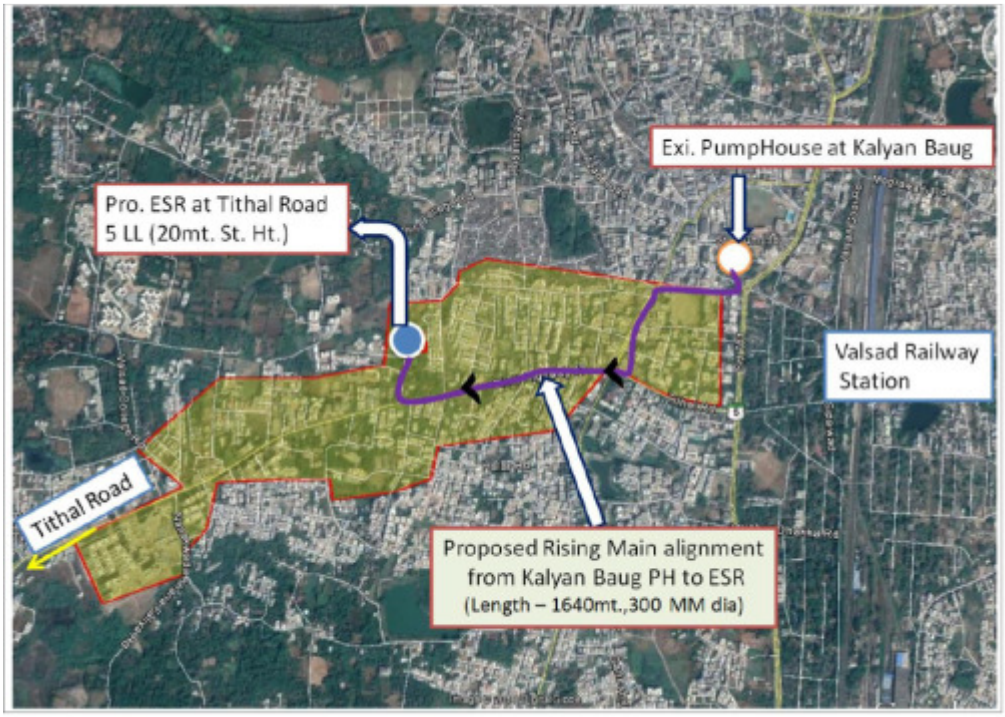
- Rising Main from Abrama HW to Kalyanbaug Sump
- Rising Main from Kalyanbaug Sump to ESR at Tithal road
- ESR (5 Lakh Liter capacity) at Tithal Road
- Pipe Line from proposed Tithal Road ESR to existing main pipeline at Tithal road (For connection of proposed ESR to Existing network)"
- House service connections (9000 nos) and Road restoration
- Instrumentation and SCADA work

- Rising Main from Abrama HW to Kalyanbaug Sump



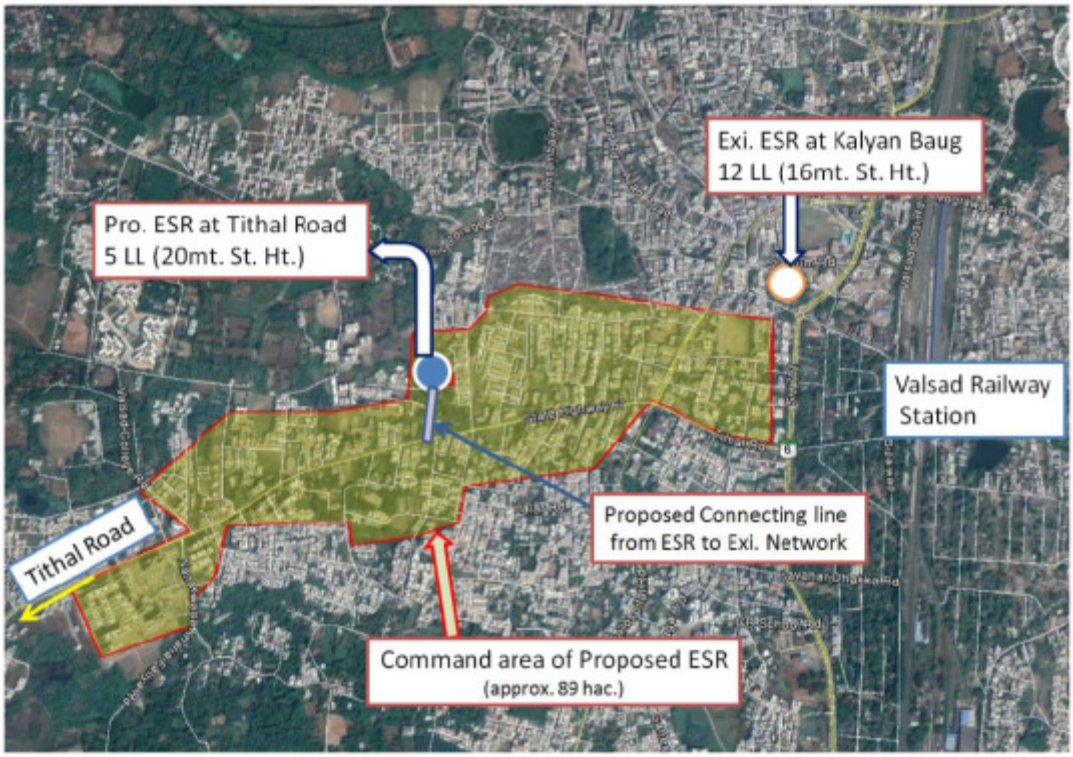
Details for Proposed Rising Main from Abhrama Headwork to Kalyan Baug Sump - For Tender reference only

- Rising Main from Kalyanbaug Sump to ESR at Tithal road



Details for Proposed Rising Main from Kalyan Baug Sump to ESR at Tithal Road - For Tender reference only

- Pipe Line from proposed Tithal Road ESR to existing main pipeline at Tithal road (For connection of proposed ESR to Existing network)"



Details for Proposed ESR at Tithal Road and Connection Pipeline from ESR to Existing Network - For Tender reference only

- **INSTRUMENTATION AND SCADA SYSTEM**

All the Pump House and WTP are presently working on Manual mode by Valsad Nagarpalika.

The main aim of instrumentation and SCADA system is to convert manual to automize system using SCADA, automation & instrumentation technology in the plant auto run, collection and analysis of data and in developing total water life cycle solution. Also, to ensure that the offered treatment process is the most appropriate in terms of both efficiency of treatment and cost.

Scope of work under instrumentation and SCADA system includes automation of intake well, all WTP and all pump house.

SPECIFICATIONS

GENERAL:

ELEVATED SERVICE RESERVOIR:

Conducting site investigations(site survey & soil investigation), designing (hydraulic, structural and aesthetic) complying provisions of relevant Indian standards, requirements of Tender technical specifications, obtaining approvals of designs and constructing RCC Elevated service Reservoir of the following capacity and height , using data of geotechnical investigation and site condition of proposed site , Seismic zone 3, Wind speed Zone. Including necessary accessories and piping, including necessary hydraulic testing, structural testing; material testing etc.; complete as directed by Engineer-in-charge (turn-key job). Including (1) Container shape any suitable type (or as specified), (2) Staging consisting of column brace trestle/shaft/combination column brace trestle and shaft as appropriate (or as specified) and (3) Appropriate foundation system. This includes excavation in all types of soil strata (including hard rock), casting100 mm thick P.C.C. levelling course in M-15 , Refilling the pit with proper soil and disposing of the surplus stuff within all lead and lift. (4) This will also include cement plaster in CM 1:3 with approved water proofing compound to inside face of container. (5) All types of labour & material charges of lowering , laying, erecting / hoisting & joining of pipe assembly of Inlet, Outlet overflow, washout and bye pass arrangement as per hydraulic design are including. (6) Providing and fixing accessories(specified) like MS / GI Ladder CI Manhole frame and covers, water level indicator , lightening conductor, GI Pipe railing around walk way, at roof level, at gallery and around landing of inside shaft, Adequate cowl type ventilators with stainless steel jali. (7) Scope of work includes constructing RCC spiral staircase with adequate tie beams, staircase footing, and B.B. Masonry chambers for valves. Ventilating shaft and ventilators as well as door in shaft. (8) Including providing and applying three coats of cement paint/snowcem (as specified) to the whole structure. (9) It also includes satisfactory water tightness test as per relevant I.S. Code and painting name of scheme & capacity on the tank as per direction of engineer in charge. (Seismic Zone -3)

Providing and fixing accessories like MS / GI Ladder, CI Manhole frame and cover, water level indicator, adequate cowl type ventilators or lantern type ventilator with stainless steel jail.

B.B. Masonry chambers for valves. Providing and applying three coats of cement paint / snowcem to the outside face of structure. It also includes satisfactory water tightness test as per relevant I.S. code and painting name of scheme and capacity on the tank as per direction of engineer in charge.

List of Indian Standards for Design of ESR:-

The structural design of ESR shall be in accordance with provisions relevant I.S.

(1) I.S. 3370, Part – 1 to 4, 2009/1965 or latest revised.

(2) I.S. 456 – 2000 or latest revised.

(3) I.S. 1893 – 2000 /1984 or latest revised.

(4) I.S. 875, Part – 1 to 3, 1987 or latest revised.

General Specifications:-

The minimum concrete grade for RCC shall be M-30.

TMT Fe 415 / 500 grade reinforcing bars confirming to I.S. 1786 / 1139 shall be considered in design. TMT bars shall be provided. Any other steel can be used with approval of C.E. in situation of non availability in market without extra cost.

Minimum size (or thickness) of various components shall be provided as per I.S. Standard. Practice of G.W.S.S.B. Minimum dimensions specified for various components in tender data / specifications shall be provided without fail.

The safe bearing capacity (SBC) shall be referred from SBC test report which has to be carried out by contractor. If poor soil is found / water table is met with during excavation SBC shall be scientifically ascertained and design shall be revising. No extra shall be paid for increase in quantity.

CI pipes and special shall only be used if type is not specified in tender.

The ESR shall be covered with RCC roof slab. All materials shall be anti-corrosive. The water contact surface including the freeboard area, the ceiling, walls of the ESRs and all steel components shall be provided with anti corrosive protection and protection from chlorine effects. Access to ESR roof shall also be provided.

Criteria for preparation of designs:

Capacity of the tank shall be the volume of the water it can store between the designed full supply level (F.S.L) and lowest supply level (L.S.L) i.e. the level of the lip of the outlet pipe. Due allowance shall be made for 20 mm thick W.P plastering the tank from inside, while calculating the capacity of the tank.

Freeboard is the vertical distance between F.S.L. and Sofit of covering slab or dome or beam supporting the cover. In any case the free board shall not be less than 300 mm from bottom of beam.

Dead storage shall be the storage capacity of water below L.S.L. depth of dead storage shall be the vertical distance between the top outlet level and wash out level. The washout pipe level shall be at the lowest portion of the container.

Minimum depth of water for dead storage shall be 150 mm even for flat bottom slab and not more than 500 mm for inlet at bottom for dome slab type tank.

Water depth in the tank shall be the vertical distance between L.S.L. and F.S.L. of tank.

Bearing capacity shall be determined by carrying out actual soil exploration and tests due to conditions as mentioned in para 2.0 of IS 1992-1969. The same shall be carried out by a Government laboratory or any other approved laboratory and allowable bearing capacity so arrived shall be taken as the basis of design. The factor of safety adopted in case of actual test shall be as per clause 6.1 (A) of IS 6403-1971.

IS: 1893 (Part-I and Part-II):2002, IS 875 Part-III 2002, IS 13920 and IS 4326 shall be followed.

The contractor shall submit a note on design methodology and construction as prepared by design engineer after the award of contract. The note should indicate general description and salient features of the design covering following points.

i) Capacity

ii) Shape & type.

iii) S.B.C. adopted in the design i.e. S.B.C. of strata based on actual test report and type of foundation proposed with proper justification.

iv) Site plan showing location.

v) Line diagram showing dimensional and sectional elevation with important levels.

vi) Plan showing piping arrangement.

vii) Design parameters proposed to be adopted for detailed design.

Design Requirements:

Foundation for ESR

The foundation shall be designed for actual S.B.C. of strata confirmed by plate load bearing test. Minimum depth of foundation shall satisfy the following criteria.

a) Depth in soft rock shall not be less than 1.0 m or depth in hard rock shall not be less than 0.5 m.

b) The total depth in all strata put together shall not be less than 2.0 m for individual footing.

c) In black cotton soil raft shall be provided at minimum depth of 3 m. No pile foundation shall be allowed

The free board shall be 300 mm below soffit of roof beam and shall be included in the depth of water for design purpose.

Maximum actual water depth excluding free board shall not exceed 6.0 m.

Minimum dimension of member shall be as below:

b. Container wall 200 mm

Bottom slab 200 mm

Roof slab 125 mm

If dome is provided at the top the thickness shall not be less than 100 mm.

The design shall be for seismic zone as per Indian standard.

The width of braces shall be of the following in case of seismic zone & above.

Width to depth ratio in case of braces shall preferably be more than 0.3.

Uplift pressure on the foundation of structure should be considered as per available water table at site in rainy season. However minimum uplift up to 50 % of depth of foundation below ground level should be considered in the design.

Minimum dia of main bars in the footing shall be 12 mm and minimum clear distance between reinforcing bars shall not be more than 180 mm.

Water density shall be taken as 9.81kN/m3.

Age factor for increase in strength shall not be considered for design.

The foundation shall be checked for negative pressure on soil due to combined direct & bending stresses. Negative pressure shall not be allowed on the foundation soil.

The depth of footing on the face of column shall not be less than 1/3rd of the spread of footing from the face.

Corrosion resistant steel TMT Fe – 415/500 (Make: SAIL, TATA TISCON, RINL (VIZAG) shall be used.

Minimum steel: Design requirements as set out in relevant codes in respect of steel shall be fully satisfied. However following minimum steel should be provided.

a. Vertical steel in columns	:	i) The cross sectional area of longitudinal reinforcement, shall not be less than 0.8 percent nor more than 6 percent of the gross cross sectional area of the column. NOTE: The use of 6 percent reinforcement may involve practical difficulties in placing and compacting the concrete, hence lower percentage is recommended. Where bars from the columns below have to be lapped with those in the column under consideration, the percentage of steel shall usually not exceed 4 percent. ii) In any column that has a larger cross-sectional area than that required to support the load, the minimum percentage of steel shall be based upon the area of concrete required to resist the direct stress and not upon the actual area.
b. Horizontal links in columns	:	Not less than 8 mm dia at 200 mm center to center or 10 mm dia not more than 300 mm center to center.
c. Exposed R.C.C. surface	:	On both faces when thickness is 150 mm or more 2 kg/ sqm in one direction. -2 kg / sqm in perpendicular direction. The above requirement is satisfied if 8 mm bars @

200 mm center to center or 10 mm bars @ 300 mm center to center are provided.

Even if design steel is less than above, the above minimum shall be provided.

d. Water Retaining Members : The minimum reinforcement in walls, floors, roofs in each of two directions at right angles shall have an area of 0.35% of the concrete section in that direction for sections upto 100 mm thick. For section of thickness greater than 100 mm and less than 450 mm the minimum reinforcement in each of the two directions shall be linearly reduced from 0.35 % for 100 mm thick sections to 0.2 % for 450 mm thick section. For section of thickness greater than 450 mm minimum reinforcement in each direction shall be kept at 0.2 %. In concrete sections of thickness 225 mm or more, two layers of reinforcing steel shall be placed one over each face of the section to make up the minimum reinforcement specified in this clause.

Minimum cover to reinforcement shall be as per I. S. 456 – 2000 and I. S. 3370 (Latest version).

Clear cover shall be provided as below:

a) Footing/ raft : 60 mm at bottom, sides and at top

b) Columns : 40 mm

c) beams, slabs, vertical wall, gallery landings. : 40 mm

Maximum spacing of Reinforcement: Maximum spacing of main reinforcement in slab or walls shall not be more than 150 mm center to center. The spacing of secondary bars, such as distribution steel or vertical bars in columns shall not be more than 300 mm.

Design shall be based on accepted bases and well known methods of design as well as the provision of I. S. S. (Latest edition). However methods based on experimental investigation on models as mentioned in para 18.2 3 in I. S. 456 – 2000 shall not be allowed. Similarly the methods / practice of design having no documented evidence shall not be entertained. Only well defined & well known methods of design shall be followed.

Construction requirement:

The Min. concrete grade for RCC shall be M30. Proportion of concrete ingredients shall be as per Mix design using weigh batching .

The BB Masonry cabin with MS door shall be constructed when spiral staircase is outside the staging. Water level indictor shall be provided and fixed float type

/electronic (as specified)CI pipes & specials shall only be used, Effective curing shall be carried out as per specifications

Auxiliary Items of Work:

1. R.C.C. staircase of 1.0 m clear width with R.C.C. parapet in M30 concrete shall be provided from G.L. to bottom slab walkway. Necessary tie beams connecting external columns of ESR & staircase at every brace level shall be provided. M. S. ladder shall be provided from bottom slab walkway to roof slab level for access.

   R.C.C. cantilever catwalk (Gallery) of 1.0 m clear width with three rows of 25 mm Φ G. I. pipe railing shall be provided at bottom floor level. The railing shall be in 400 mm side wall edge of gallery, R.C.C posts of 150 mm diameter constructed at 2.0 m center to center along the side wall at outer edge of gallery and 1.0 m high. At top slab also similar G. I. pipe railing on 100 mm diameter R.C.C. post & at 2 m spacing shall be provided. For any structure for more than 2.0 m height above ground level hand railing is required.

2. Six numbers C. I. Ventilators of 150 mm dia in addition to central ventilating shaft shall be provided on top slab of ESR as directed by Engineer.

3. One No. of C.I. Medium class Manhole frame & covers (wt. 53 Kg.) with locking arrangement shall be provided and fixed in the roof slab of ESR as directed by Engineer.

4. Electronic water level indicator assembly of approved type and make shall be provided & installed as directed by Engineer.

5. Vertical & Horizontal piping of DI. double flanged pipes & D.I. Double Flanged Specials of required sizes for inlet, outlet, overflow, bye pass & washout arrangement together with suitable DI. double flanged sluice valves shall be provided as per approved drawings. For washout one tee shall be fixed on the outlet pipe with one sluice valve of suitable diameter. Sluice valves confirming to IS 14846 – 2000 of Kirloskar, IVC, IVI make only shall be provided.

6. Required number of B. B. masonry chambers of suitable size, with C. I. manhole frame & cover shall be provided and constructed at suitable locations for sluice valves and drainage line as directed by Engineer.

7. Inside and Outside surface of tank, exposed faces of columns, braces, beams, bottom portion of gallery & bottom slab and all exposed surfaces of slab be provided with smooth finish and then three coats (one primary coat of white cement and two coats of snowcem) of approved shade of snowcem paint as per colour scheme approved by the Engineer shall be rendered.

8. Internal surface of container including top slab bottom shall be provided with two coats of epoxy paint (food grade) as directed by Engineer.

9. Letter indicating capacity of tank, name of scheme, year of construction shall be embossed or engraved on vertical wall of container & shall be painted with suitable shade of oil paint in two coats as directed by Engineer.

10. On completion of work hydraulic test or water tightness test shall be done as per standard specification till satisfaction of the Engineer. Water required for testing & construction shall be made available by the contractor at his cost. If during testing

any damage or leakage or sweating occurs to the structure it will be the responsibility of the contractor to rectify the same.

11. Drainage arrangement consisting of RCC NP 3 pipes to carry away the wash water and overflowed water shall be provided upto nearby Nalla or surface drain. The length of drainage pipe shall be upto 100.0 meters only.

12. Plinth protection of min width 1.2 m and thickness of 0.1 m in PCC M 15 shall be provided all around the structure as directed by Engineer.

Requirement of Auxiliary items of works:

1. R. C. C. Stair Case

R. C. C. stair case of 1.0 meter clear width shall be provided form G.L. to bottom slab gallery level. Structural details shall be as per approved design and drawing. The tread and rise of the steps shall be 300 mm and 200 mm respectively. A sturdy C. I. gate of 2.5 m height with locking arrangement shall be provided at the start of the stair case. The construction of stair case should progress as along the main reservoir structure & it should not lag behind in any way. The Engineer should be able to inspect & check the reinforcement at each brace level using this stair case only.

2. Aluminium Ladder

Aluminium ladder 450 mm wide shall be made up of aluminum rectangular section of 65 x 35 mm (3 mm thick) and 25 mm bars as approved by Engineer. Welded as 300 mm center to center. The ladder shall be provided in two flights i.e. first flight from Bottom slab to intermediate landing and second flight from intermediate landing to Top slab level. The landing shall be casted homogeneously with the container wall and shall be 1.0 m x 1.0 m size. It should have G. I. pipe railing. Aluminium ladder shall be provided inside the container of the ESR.

3. M. S. Ladder

The M.S. ladder shall be provided & fixed to give access to the top slab from bottom slab gallery. The ladder shall be comprising of 65 mm x 65 mm x 6 mm. M. S. angles placed at 450 mm apart with 16 mm M. S. bars in double rows as steps at 200 mm center to center distance. The ladder shall be properly fixed at site as directed and bottom & top shall be properly embedded in 1:2:4 C.C. block. In order to have stiffness to the ladder cross supports or stiffeners at suitable intervals as directed shall be provided of suitable M.S. flats duly embedded in walls and welded to the ladder. The M. S. ladder & supports shall be provided with three coats of anticorrosive paint as directed.

4. G. I. Pipe Railing

Hand railing around the walkway (Balcony), stairs and landing shall be fixed on a side requiring safety. Railing to consist of 25 mm diameter Class B GI pipes in three rows (one at the top and other at equal interval above finished floor level) and 1000 mm high fixed in 150 mm dia R.C.C. vertical post at a maximum distance of 2000 mm centers with all accessories like elbows, tees etc. including welding, threading and fixing in cement concrete floor. Railing shall be painted in three coats of approved oil

paint to protect it against corrosion as directed by Engineer. For any structure for more than 2.0 m height above ground level hand railing is required.

5. Stainless Steel Grating

20 mm Dia stainless steel bars welded grating with 100 mm c/c spacing, fixed firmly in the over the outlet pipe and drain pipe.

6. Electronic Water Level Indicator

The electronic water level indicators are used for direct measurement of liquid level in tanks. The specifications of electronic water level indicator shall be under:

1. Electrical

Power supply: Operating voltage 230 V AC nominal + 10 %, 50 Hz.

Indication: 16 x 2 alphanumeric LCD

Low level and high level audio alarm (adjustable).

2. Mechanical

Mounting: Wall type.

Size: 255 mm (W) x 182 mm (H).

Enclosure: IP 65 (Splash proof) UV protected virgin plastic cabinet.

The display unit shall be housed in splash proof cabinet to with stand the harsh environment generally encountered in practice. Clear LCD display shall be easily readable from a wide viewing angle.

The sensors shall be of sufficient length and resolutions so that the unit can be used anywhere in premises irrespective of the size & shape of the tank.

Electronic Water level indicator of approved make with constant display placed in office room shall be provided as directed by Engineer.

7. Ventilators

A R.C.C. ventilator as shown in the drawing fixed with 24 gauge square mesh of 14 gauge SS wire around the circumference shall be provided at top slab. In addition to this 6 Nos. of C. I. ventilators (J type) of 150 mm dia. shall be provided & fixed in roof slab as directed by Engineer.

8. Plinth Protection

Plinth protection all around the structure shall be provided as directed by Engineer. The width of plinth protection shall be min of 1.2 m and 0.1 m thickness and shall have slope towards the edge so that the water is drained out and do not enter the foundation. The plinth protection shall be in M 15 (1:2:4) PCC . The overburden or top soil from a depth of 0.3 m shall be removed by excavation & it shall be filled with murrum & boulder in layers. This filling shall be watered and well rammed as directed by Engineer. On this PCC, M 15 grade shall be provided and finished smoothly.

All the piping's like inlet, outlet, washout and over flow and respective fittings like duck foot bend, bell mouth, crippling flange will be as per approved drawings. The material of all the piping's shall be CI as per approved drawings.

A. DATA SHEET FOR ESR

SR NO	PARTICULARS	PARAMETERS / REQUIREMENT
1	**GENERAL**	
1.1	Item	Elevated Service Reservoir
1.2	Type	Circular or rectangular As per Tender Document
1.3	Capacity	5 Lakh litre at Tithal Road
1.4	Staging Height	20m
1.5	Location	Tithal Road
2	**DESIGN DATA**	
2.1	Control Levels	
	a) Avg. Ground Level	As per network diagram
	b) Bottom Tank	As per network diagram
	c) F.S.L	As per network diagram
	d) Min. Water Level	As per design
	e) Free Board	0.30 M min from beam bottom or lowest point of dome for dome type roof.
2.2	SBC At site	Contractor has to carry out SBC for design purpose. SBC report to be furnished during detailed engineering.
2.3	Water table	Contractor to carry out investigation for design purpose during monsoon season, retrieve data of last five years from EE and as per actual site condition during execution and the maximum depth of water table should be consider for design purpose.

2.4	Seismic Zone	Seismic Zone-III
2.5	Water Density	9.81 kN/cum
3.0	**DESIGN REQUIREMENT**	
3.1	Standard Code	IS 3370 Part I to IV 1995 or latest revised IS 456-200 or latest revised IS 1893-2002 part-1 to 5 or latest revised IS 875 Part i to iii or latest revised IS 10262-2009 or latest revised IS 13920-1993 or latest revised
3.3	Grade of Concrete	M-30 (min.)
3.4	Grade of Steel	TMT Fe-415/500 steel to be used for non water retaining structure and CRS Fe 415 /500 for Water retaining structure.
3.5	Water Density	9.81 kN/Cum
3.6	Min. Reinforcement for all members	As per latest IS code and General Technical specification
3.7	Foundation	The foundation shall be designed for actual S.B.C. of strata confirmed by soil testing during detailed engineering. The total depth shall not be less than 1.5 m for individual footing. Minimum thickness of 100 mm to be considered for leveling concrete with M15 grade.
3.8	Vertical wall	As per General Technical specification
3.9	Bottom Slab	As per General Technical specification
3.10	Top Slab	As per General Technical specification

3.11	Clear cover	Foundation – 60 mm Column braces , Beams ,Slabs - 40 mm Other element as per latest IS code
3.12	Type of Pipe CI vertically cast double flanged / spun pipe	The Dimension of Inlet , Out let , Overflow & Wash out Pipe are separately & As per design
3.13	Size Of Butter fly valves IS 13095 & Sluice Valve as per IS 14846	As per BOQ
3.14	Size of Valve Chamber	As per BOQ

DI PIPES - ISI MARKED ONLY

Providing and supplying D. I. K-9/K-7 grade pipes with internal cement mortar lining including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. as directed by Engineer-in-charge

Applicable Codes:

The manufacturing testing, supplying, at work sites of Ductile Iron pipes shall comply with all currently applicable statutes, regulations, standards and codes.

In particular, the following standards, specified herein shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of specifications conflict with the requirements of the codes and standards, this specification shall govern.

IS: 8329	Specification for Centrifugally Cast (spun) Ductile Iron pressure pipes for water, gas and sewage specification.
IS: 1387	General requirements for supply of metallurgical materials.
IS: 1500	Methods for Brinell hardness test for metallic materials.
IS: 9523	Ductile Iron fittings for pressure pipes for water, gas and sewage.
IS: 12820	Dimensional requirements. of rubber gaskets for mechanical Joints and push on joints for use with cast Iron pipes and fittings for carrying water, gas and sewage.
ISO: 4179	Ductile iron pipes for pressure and no pressure-Centrifugal cement mortar lining - General requirements.
ISO: 2531	Ductile iron pipes, fitting and accessories for pressure pipe lines.
IS: 12288	Code of practice for use & laying of Ductile iron pipes.

1.1 MANUFACTURING

1.1.1 General

1. The pipes shall be of centrifugally cast (spun) Ductile Iron pipes K-9/K-7 class with internal cement motor lining confirming to IS 8329: 2000. The pipes shall be of push on joint type (Rubber Gasket Joints). The flange connection shall be used only in case of fitting of specials or under special circumstances as directed by Engineer in Charge.

2. The pipes shall be coated with zinc coating and finishing layer shall be of bitumen and have factory provided internal cement mortar lining as per the provisions of IS 8329: 2000 the mortar thickness shall be minimum 5 mm as per Table 15 of the code. The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS 8329/IS 9523.

3. The pipes shall be supplied in standard length of 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety shall also be supplied with a rubber EPDM/ (SBR) gasket. The flanged joints shall confirm to Clause 6.2 of IS: 8329.The pipe supply shall include one rubber gaskets for each flange. Any change in the stipulated lengths will be approved by the Engineer- in -Charge. The gaskets shall conform to IS 5382:1985. The gaskets shall also be supplied by the contractor. They shall preferably be manufactured by the manufacturer of the pipes. In case they are not, it shall be the responsibility of the contractor to have them manufactured from a suitable manufacturer under his own supervision and have it tested at his / sub contractors premises as per the instruction and to the satisfaction of the Engineer- in -Charge. The pipe contractor shall however be responsible for the compatibility and quality of the products. The flanged joints shall conform to Clause 6.2 of IS 8329

4. VALSAD NAGARPALIKA representative shall at all reasonable times have free access to the place where the pipes are manufactured for the purpose of examining and testing the pipes and for witnessing the test and manufacturing.

5. All tests specified either in this specification or in the relevant Indian Standards shall be performed by the supplier/contractor at his own cost and in presence of employer's representative if desired. For this, sufficient notice before testing of the pipes shall be given to employer.

6. If the test is found unsatisfactory, employer may reject any or all pipes of that lot. The decision of NAGARPALIKA Representative in this matter shall be final and binding of the contractor and not subject to any arbitration or appeal.

1.1.2 Inspection and Testing of pipes during manufacture

Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329 / IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS: 8329. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/IS: 9523.

Brinell Hardness Test

For checking the Brinell hardness, the pipes used for the ring test and tensile test shall comply with the requirements specified in IS: 1500/IS: 8329.

Retests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in IS: 8329 / IS: 9523 for a period of minimum 15 seconds, during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

The pipes shall be subjected to following tests for acceptance:

Visual and dimensional check as per Clause 13 and 15 of IS 8329

Mechanical Test as per Clause 10 of IS 8329

Hydrostatic Test as per Clause 11 of IS 8329

The test report for the rubber gaskets shall be as per acceptance tests of IS 5832 and will be in accordance to Clause 3.8. The sampling shall be as per the provisions of the IS 8329.

Markings

All pipes will be marked as per Clause 18 of IS 8329 along with the requisite information as provided below:

- Manufacturer name / stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end
- Employers mark as “GUDM"

Coatings

Pipe shall be supplied internally (cement mortar lining) and externally with Zinc coating along with a finishing layer of bituminous coating as per IS 8329:2000. The materials and finishing shall be as per the relevant specifications.

1.2 JOINTS

1.2.1 General

Jointing of DI pipes and fittings shall be done as per IS 12288 and manufacturer’s recommendations. Rubber sealing rings/gaskets used for jointing shall conform to IS 638, IS 12820 and IS 5382.

1.2.2 Spigot and Socket joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS 12820. The gaskets/sealant used for joints shall be suitable for water conveyance. The material of rubber gaskets for use

with mechanical joints and push-on-joints shall conform to IS: 5382.

1.2.3 Flanged Joints

These shall be of 10 bar rating and shall comply with dimensions and drilling details as specified in IS 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. The bolts shall be of mild steel unless otherwise specified. They shall be coated with cal tar epoxy coating after tightening.

1.2.4 Slip on Type Couplings

Slip-on type couplings shall include the following couplings:

Straight flexible couplings

Stepped flexible couplings

Slip-on type couplings shall be procured from approved suppliers whose fittings meet the same Specification. The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Slip-on type couplings shall be protected if buried with Densomastic and Densotape wrapping or similar approved material applied in accordance with the manufacturer's recommendations. Flexible joints shall be harnessed or tied where shown on the Drawings. Flexible couplings shall be supplied with transit protection.

1.3 THRUST BLOCKS

Anchorage in the form of a thrust block at each deflection in the horizontal and/or in vertical alignment of the pipeline shall be provided as per the design requirements to resist any unbalanced pressure at the bends. Gravity type thrust blocks shall be provided at horizontal and vertical deflections in the pipeline, which shall be designed according to the test pressure and the soil conditions at the site of the thrust block. Before designing the thrust blocks the Contractor shall assess the stability of the soil considering erosion due to wind and water. The general guidelines to be followed for providing and designing of thrust blocks shall be as under:

The thrust blocks may not be required for bend angles up to 5%. However, necessary calculations shall be submitted by the Contractor for approval by Employer to establish that the thrust shall be taken care by pipe itself and that it is safe not to have the thrust block.

The thrust shall be designed according to the field test pressure of the pipe.

For above ground pipelines, thrust blocks shall be designed to take 100% thrust.

For buried pipelines, thrust blocks on continuous pipe line sections shall be designed considering 50% thrust to be taken by block and balance by pipe as per CPHEEO manual.

For buried pipelines, thrust blocks near valve chambers and/or any other dismantling joints shall be designed to take 100% thrust.

In rock the passive pressure of rock shall be considered for thrust block design

The thrust blocks shall be of concrete M20, cast in-situ, with minimum surface reinforcement of 5 kg/m2. No formwork is required to be used for construction of thrust blocks in buried conditions, unless desired by the Contractor. The calculations for the dimensioning and the shape of the thrust blocks shall be approved by the Employer.

Anchor blocks shall also be located wherever there is a transition between above ground and buried pipelines. All such anchor blocks shall have flexible joints at either end to allow for small amounts of settlement to occur.

The Contractor shall construct the thrust blocks as early in the program of work as is practical, and at least six months prior to installation of the above ground pipeline in order to reduce the risk of settlement imposing additional loads on the pipeline supports. All thrust blocks are to be completed on each section before the sectional hydraulic testing is conducted.

Where possible, the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlying the rock shall be excavated and replaced with class M15 mass concrete. In the event of no rock being encountered, the base of the thrust block shall be cast against undisturbed ground. Any ground, which in the Employer opinion is unsuitable, shall be excavated and replaced with class M15 mass concrete.

1.4 VALVE CHAMBER

Valve chambers shall be constructed according to approved drawings suitable for the respective valve. They shall be constructed as described in BOQ. The chambers shall be constructed after the laying of the pipes and the assembly of specials and valves. The size of the chambers shall be according to the following criteria/ as per direction of Employer.

Minimum distance of flanges from walls	:	30 cm
Minimum distance of sockets from walls	:	30 cm
Minimum distance between highest point of equipment and roof slab	:	30 cm

Pipes passing through walls should be coated by two layer of soft material (hessian felt) to allow for differential settling and longitudinal expansion if directed by Employer. Only metallic pipes may be cast into the walls for anchoring purposes.

1.5 LUBRICANT FOR PIPES AND SPECIALS

Lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-on rubber ring joints shall confirm to IS 9523.

1.6 DI PIPE HANDLING, LAYING, JOINTING, TESTING AND COMMISSIONING

- Laying of DI pipes shall conform to IS: 12288. All pipes, fittings and material shall be tested and approved by the Engineer- in -Charge before being laid. Polyethylene sleeves wound pipes shall be used for water logged areas as directed by the Engineer- in -Charge.

- The transportation and handling of pipes shall be made as per IS 12288.
- Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used. When using crane hooks at sockets and spigot ends; hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying according to the instructions of the pipe manufacturer. the trench must not be refilled before laying of the pipes
- All specials like bends, tees etc. and appurtenances like sluice or butterfly valves etc. shall be laid in synchronization with the pipes. No pipe shall be laid in wet trench conditions. On gradients of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe laid does not move into or out of the socket of the laid pipe during the jointing operations. The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.
- Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which affect the design and laying of pipeline. The assembly of the pipes shall be made as recommended by the pipe manufacturer using suitable tools.
- Where a pipe line crosses State highway, National highway, canals, railways etc., pipe shall be laid after taking approval of the competent authority. All the expenses in this regard shall be taken care by contractor.

1.7 PIPE TESTING AND COMMISSIONING

- The pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). Contractor shall test stretches not exceeding 1 km. After successful organization and execution of tests the length may be extended to more than 2 km after approval of the Engineer- in -Charge.
- The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. Complete setting of the thrust blocks. Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches. The testing conditions for the pipelines shall be as per the test pressures and condition laid out in IS 8329 for DI pipes.

The testing conditions for the pipelines are summarized as follows:

- Maximum hydrostatic test pressure for K9 pipes shall be 2.0 times of maximum design pressure in the pipeline.
- Pre test and saturation period with addition of make-up water
- Pressure: Test pressure

- Duration: 3 hrs for DI pipes without cement mortar lining / 24 hrs for DI pipes with cement mortar lining
- Pressure test with addition of make-up water
- Pressure: Test pressure
- Duration: 3 hrs
- Test criteria for DI pipes: Q=1 litre / km per 10mm of pipe per 30 m test pressure per 24 hrs.
- All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount 'Q', calculated by the above formula. All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test have been obtained.

- **CROSSING: GENERAL SPECIFICATIONS**

At public highways, or at such other crossings as are shown in the construction drawings issued by the company the pipeline shall be installed in MS casing pipe conforming to the specifications given herein.

(a) The casing pipes shall be installed in accordance with the details given in drawing and the casing, bushing and insulators, etc., shall be installed on the carrier pipe as detailed in drawings. Casing pipe size shall be as per approved drawing of sanctioning authority, Casing shall be installed with even bearing throughout its length and shall slope towards one end, as specified or desired by the engineer-in-charge. The ends of the casing shall be sealed to outside of carrier pipe in accordance with the details given in drawing.

(b) Before installation, holes for installing vent pipes shall be cut and burrs if any shall be removed. The welding of both carrier pipe and casing pipe shall be done in accordance with the welding specifications, given herein. Before installing the casing pipe, it should be cleaned of all internal obstructions and during installation care should be taken to keep the inside clean.

(c) The section of carrier pipe to be placed in any casing shall be closed at each end, hydrostatically tested preferably with dead weight tester for at least two hours. Only on successful completion of this test, shall the carried pipe section be inserted in the casing pipe. The installation of casing may open cut as circumstances may permit or require as directed by the engineer-in-charge.

(d) The installation of casing in bended section of the carrier pipe shall be performed by meter bends of the casing pipe provided that the length of each meter cut out of casing pipe shall be such as to provide a clearance of at least 1-1/2" between the inside of the casing pipe and the outside of the coated carrier pipe.

(e) Excavation for casing installation shall be immediately backfilled at the completion of the work with suitable solid matter and packed thoroughly to prevent seepage of water into the excavation.

- **ROAD AND IRRIGATION CANAL CROSSINGS :**

(a) At road and canal crossings the work shall be performed to the specifications of local authorities or such public bodies as may be in charge (S) of roads and canals to be crossed.

(b) In case, however the minimum requirements of the governing agencies are less than those set out in the drawing or the specifications given herein, then the requirements given in the drawings and the specifications given for encased line shall be followed.

(c) Whereas the casing pipe in the case of encased line to be laid normal by boring, tunneling, engineer-in-charge may at his discretion permit open-cuts to be made for the installation of casing provided, however, that the TENDERER shall procure the necessary permit / license for the same from competent authority. At locations wherein the open cut methods are permitted, the TENDERER shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in-charge in writing , if Open Cut method is not permitted by authority, pipe is to be laid through Push Through Method. and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The TENDERER shall produce a certificate in writing from concerned authorities for its satisfactory restoration and payment therefore.

(d) At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without cutting the casing. The carried pipe shall extend at least 2 meters beyond the end of casing pipe at either end.

(e) At road crossings the TENDERER shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer-in-charge. Where the installation of the casing has been made by open cut TENDERER shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.

(f) At all railways pipeline crossings shall be bored with horizontal boring machine.

(g) The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the COMPANY and TENDERER for each category of work prior to commencement of actual work.

(h) Pipeline under Road Track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier pipes, testing, lowering in, installation of vent assembles, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in addition to the specifications given herein.

The TENDERER shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The item shall be procured by the TENDERER himself as per the provisions under the appropriate head of work in case TENDERER so desires. The representative of the COMPANY may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the particular work defined under the proper head shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.

On both ends of pushing concrete supports are to be provided as per direction of engineer-in-charge.

5.1 Transporting of Pipes

All pipes manufactured in the factory and temporarily stacked in the Contractor's yard shall be transported to the site of laying after cleaning them internally etc. The item of transport covers the cost of loading in the factory, transporting to the site of laying or to stacking yard selected by the Engineer in its vicinity and unloading and stacking them carefully in such a manner that the material so kept is not easily disturbed or rolled away from the place of stacking. The loading in the factory shall be carried out by means of either a crane, gantry or shear legs, so as not to cause any damage to the finished material. Similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The contrivances to be used for unloading will be different in different situations and in each case the one approved by the Engineer shall be adopted. The material stacked at site shall be jointly inspected by the Engineer and the Contractor and defect or damage noticed shall be repaired to the satisfaction of the Engineer before payment is admitted.

The stacking ground, both in the Contractor's yard and at the site of laying shall be selected in such a way as not to get waterlogged during monsoon. If this cannot be done, the pipes shall be supported on sleepers to avoid contact with wet earth.

As explained in earlier paragraphs, materials such as pipes, tapers, etc. may be transported to the site of laying as soon as the material is finished in all respects with the permission of the Engineer.

5.2 Procedure for Receiving DI Pipes:

5.2.1 Handling of Pipes,

It is essential to avoid damage to the pipes, or their coatings at all stages during handling. The pipes shall be handled in such a manner as not to distort their circularity or cause any damage to their surface treatment. Pipes shall not be thrown down from the trucks nor shall they be dragged or rolled along hard surfaces. Slings of canvas or equally non-abrasive materials of suitable width of special attachment shaped to fit the pipe ends shall be used to lift and lower coated pipes to prevent damage to the coating.

Great care shall be taken in handling the pipe right from the first operation of

manufacture until they are delivered to the store. No defective or damaged pipe shall be allowed in the work without rectification/replacement to the satisfaction of the Engineer. Any damage to the coating shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

5.3 Laying of Ductile Iron Pipes and Fittings / Specials

5.3.1 Scope

The specification covers laying of DI pipes and DI fittings/specials for overground/underground works.

5.3.2 Applicable codes

The laying of pipes and fittings/specials shall comply with all currently applicable status, regulation, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred to. In all cases, the latest revision of the standards/codes shall be referred to. If requirements of this specification conflict with the requirements of' the standards/codes, this specification shall govern.

5.3.3 Codes of practice

IS:8329	Centrifugally cast (spun) Ductile Iron pressure pipe for water, gas and Sewage.
IS:3764	Excavation Work - Code of Safety.
IS:12288	Code of Practice for use and laying of Ductile iron pipes.

5.3.4 Carting & handling

Pipes and fittings/specials shall be transported from the factory to the work sites at places along the alignment of pipeline as directed by Owner/Engineer and as specified by manufacturer. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes for by any other approved means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at

intervals in order to permit access from one side to the other. in case of spigot socket pipes, care should be taken regarding orientation of pipes while unloading. As far as possible pipes shall be unloaded on one side of the trench only. All pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for recantation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fitting/specials along concrete and similar pavement with hard surfaces shall be prohibited.

5.3.5 Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stock shall not exceed 1.5m. Fittings/specials, shall be stacked under cover and separated from pipes.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they are not left out on the ground in the sun or overnight under heavy frost or snow conditions.3

5.3.6 Laying

5.3.6.1 Excavation

Before excavating trench the alignment of pipeline shall be approved by Engineer. The excavation shall be carried out in accordance with the specifications mentioned under Section 4, Parts 1 and shall be done such that it does not get far ahead of laying operations.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for the traffic to use the roadways. The relevant Indian standards and the rules and

regulations of local authorities in regards to safety provisions shall be observed.

Suitable fencing shall be provided along the sides of trenches and pits. The posts of fencing shall be of timber securely fixed in the ground not more than 3 in apart and they shall not be less than 75 mm in diameter or less than 1.2 m above surface of the ground. There shall be two rails, one near the top of the post and the other about 450 mm above the ground and each shall be from 50 mm to 70 mm in diameter and sufficiently long to run from post to post to which they shall be bound with strong rope. The method of projecting rails beyond the post and tying them together where they meet will not be allowed on any account. All along the edges of the excavation trenches a bank of earth about 1.2m high shall be formed where required by Owner/Engineer for further protection.

The road metal and also the rubble packing shall first be stripped off for the whole width of the trench/pit and separately deposited in such place or places as may he determined by Owner/Engineer.

During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit, or as may be necessary to prevent the sides of the trench pit to slip or fall, or at such a distance and in such a manner as to avoid covering fire hydrants, sluice valves, manholes covers etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organisations or otherwise as Owner/Engineer may direct.

Contractor shall take into account additional excavation if any as Owner/Engineer may require in order to locate the position of water pipes, drains, sewers etc. or any other works which may be met with, in or about the excavation of trenches/pits while quoting the rates for excavation of trenches/pits while quoting the rates for excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as Owner/Engineer may direct, and shall be protected by the Contractor from damage during the progress of the work. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipe line of water, gas, sewage etc.

If the work for which the excavation has been made is not completed by the expected date of the setting of monsoon or the setting in of rain whichever is earlier, or before the day fixed by Owner/Engineer for filling in any excavation on account of any

festival or special occasion, Contractor shall backfill such excavation and consolidate the filling.

Utmost care shall be taken to see that the width of the trench upto ground level is not more than that specified in 'Data sheet – B'. If any extra width is provided in the pipezone, the Contractor shall have to provide remedial measures in the form of lime concrete or rubble masonry otherwise at the discretion and to the satisfaction of Owner/Engineer. If rock is met with, it shall be removed to 15 cm below the bottom of pipes and fittings/specials and the space resulting shall be refilled with granular materials and properly consolidated. Bottom of trenches/pits shall be saturated with water well rammed wherever Owner/Engineer may consider if necessary to do so.

Wherever a socket or collar of pipe or fitting/special occurs, a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand all around the socket in order to make the joint, and the grip shall be maintained clear until the joint has been approved by Owner/Engineer.

When welding is to be carried out with the pipes and specials in the trench, additional excavation of not more than 60 cm in depth and 90 cm in length shal1 be made at joints in order to facilitate welding.

The excess excavated material shall be carried away from site of works to a place upto a distance as directed by Owner/Engineer. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Engineer are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be carried out by Owner/Engineer and any claim or dispute shall not be entertained in this respect.

The contractor shall make proper provision for protecting the work by fencing, watch and ward lighting at right on in an other manner as may be directed by Engineer.

5.3.6.2 De-watering

During the excavation, if subsoil water is met with Contractor shall have to provide necessary equipment and laborers for dewatering the trenches/pits by bailing out water or water mixed with clay if pumping out subsoil water is found to be necessary, Contractor shall provide sufficient number of pumps for the same. In both the above cases the excavation shall be done to the required level and the pipes shall be laid to

proper alignment and gradient. Contractor shall also make necessary arrangement for the disposal of drained water to nearby storm water drain or in a pit if allowed by Owner/Engineer. In no case the water shall be allowed to spread over the adjoining area. Before discharging this water into public sewer/drain, Contractor shall take necessary permission from the local authorities.

5.3.6.3 Special foundation in poor soil

Where the bottom of the trench and subgrade is found to consist of material which is unstable to such a degree that in the opinion of Owner/Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, limbers or other materials, in accordance with relevant drawings and as instructed by Owner/Engineer shall be constructed.

5.3.6.4 Wooden shoring

Contractor shall suitably design polling bards, waling and struts to meet different soil conditions that might be encountered in excavating trenches/pits. The horizontal and vertical spacing of struts shall be prevented from collapse but also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience and/or delay that might be caused in lowering pipes in trenches as a result of adopting improper spacing of struts by Constructor shall be his sole responsibility. No part of shoring shall at any time be removed by Contractor without obtaining permission from Owner/Engineer. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

Owner/Engineer may order portions of shoring to be left in the trenches/pits at such places, where it is found absolutely necessary to do so avoid any damage which may be caused to buildings, cables, gas mains, water mains, sewers etc. in close proximity of the excavation, by pulling out the shoring from the excavations. Contractor shall not claim, on any reason whatsoever, for the shoring which may have been left in by him at his own discretion.

5.3.6.5 **Steel plate shoring**

Where the subsoil conditions are expected to be of a soft and unstable character in trench/pit excavation, the normal method of timbering may prove insufficient to avoid subsidence of the adjoining road surface and other services. In such circumstances Contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, waling etc. as per the instructions manner and method directed by Owner/Engineer. Contractor shall supply, pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the specification.

5.3.6.6 **Boning staves and sight rails**

In laying the pipes and fittings/specials the centre for each manhole/chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances therefrom to be well clear of all intended excavation, so arranged that a sight rail when fixed at a certain level against the post shall cross the centre line of the manhole/chamber or pipe lines. The sight rail shall not in any case be more than 30 m apart, intermediate rails shall be put up if directed by Owner/Engineer.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of metres and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top edge of the tee-head at a distance equal to the outside diameter of the pipe of' the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The centre line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the centre lines of nay converging pipes. A line drawn form the tip edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the tee letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee-heads and cross-

piece of the boning staves shall be painted black.

For the pipes converging to a manhole chamber at various levels, there shall be a rail fixed every different level. When a rail comes within 0.60 m of the surface of the ground, a higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall in no case be removed until the trench is excavated, the pipes the laid Owner/Engineer gives permission to proceed with the backfilling.

5.3.6.7 Bedding

The type of bedding for pipes shall be as per Data Sheet - B.

DATA SHEET – B

1.1.1.1.	Item No.	Specification
1	Width of trench	
2	Bedding for pipes	As per drawing

5.3.7 Laying of Pipes and Fittings/Specials

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas, sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Owner/Engineer. Pipes and fittings/specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings/specials shall be made by Contractor. In no case pipes and fittings/specials shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings/specials shall be used to lift and lower the coated pipes and fittings/specials. The pipes and fittings/specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes and fittings/specials damaged during lowering or aligning shall be rejected by Owner/Engineer. Manufacturers recommendations are to be followed for laying

pipes.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. pipes and fittings/ specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings/specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Owner/Engineer. During the period that the plug is on, the Contractor shall take proper precautions against floating of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted the deflection allowed at joints shall not exceed 2 1/2o. In case of pipes, with joint to be made with loose collars, the collars shall be slipped on better the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner by using tools and taking precautions as per manufacturers'' recommendations without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

5.3.8 Repairs of Damaged Cement Mortar Linings

The mortar lining is strongly bonded with the pipe wall at all places. However, near the spigot end due to rough handling of pipes or on account of incidental shock loads the mortar lining may get damaged over a small area. Such damages if taken place shall be immediately identified and repaired before installation. When repairing damaged cement-mortar-lining, the following shall be adhered to:

5.3.8.1 Materials required

(a) Standard Cement (of the same quality as in the lining)

(b) Argillaceous Sand (size of coarse grains max. 1.6 mm)
(c) Acrylic Emulsion for cement mortar
(d) Potable water

5.3.8.2 **Preparation of the areas to be repaired**

The damaged lining shall be removed with hammer and chisel, with due care without disturbing the surrounding lining. Contractor shall supply protective spectacles for workmen to prevent penetration of cement fragments into their eyes.

5.3.8.3 Composition of repair mortar

The proportion of the materials will be as follows:

5.3.8.4 Dry mixture of mortar:

One part of cement

One part of sand

5.3.8.5 Emulsions:

One part of acrylic emulsion

Four parts of potable water

Firstly the dry sand and the dry cement shall be mixed separately. The acrylic emulsion shall be added to the water stirring constantly (The container for acrylic emulsion should be resealed at once after use and stored in a cool place)Small quantities of the treated water shall be gradually added to the cement and sand mixture mixed thoroughly. Care shall be taken not to prepare too large quantity of cement to avoid premature hardening.

Any loose sand from the areas to be repaired shall be brushed off. Moisten the areas under repair and surrounding areas with water but avoid water accumulations. Mortar is to be applied to cleaned areas and the lining surface is to be smoothened.

5.3.8.6 After - Treatment of repaired areas

In order to ensure faultless hardening of cement it is recommended that the repaired area to be covered temporarily with plastic sheet. In the case of diameters exceeding DN 300 it is possible that after cutting off a piece the new spigot end has become out of round. On account of the elastic and plastic properties of ductile iron, it is possible to re-round these pipe ends. This shall be done on site by means of a hydraulic or mechanical jack, acting from inside and pressing outwards or by using a press acting

from outside the pipe and pressing inwards by the contractor.

In order to avoid damage to the cement mortar lining it is recommended that hardwood ads of a shape to match the pipes internal diameter be used. The re-rounding device should remain in place during assembly. If necessary the manufacture may consulted for resounding.

5.3.9 Thrust Blocks

Thrust blocks shall be provided, to counteract hydraulic thrust, at requisite places as per design as directed by Engineer In-charge.

5.3.10 Jointing

Jointing for pipes and fittings/specials shall be done in accordance with the relevant specifications for DI pipes and DI fittings and as recommended by manufacturer.

The recommended bolting torque to be followed for assembling flanges as specified in manufacturer instructions.

5.3.11 Testing And Commissioning

Testing and commissioning of pipes shall be done in accordance with the relevant specification.

5.3.12 Backfilling

Trenches shall he backfilled with approved selected excavated material only after the successful testing of the pipeline as directed by engineer. The tamping around the pipe shall be done by hand or other hand-operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both side of the pipe in such a manner that unequal pressure does not occur. Backfilling shall be done in layers not exceeding 30 cm. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline. Where timbers are placed under the pipeline to aid alignment, these timbers shall be removed before backfilling.

5.3.13 Reinstatement Of Road/Footpath

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the relevant specifications after completion of work.

5.3.14 Clearing Of Site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by Owner/Engineer and the construction site left clean to the satisfaction of Owner/Engineer.

5.3.15 Cleaning, Disinfectioning And Commissioning Of The Pipeline

Upon completion of newly laid main, the main shall be disinfected as directed by the Engineer.

The main shall be flushed prior to disinfection except when the tablet method is used. After initial flushing, the hypochlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solution may be fed with a hand pump.

In the case of main of large diameter, water from the existing distribution system or other approved source of supply shall be made to flow at a constant measured rate into the newly laid pipeline. The water shall receive a dose of chlorine also fed at constant measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'slug' of chlorinated water that will as it passes along the line expose all interior surfaces to a concentration of at least 300 mg/l for atleast 3 hours. As the chlorinated water flows past tees and crosses related valves and hydrants shall be operated so as to disinfect the appurtenances.

In the case of newly laid mains in which scrupulous cleanliness has been exercised the tablet method can be adopted and in this method, the initial flushing is dispensed with. The calcium hypochlorite tablets are placed in each section of pipe and also in hydrants, hydrant branches and other appurtenances. The tablets shall be attached by an adhesive and must be at the top of the main. The main shall then be filled with water and the water shall remain in the pipe for atleast 24 hours.

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the mains is not higher than that generally prevailing in the system or less than 1 mg/l.

After final flushing and before the water main is placed in service, a sample (s) of water shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory,

samples are obtained before the main is placed in service.

The Contractor is expected to carry out the disinfection work as a part of laying the pipes and his rates for laying the pipes should include the disinfection and other connected works till the main is placed in service, unless otherwise specified in the schedule.

5.3.16 Method of Measurement

The measurement shall be recorded in running meter of pipe length laid along the centerline of axis of pipeline including specials surcharge tee, enlarge, reducer and bend, correct up to 0.01 m length.

5.3.17 Payment

As per payment schedule in price bid.

- **DRAIN PUMP:**

For dewatering the stuffing box leakage one number portable horizontal submersible mono set is to be provided with impeller of cast Iron. It shall be with double mechanical seals to prevent ingress of moisture in to the motor. It shall be complete with automatic level switch, common pipe of 40 mm steel pipe for the pump to connect it to the nearest drain. Discharge capacity of drain pump shall be 10 m3/hr against 10 Mtrs head.

DI SPECIALS

Manufacture, Supply & Delivery of Ductile Iron Flange socket spigot bends, tees, reducers or any other specials as per BS-EN-545/1995 Class-A series K12 suitable for use with D.I. Pipes manufactured as per IS:8329/1994 delivery of specials is to be made to site of works including all taxes, loading, unloading, carting, stacking, insurance, inspection charges, octroi etc. complete. With external bitumen & zinc coating & internal cement mortar lining

All Specials shall conform to the requirements of the UK Water Industry Specifications BS-EN-545/1995 Class-A series K12 suitable for use with D.I. pipes manufactured as per IS:8329/1994 for both Socket and Spigot Type and Flanged End Types of Fittings.

Fittings/specials shall comply with all currently applicable status, regulation, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred to. In all cases, the latest revision of the standards/codes shall be referred to. If requirements of this specification conflict with the requirements of' the standards/codes, this specification shall govern.

Codes of practice

IS:8329	Centrifugally cast (spun) Ductile Iron pressure pipe for water, gas and Sewage.
IS:3764	Excavation Work - Code of Safety.
IS:12288	Code of Practice for use and laying of Ductile iron pipes

PROVIDING AND SUPPLYING ISI MARK SLUICE VALVES

The Contractor has to prepare approved Quality Assurance Plan (QAP) as per Specification and latest IS Code provisions before manufacturing.

Sluice valve as per IS: 14846 or its latest revision.

General

The contractor shall be covering manufacturing, supplying and delivery of sluice valve conforming to IS: 14846 or its latest revision (specification for sluice valves, 50 to 900 mm size) with ISI certification.

Standards

The CI sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below with ISI certification mark on each sluice valve.

Temperature Variation

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 4℃ to 45℃.

Marking

The legible and indelible marking upon each valve shall indicate the following:

(1) ISI certification mark on each sluice valve
(2) Manufacture's brand name and/or trade mark
(3) Size of valve and nominal pressure of valve
(4) Serial number of cast
(5) Serial number in punch
(6) Where a valve has been tested for only open-end-test, it should be marked 'O' distinctly and permanently
(7) Any other important matter that the manufacturer deems fit to be inscribed embossed

Test Certificate

- The contractor shall provide manufacture's test certificate for every batch / lot of valves manufactured and supplied.
- The contractor shall also produce, in addition to the manufacture's test certificate, the inspection certificate issued by the authorized person / agency appointed by employer for the same purpose. The inspection charges of the authorized person / agency as fixed by employer shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of employer.

Nominal Pressure

Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" (1 Mpa = 10 kgf/m^2 approx.).

The nominal size shall refer to the nominal bore at any point, and shall not be less than the nominal size required.

Material

The materials for different component / parts of the sluice valve shall conform to the requirements given in table below:

Materials for Components / Parts of Sluice Valve

Sl. No.	Component	Material	Reference	Grade of Designation
1	Body, bonnet, wedge, stuffing box, gland thrust plate, cap	Grey cast iron	210-FG 1978(1)	
2	Stem	High tensile brass	320-1962(2)	Alloy 1 of 2
3	Wedge nut	Leaded tin bronze	318-1962(3)	2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318-1962(3)	2
5	Bolts	Carbon steel	1367-1967(4)	Class 4.6
6	Nuts	Carbon steel	1367-1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712-1971(5)	C
8	Gland packing	Jute & hemp	5414-1969(6)	-

(1) Specification for grey iron castings (third revision)
(2) Specification for high tensile brass roads and sections (revised)
(3) Specification for leaded tin bronze ingots and casting (revised)
(4) Specification for technical supply condition threaded fasteners (first revision)
(5) Specification for compressed asbestos fiber jointing (first revision)
(6) Specification for gland packing, jute and hemp

Manufacture

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double-flanged-end connections.

Flanges

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of IS: 1538 (Part I to XXII), 1976 (Specification for Cast Iron fittings for pressure pipes for water, gas and sewage) or its latest revision.

Constructional Features

1	Standard	IS: 2906 above 300 mm size and IS: 780 up to 300 mm size

2	Stem	Non rising
3	Ends	Flanged, flat faced flanges having off-center bolt holes
4	Bonnet	Bolted
5	Disc	Solid wedge
6	Operation	Manually operated
7	Seat	Body - Renewable Disc - Renewable
8	Other requirements	Valves shall close in clockwise rotation of the hand wheel
9	Body & bonnet	CI, IS: 210 GR 260
10	Disc	CI, IS: 210 GR 260
11	Stem	SS, AISI - 410
12	Body seat	SS, AISI - 316
13	Disc seat	SS, AISI - 316
14	Stem nut	Bronze, IS: 318 Gr LTB2
15	Stuffing box	CI, IS: 210 GR 260
16	Gland	CI, IS: 210 GR 260
17	Packing	Graphited Asbestos
18	Bolts, studs & nuts	Carbon Steel, IS: 1367 Class 4.6 / 4

Cleaning and Painting

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the valve. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and adhere perfectly to the surface.

The inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odor to the water.

Testing and Inspection

Valves shall be offered for visual inspection and dimensional check. The hydrostatic testing shall be witnessed by the Employer.

Valves above 300 mm size shall be tested as per IS: 2906. Valves up to 300 mm size shall be tested as per IS: 780.

Valve shall be dispatched only after NAGAR PALIKA approval for dispatch.

Fixing of Valves

Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. The chambers for housing the valves shall have stable and firm foundations. The chamber and top roof cover with removable lid shall be provided so that it shall be possible to remove or replace or recondition the valves seats and to remove the parts without removing the valves from the pipe work. For this, suitable flange adapters may be provided. Butterfly valves shall have high nitrile rubber seats, preferably metal reinforced, unless otherwise specified and shall be installed in the pipe work in such a manner that they can be removed from the line for dismantling and replacement of rubber seats.

Where the valves are required to be operated electrically, actuators shall be sized to guarantee valves closures at maximum possible differential pressure across the valve. Each actuator shall be supplied with installation, instructions and wiring diagrams and sufficient spare parts.

Valves used on pipeline shall be straight, through type, and non chokable. Each valve or its operation equipment shall bear an approved name plate stating its function. All operation spindles, gears and head stocks shall be provided with adequate points for lubrications.

The tightening of nut and bolts shall be done smoothly in such a way that no excessive strain occurs on any one side. The nuts shall be tightened on diametrically opposite site at a time.

AIR VALVE (TEMPER PROOF)

Providing and supplying C. I. Air valves of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. Lowering, laying and jointing in position following Air valves including cost of all labour, jointing material, including pipe, nuts & bolts etc. all fixtures and giving satisfactory hydraulic testing etc. The cost should also include fixing valves with DI pipes complete:

General

The contractor shall be covering manufacturing, supplying and delivery of:

Air valve conforming to IS: 14846 or its latest revision (Specification for Air valves with ISI certification).

Classification

- Air valve shall be of two types
  - (a) Single Air valve
  - (b) Double Air valve
- Single air valve shall have single small or large orifice for releasing air during pipe filling and ventilating the pipe during emptying. Air valves up to 40 mm dia shall be directly screwed on the main.
- Double air valve having two ball chambers on outlet of large capacity shall be provided for admission and release of bulk volume of air during emptying and filling of the main. Another of small outlet type for the escape of smaller quantities of air accumulating under pressure. They shall be of flanged type.

Materials

- **Cast Iron**

  Cast Iron for bodies' pressure covers, splash covers, glands, caps, joints support rings shall be best gray iron of selected grade, 20 of I-S-210-1978 specification for grey iron castings.
- **Gun Metal**

  Gun metal shall be of mixture of 88% copper, 10% tin and 2% zinc having excellent hard wearing qualities, Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gun metal.
- **Forged Bronze**

  Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminum bronze. The produce shall possess much greater strength than ordinary cast product.
- **Mild Steel**

  Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and shall confirm to IS: 226-1975 specification for structural steel.
- **Material for Balls**

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per IS: 638-1965 specification for rubber and insertion jointing.

- **Flange Jointing Materials**

  The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and Insertion jointing. The fiberboard shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

Dimension

Dimension of the Air Valves shall be as per relative item mentioned in Schedule B of the tender.

Characteristics

- Small orifice valves shall have rubber covered balls and nipples of forged bronze or special alloy in to brass plug.
- Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged. The flanged shall be faces and drilled to ISS.
- Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surface perfectly smooth.

Coating

- Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned and before rusting commences shall be coated by dipping in a bath containing a composition having a tar base.
- The coating shall be such that it shall not impose any test of small to water. The coating shall be smooth glossy and sufficiently hard. It shall not chipped when scratched lightly with the point of penknife.

Inspection and Testing

- The Engineer-in-charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials, which does not confirm to the specified requirements.
- The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests, i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

Manufacturer's Guarantee

The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

Information Required

The following information shall be cast on each valve body:

(a) Manufacturer's name or trademark.

(b) Size of valve

Tender Price

The tender price shall include all labour, material and machinery cost necessitated to be utilized for:

a) Proper manufacturing of the valves

b) All tests required to be undertaken at manufacturer's premises

c) Transportation of the valves either by rail and/or road services with all the covers duly and appropriately insured

d) Delivery of specials with proper loading, unloading, stacking at NAGAR PALIKA store as indicated by Engineer-in-charge

(e) Further towards proper discharge of all contractual obligations, the storage of all specials to be manufactured, supplied and delivered under the scope of contracts shall in general be made as described in Technical Specifications document

Marking

The methods of marking all the valves to be delivered under scope of contract shall ensure that all the information will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the valves shall indicate the followings:

a) Manufacture's brand name and/or trademark

b) Diameter and class of valves

c) Any other important matter that the manufacturer or purchase deems fit to be inscribed

Packing and Handling

- The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.
- When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.
- The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

Materials and Workmanship

- General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.
- All the material shall be new and of high quality.
- In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacture.

Test Certificate

- The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.
- The supplier shall also produce in addition to manufacturer's test certificate as mentioned under "inspection & testing above", the inspection certificate issued by the employer or his authorized person / agency appointed.

Inspection

This clause is applicable in general to all materials such as all types of valves, pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor.

Inspection of materials will be carried out at factory site by NAGAR PALIKA or authorized person / agency appointed by NAGAR PALIKA

The inspection call for Air Valves should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.

Inspection note issued by the inspection agency to supplier as well as consignee (Concerned Executive Engineer) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Deputy Executive Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Deputy Executive Engineer after verifying and satisfying the above requirements.

Lowering, Laying & Jointing the Air Valve

Air Valves, Single Ball, Flanged / Screwed Type

i. The single acting air valve shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

ii. The materials shall be carted to store or site of work including all freight, loading, unloading including all taxes, insurance, including necessary jointing materials such as GI Nipple saddle pieces shall be brought by the contractor for fixing of air valve.

iii. A suitable hole shall be drilled on the pipeline. The pipeline shall be of any type such as AC, PVC or CI pipes. A clamp shall be got prepared with a nipple welded on it. The clamp shall be fixed on pipe with bolts and nuts in such a way that the part of nipple fixed in the clamp shall remain in the hole drilled in pipe. The rubber packing shall be provided between the clamps and the pipe. White zinc spun yarn shall be used for fixing the nipple of air valve.

iv. Bolt holes shall be drilled according to center-lines. Bolt heads and nuts shall be hexagonal and shall conform to IS: 1363 (specification for black hexagonal bolts, nuts and lock nuts and black hexagonal screws).

v. The neoprene seat ring shall be held security in place under the low pressure cover by jointing support ring to prevent it from sagging when the ball is not soaking the orifice.

Jointing Material

i. Jointing material shall be brought by contractor with all necessary joint rings, nuts, bolts and washers for completing the joints on all the flanges of valve supplied under this contract including these flanges which will be jointed to pipe system. The lengths of bolts shall be assumed to be suitable for jointing material supported under the contract shall be inclusive of rates.

ii. Joint rings shall be of flat section at least 3 mm thick. They shall be of rubber in accordance with Is: 638-1965 or its latest edition (specifications for rubber and insertion jointing) of hardness proven in practice so as form a water tight joint and use of jointing paste shall not be allowed.

Air Valves, Double Ball, Flanged Type

General

i. The double acting air valves shall have to two ball chambers having one outlet of large capacity for admission and release of bulk volume of air during emptying and filling of the main and another having small outlet for escape of smallest quantities of entrapped air, This type of air valves shall be of flanged type with full conformation with IS: 1538 same valve shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

ii. The ball sealed orifice always remains open while air is exhausting and is immediately closed when water rises in the chamber, lifts the ball and seals the orifice. It shall also ensure that there are no recesses or pockets, sheltering, escaping air for the large orifice (low pressure) ball to drop into when the valve is

open. Turbulent air at the time of filling of pipe shall not circulate in such cavities and cause the ball to blown in to.

iii. Double acting air valve shall be bolted-up evenly on all sides after providing necessary rubber packing etc. on the flange of the Tees. Where facing of the flange is not true a line, fiber or lead wood or rubber packing shall be used. It shall be rubber insertion cloth of two plays and of approved quality. Any defects in jointing observed during the test shall be made good by the contractor till there is no further leakages are there.

Air Riser (if required)

Providing, supplying & installation of air riser pipe (GI medium duty) (Flanged pipe) of 6 m length on the pipeline at suitable place as per design and directed by Engineer-in-charge including MS flange pipe RCC foundation block & column in CC M-150 etc. complete.

Specifications for Air Riser for pipeline are as under:

Column / Footings for Air Riser shall be carried out in cement concrete M-150 using trap metal as per instructions of the engineer in charge. Materials and workmanship shall be given in concrete section.

Concrete protection block / column shall be cast in M-150. Minimum cover of concrete block to Riser Pipe shall be 100 mm all around as directed by Engineer-in-charge.

The item Air Riser includes the cost of providing and laying cement concrete M-150 base, MS Flanges, clamp, GI heavy duty as per instruction, MS flange, nut, bolts, rubber packing and cement concrete column in M-150 etc. complete.

VALVE CHAMBERS

Construction of valves chambers in brick or bela stone masonry, locally available in C. M. 1:6.Foundation concrete 150 mm thick in C. C. 1:4:8 of trap metal size 25 mm to 40 mm thick, inside cement plaster in C. M. 1:3 and cement pointing outside in C. M. 1:3 and top cover of precast RCC slab 100 mm thick (with key hole in two parts, each with handles or MS Bar etc. complete as given size) upto 1 Mt. depth from G. L. to pipe invert level including complete civil works but excluding cost of excavation and refilling. WIth cast in situ RCC slab in one single piece with fixing of CI-MH Frame and cover (excl. cost of CI-MH Frame and cover) with 23 mm thick brick masonry wall in C.M.1:6

Inside size of chamber as below: As per price bid

- Additional excavation required to be done shall be carried out as per instruction of Engineer-in-charge. For foundation chamber, 15 cm thick 1:3:6 PCC shall be provided; 23 cm thick Brick masonry walls in CM 1:6 shall be constructed.
- Second Class bricks of standard size shall be brought by the contractor and shall be got approved before use in the work from the Engineer-in-charge.
- 12 mm thick cement plaster in CM 1:3 shall be provided on inside and outside of walls up to 20 cm below G.L. Cement pointing in CM 1:3 shall be provided outside from 20 cm below G.L.
- 20 mm dia. MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.
- Chamber shall be covered with 100 mm thick RCC 1:2:4 pre-cast or cast-in-situ slab in two parts with keyholes to insert key for operation.
- Reinforcement for the cover slab shall be provided considering heavy traffic load.
- Curing of concrete, brick masonry, RCC etc. shall be done using chemical or water for 14 days.
- 12 mm dia. MS bar handles, minimum two nos., shall be provided to each piece of slab during the time of casting of slab.
- Sides of chamber shall be refilled properly with selected excavated earth.
- All the above items shall be carried out in manner as per prevailing sound engineering practices and instruction of Engineer-in-charge.
- Contractor shall submit the valve chamber drawings based on site conditions for review and approval before execution. Typical drawing is given in Volume – V, Drawings for estimation purpose only.

1.0 Excavation

Excavation, shoring, dewatering etc. for the pits of manholes, laying of pipes and fittings / specials shall be done in accordance with Employer's Requirements described elsewhere in the document.

2.0 Plain Cement Concrete

The water, sand, cement & stone aggregate of 25 mm to 40 mm nominal size shall be used of approved quality as per standard specification in IS: 456.

Workmanship: Before starting concrete work, the bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed.

Mixing: The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quality of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of breakdown of machineries and in the interest of the work, it shall be carried out on a water tight platform and shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

Transporting and placing the concrete: The concrete shall be handed from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into the final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

Compacting: The concrete shall be rammed rapidly with heavy iron rammers to get the required compaction and to allow all the interstices to be filled with mortar.

Curing: After the final set, concrete shall be kept continuously wet, if required by pounding for a period of not less than 7 days from the date of placement.

3.0 Cement Plaster

The proportion of the cement mortar shall be as approved on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per relevant I.S. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

4.0 Scaffolding

For brick work in chamber, single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not are allowed in pillars/columns less than one meter in width, or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purpose shall be filled and made good before plastering.

MDPE PIPE FOR PLOT SERVICE CONNECTIONS

GENERAL

The service connection shall include MDPE pipe of required length, rubber gasket, Ferrule, Nuts, bolts for fixing saddle or service clamp as required.

The MDPE pipes shall conform to ISO DP 4427. The ferrule for connection shall generally conform to IS: 2692. It shall be of non-ferrous material with a CI bell mouth cover and shall be fitted with a screw and plug or valve capable of completely shutting off the water supply to the communication pipe if and when required. Service pipes less than 50mm bore may be connected to mains by means of right angled screw down ferrule.

The thickness of MS flats used for fabricating service clamps should be minimum 4mm to enhance the life of the clamp. The thickness of rubber gasket (packing material) should be minimum 3mm as per IS: 5382. MS bolts and nuts to be used for fixing the saddle or service clamp should conform to IS: 1363. GI pipes shall conform to IS 1239, heavy duty class C.

For HDPE pipe saddle, the MDPE pipes shall be connected to the saddle using socket and spigot arrangement / with any other arrangement as specified by the saddle supplier. All necessary fitting required for the connections shall be deemed part of the saddle supply.

CONNECTION AT MAIN

Boring on water main should be done on the top of main. A manual drilling and tapping machine can be used for this purpose. A bore can be drilled and tapped on DI / HDPE main and ferrule can be screwed directly into the bore. The size of the ferrule should not exceed a quarter of the nominal diameter of the main and also be less than the size of the communication pipe.

The ferrule should be so set in the main that the communication pipe leads off in line with the main before curving round right angled in to its proper course. This allows for further tightening of the ferrule in the main in case of settlement of communication pipe. Minimum cover to MDPE pipes inside the property should be 20 to 30 cm along the road crossing adequate cover should be provided before the pipe enters the property boundary. The MDPE pipe pieces shall be made out of pipes conforming to ISO 4427: 1996. GI encasing of MDPE pipes shall be provided where ever required as per the direction of Engineer in charge.

SERVICE CONNECTIONS (PLOT SERVICE CONNECTIONS)-FERRULES AND STRAPS

ELECTRO FUSION SADDLE – FOR HDPE PIPES

MATERIAL

Electro-fusion saddle shall be of PE80 / PE10, SDR 11/17 and shall be of reputed make provided as per the drawings for various sizes to the satisfaction of the Engineer In Charge. Electro-fusion Branch Saddles shall be designed and

manufactured in accordance with ASTM F-1055 for use with pipe conforming to ASTM D2513/3035, F-714 and with Butt fittings conforming to ASTM D3261 as applicable

Outlets from tapping tees and branch saddles shall be spigotted in accordance with clause 6.3 or with electro-fusion sockets in accordance with clause 6.2 of ISO 4427. Mechanical fittings manufactured substantially from PE and intended for part fusion to PE pipe and part mechanical jointing to other pipe components, e.g. adapters, shall conform to the geometrical characteristics of the PE jointing system to be used. Mechanical fittings not manufactured substantially from PE shall be in accordance with ISO 14236 or other relevant standards, as applicable. Dimensions of loose backing flanges and flange adapters shall be in accordance with ISO 9624. The test pieces shall be tested in accordance with Table 4 of ISO 4427. When tested using the test method and parameters specified therein, the fitting shall have mechanical characteristics conforming to the requirements of Table 4 of ISO 4427. Mechanical fittings shall be in accordance with ISO 14236.

CONNECTIONS:

Mark the welding area with a wax crayon or marker. Scrape the pipe surface carefully using an approved scraper, after scraping; remove grease from the welding area of the pipe and inside of the branch, using an approved cleaning agent.

Immediately after scraping and cleaning, apply the branch on to the pipe watching out not to dirty the previously cleaned surfaces. Use a wrench to tighten the four screw nuts until top and bottom part of branch saddle come into tight contact. Tighten until the threaded connector A and the top part of branch saddle B meet, connect the two electric pins to the welding connectors of the branch saddle. After completing the welding process using Electro fusion method (using suitable electro-fusion equipment), verify that no material has leaked out of the joint between the pipe and the fitting and wait for cooling (20 minutes). Proceed now with the perforation of the pipe. You can either leave the under clamp on the saddle or remove it as per the instructions of engineer In Charge

SADDLE STRAP-FOR DI PIPES

Strap Saddle for service connection from water distribution mains shall be of wrap around design, wide skirt and wide straps support, which shall reinforce the pipe while providing excellent stability to the saddle. Saddles for service connections shall be of fastened strap type with threaded outlet for service connection.

The service connection threading sizes shall conform to IS: 554. Saddles shall be suitable for DI pipes of nominal size 4” (NB 100) with nominal service connection size from ½” (NB 15). The straps shall be elastomeric coated (insulated) type for firm grip on pipe as well as to protect the coating on the pipe and to insulate the un-identical metals. Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size ½” (M12) shall be used for saddles of size for 4” (NB 100). The sealing between the saddle and mains shall be obtained by using a profiled elastomeric seal matching to the curvature of the pipe. The seal shall be of elastomeric type, suitable for all potable water applications. The Material of construction of the body, straps, fasteners etc. shall be of a non corrosive material such as engineering plastic (PE/PP) or

stainless steel or a combination of both. The design of the saddle body should be such that, the service connection outlet metal insert shall project out towards pipe side and align with the hole drilled on the pipe to ensure positive locking against rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading. The clamp saddles shall be suitable for maximum working pressures upto 10 bars.

SADDLE BODY

Non corrosive Engineering Plastic body moulded with Stainless steel threaded metal insert for tapping outlet. Also, the stirrup metal plate shall be duly embedded in the plastic body, except at the place of nut-bolt lugs. Threading size and dimensions shall conform to IS: 554. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

SADDLE STRAP

Saddle straps shall be made of stainless steel 304 grade to prevent corrosion over the long service life. Strap Insulation: Elastomeric (rubber) insulation / lining shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe to prevent the saddle from rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

SADDLE SEAL

It shall be virgin rubber SBR Grade 30 / NBR (NSF 61 approved). It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be gridded mat, with tapered ends, with the outlet section having oring contacting the saddle body multiple o-rings contacting the pipe, preferably with a Stainless steel reinforcing ring insert moulded to prevent expansion under pressure.

NUTS-BOLTS- WASHER

Stainless Steel Type 304, NC rolled thread, Tightening torque for ½" (M12) nut-bolt: 14-15 kg.m. The general arrangement of Strap Saddle with PP Compressive Male Thread Metal Insert Elbow is shown below; The joints in service connection between MDPE pipe and UPVC Ball Valve and the Water Meter shall be tamper proof / not easily dismantled by the Consumers as directed by the Engineer.

FERRULE MATERIALS

Ferrule saddle straps shall be of gunmetal to BS EN 1982 grade (ISO R1338) or equivalent, with two or four bolts depending upon the width of the saddle. Bolts shall be of stainless steel to BS6105 grade A2 with grade A4 nuts, BS EN ISO 3506 and be resistant to corrosion. The strap shall preferably be designed to have locating recesses to prevent the bolt head(s) from turning when the upper nut is being

tightened. Ferrule outlets shall be either of a metallic material complying with the specification for ferrule saddle straps above, or of a thermoplastics material that does not suffer from corrosion in potable water (pH range 6 to 8) or low resistivity soils (200 ohm.cm or less).Compression fittings for house service connections shall comply with ISO 14236, with materials of construction as per clause 5 in the Standard as follows:

Body	- polypropylene
Nut/cap	- polypropylene
Clip ring	- POM (acetylic resin)
Packing bush	- polypropylene
"O" ring	- NBR
Threaded metal inserts	- SS304 with BSP threads

For clear identification of water services, fitting nuts shall be coloured blue and the body black. All threads shall be BSP. The dimensions of compression fittings shall be in accordance with clause 7.1 of ISO 14236.The pressure rating of compression fittings shall be PN 10 as per clause 8 of ISO 14236. Performance testing shall be as follows:

Clause 8.2.1 Leak tightness under internal pressure
Clause 8.2.2 Resistance to pull-out
Clause 8.2.3 Leak tightness under internal vaccuum
Clause 8.2.4 Long term pressure test for leak tightness for assembled joint
Clause 8.3.2.1 MRS value as per ISO 9080
Clause 8.3.3.1 Resistance to internal pressure

All materials or components coming into contact with water shall comply with the following:

Metallic components shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odours or discoloration.

Non-metallic components shall be approved as being free from adverse health effects. Compliance with national or international standards shall be demonstrated by production of appropriate third party certification.

Compression fittings for conveyance of water for human consumption shall conform to BS 6920 for effects on water quality, and certificates demonstrating compliance with the following parameters shall be provided: odour and flavour of water, appearance of water, growth of micro-organisms, extraction of substances that may be injurious to public health (cyto toxicity), and extraction of metals.

GENERAL CIVIL WORKS

1.1. GENERAL:-

i. The site on which the pipelines are to be laid and shown on plan and the area required for setting out other operation cleared and all obstruction loose stones and materials. rubbish of all kinds slumps brushwood as well as trees shall be removed as directed the roots shall be entirely grubbed up.

ii. The products of the clearing to be stacked in such a place and in such a manner. as directed by the engineer.

iii. In jungle clearing all trees not specially marked for preservation bamboos jungle wood and brushwood shall be out down their roots grubbed up. All wood and materials from the clearing shall be the properly of the Board shall be arranged as directed by the Board Engineer or his authorized agent the materials pronounced as useful by the engineer will be conveyed and properly stacked as directed within the specified limit. Useless materials will be burnt of otherwise disposed off as directed

1.1.2 1.2 SETTING OUT:-

The centre lines of all pope trenches etc. shall be given by the Engineer-in-charge. and it will be the responsibility of the contractor to install substantial reference marks. Bench marks etc. and maintain then as long as required true to line. level curve and slopes. The Contractor shall assume full responsibility for alignment and dimension of each trench.

The labor materials etc. required setting cut and establishing bench marks and other reference marks shall be arranged by the Contractor at his own cost.

1.3 EXCAVATION:-

The excavation incl. dewatering for the pipe trenches shall incl. removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipe lines exactly in accordance with alignment levels grades and curves shown on the plants or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as per as possible or according to the angle of response various soils. Unless there is a specific extra provision in the contract for shoring and strutting for cutting side slopes the contractor shall at his own do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge when the state need such treatment. The Contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or sloped as directed by the Engineer. The Contractor shall, at his own cost to removes such portions of boulders of rocks. as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by Contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with

watering, ramming etc. as directed by the Engineer and at the cost of contractor. Other hard excavation shall be cleared of all sort and loose material and cut to a firm surface. Either level stepped as directed by the Engineer. The Engineer may order such charges in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The Contractor shall, at his own expense, make provision for all pumping, dredging bailing out of draining water and the trenches shall be kept free of water during laying work. After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipe line will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

1.4 SHORING AND STRUTING:-

Unless specifically mentioned in the contract, excavation of slopes to prevent falling in of sides or providing, fixing maintaining and removing, shoring, bracing etc. shall not be paid for. The Contractor shall be properly upheld. The Contractor shall got approval of design of shoring. The shoring shall be of sufficient strength of resist side pressure and ensure safety from slope and blows and to prevent to work and property injury persons. If shall be removed as directed after all the items for which it is required are completed. During excavation if water connections, sewerage connection, telephone lines etc. are damaged by the contractor. The same shall have to be restored by the Contractor without any extra payment.

1.5 PROTECTION:-

The trenches shall be strongly fenced and red light single shall be kept at night in charge of watchman to prevent accidents sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The Contractor shall be entirely responsible for any injury to life and damage to the properties etc.Necessary protection work such as guide ropes crossing places. Barricades, caution boards etc. shall be provided by the Contractor.

1.6 Thrust Blocks

Anchorage in the form of a thrust block at each deflection in the horizontal and/or in vertical alignment of the pipeline shall be provided as per the design requirements to resist any unbalanced pressure at the bends. Gravity type thrust blocks shall be provided at horizontal and vertical deflections in the pipeline, which shall be designed according to the test pressure and the soil conditions at the site of the thrust block. Before designing the thrust blocks the Contractor shall assess the stability of the soil considering erosion due to wind and water. The general guidelines to be followed for providing and designing of thrust blocks shall be as under:

- The thrust blocks may not be required for bend angles up to 5%. However, necessary calculations shall be submitted by the Contractor for approval by Employer to establish that the thrust shall be taken care by pipe itself and that it is safe not to have the thrust block.

- The thrust shall be designed according to the field test pressure of the pipe.
- For above ground pipelines, thrust blocks shall be designed to take 100% thrust.
- For buried pipelines, thrust blocks on continuous pipe line sections shall be designed considering 50% thrust to be taken by block and balance by pipe as per CPHEEO manual.
- For buried pipelines, thrust blocks near valve chambers and/or any other dismantling joints shall be designed to take 100% thrust.
- In rock the passive pressure of rock shall be considered for thrust block design
- The thrust blocks shall be of concrete M20, cast in-situ, with minimum surface reinforcement of 5 kg/m2. No formwork is required to be used for construction of thrust blocks in buried conditions, unless desired by the Contractor. The calculations for the dimensioning and the shape of the thrust blocks shall be approved by the Employer.
- Anchor blocks shall also be located wherever there is a transition between above ground and buried pipelines. All such anchor blocks shall have flexible joints at either end to allow for small amounts of settlement to occur.
- The Contractor shall construct the thrust blocks as early in the program of work as is practical, and at least six months prior to installation of the above ground pipeline in order to reduce the risk of settlement imposing additional loads on the pipeline supports. All thrust blocks are to be completed on each section before the sectional hydraulic testing is conducted.
- Where possible, the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlying the rock shall be excavated and replaced with class M15 mass concrete. In the event of no rock being encountered, the base of the thrust block shall be cast against undisturbed ground. Any ground, which in the Employer opinion is unsuitable, shall be excavated and replaced with class M15 mass concrete.

1.7 Backfilling

Backfilling of trenches for pipes shall be commenced after the pipes have been successfully tested. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

All fill material shall be subject to the Engineer's approval. If any material is rejected by the Engineer, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed of as directed by Engineer after the filling work is completed.

Back fill material

To the extent available, selected surplus soils from excavations shall be used as backfill provided that it complies to IS 12288 and such material consists of loam, clay, sand, fine gravel or other materials which are suitable for backfilling. All backfill material shall be free from clods, salts, sulphates, cinders, ashes, slag, refuse, rubbish, lumps, vegetable or organic material, lumpy or frozen material, boulders, rocks or stone or other foreign material. All lumps of earth shall be broken or removed. If fill material is required to be imported, the

Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Engineer.

1.1.3 Backfilling of Pipe Trenches

For the purpose of back filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

Zone-A	From the bottom of the trench to the level of the centre line of the pipe in case of excavation in soil and from the top of the pipe bedding to the level of the centre line of the pipe in case of excavation in rock.	Backfilling in this zone shall be done with carefully selected excavated material compacted by hand in layers not exceeding 150 mm with 95% proctor density. The back-filling material shall be deposited in the trench for its full width of each side of the pipe, specials and appurtenances simultaneously. Special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe.
Zone-B	From the level of the centre line of the pipe to a level 300 mm above the top of the pipe.	Backfilling in this zone shall be done with carefully selected excavated material compacted by hand or approved mechanical methods in layers not exceeding 150 mm with 95% proctor density, special care being taken to avoid injuring or moving the pipe.
Zone-C	From a level 300 mm above the top of the pipe to the top of the trench.	Backfilling in this zone shall be done with suitable excavated material and shall be compacted using mechanical compactors in layers not exceeding permissible thickness relevant to the type of mechanical compactors deployed to achieve 95% Proctor Density.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the subgrade of the structures shall be made with sand in accordance with IS 12288.

The Contractor shall take proper precautions against the risks of floatation. Should any section of the pipeline be affected by floatation shall be removed and reinstalled to the satisfaction of the Engineer

The Contractor shall carry out field tests that on each layer to confirm that the specified density has been obtained.

All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof, and the manner of depositing and compacting shall be subject to the approval of the Engineer, but the Contractor will be held responsible for any displacement of pipe or other structures, any

damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

Trenches crossing a road shall be backfilled with selected material placed in layers not exceeding 15 cm in thickness after compacting, wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content of the surrounding material. Any deficiency in the quantity of material for backfilling the trenches shall be supplied by the Contractor at his expense.

The Contractor shall at his own expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The Contractor shall not use backfilling for disposal of refuse or unsuitable soil.

1.8 Reinstatement of Road/Footpath

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the Employer's Requirement after completion of work.

1.9 Inspection and Testing

The entire procedure of applying the paint as specified will be rigidly inspected right from the cleaning stage to the application of final coat by the Engineer. If, at any time, it is found that the procedure of applying the paint or defects noticed, all such painting work done shall be rectified or redone by the Contractor at his own cost, as directed by the Engineer.

Samples of the paint brought by the Contractor shall be sent to the testing laboratory for testing, as directed by the Engineer,. If any sample is found to be not conforming to the specifications, the entire consignment to which the sample may pertain shall be rejected. Samples shall be taken at intervals at the option of the Engineer. The entire cost incidental to such testing shall be deemed to be included in the rates quoted by the Contractor.

1.10 Clearing of Site

All surplus materials, all tools and temporary structures shall be removed from the site as directed by the Employer and the construction site left clean to the satisfaction of the Employer.

1.11 Dynamic commissioning

The dynamic commissioning shall commence after the work has been physically completed to the satisfaction of the Employer- in -Charge. It shall simulate the design and operation conditions which are as follows:

- Water being put into the system through overhead tank or direct pumping as the case maybe.
- Closing of the valves against full static or dynamic pressure.
- Operation of all valves including scour valves (open-close-open).
- Operation of all air valves.

SCADA AND INSTRUMENTATION WORKS

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1. Scope of work

1.1. General:

1.1.1. The scope of work covers the design, detailed engineering, preparation of construction drawing, manufacture, acceptance testing at manufacturer's works or at any accredited agency, supply, packing, forwarding and delivery from manufacturer's works/ place of storage to erection site including transit insurance, unloading, storage at site, assembly, erection, testing, installation, commissioning, performance demonstration/ trial run, Operation & Maintenance and handing over along with all necessary spares of original ratings & specifications on Design Build basis. Inland and overseas transit insurance, transport, testing at site shall be in the scope of the Contractor. Tender BOQ along with detail technical specification are to be referred which are the minimum requirements; Contractor to ensure that design & equipments are as per technical specifications & system requirements.

1.1.2. As this is turnkey project, the contractor is responsible for entire contract and has to use their skills and expertise in execution and thereby prove successful performance of the entire system.

1.1.3. Any equipment/accessories not explicitly indicated in this specification, but considered essential for proper functioning of process shall be included in Contractor's scope of work and supply.

1.2. Contractor's scope of work & supply shall include, but not limited to the following:

1.2.1. The Scope of work shall comprise of design, engineering, planning, manufacture / procurement, supply, packing, transportation, delivery at site, installation including associated civil, electro-mechanical works etc., testing, commissioning and comprehensive O&M of the following on a minimum, but not limited for the proposed Flow meters, water meters**,** various instrumentation and equipments of pumping station and WTP, Data Loggers/RTU/ PLC for Web Based Monitoring System Monitoring Station for Water Transmission and Distribution Network.

1.2.2. Contractor shall execute complete Instrumentation & Control package on turnkey basis to the satisfaction of Client. Contractor shall comply with all the requirements of scope of work and supply; list of measurements & controls, submission of drawings & documents; supply of instruments.

1.2.3. All field instruments (sensors/transmitters etc.) as required for monitoring / alarm functions involved in the process.

1.2.4. Existing flow meters at head works (Inlet/Outlet) are to be surveyed and considered and provide RTU for communication with Web Based Monitoring System and those flow meters which are not Communicable are to be replaced in consultation with Department/ Engineer In Charge.

1.2.5. All erection hardware and accessories like branch cable trays from field sensors to RTU, impulse tubes with fittings & accessories, drain/vent valves, root valves, cable glands, structural frames/supports, expander & reducer etc. as required for complete & proper installation of the instrumentation & control equipment, are included in Contractor's scope of work.

1.2.6. Supply of UPS (wherever necessary) of adequate capacity, with battery backup of minimum eight (8) hour. AC/DC power distribution from with adequate number of wired spares (minimum 20% after commissioning) breakers and 240V AC/ 24V DC converters (redundant) for I&C Equipment and System.

1.2.7. Supply, laying & termination of Instrumentation, Control, Power & any other special cables as required for entire system under Contractor's scope. Scope shall also include preparation of engineering documentation like cable schedule and Inter- connection diagram.

1.2.8. Interior Designing, supply and installation of all required furniture inclusive of system consoles required to house the servers, monitors etc,

1.2.9. Design, supply, installation, testing and commissioning of air-conditioning system for Server as necessary and to the approval of the engineer.

1.2.10. Design, supply, installation, testing and commissioning of GPRS communication receiver / transmitter unit with associated hardware & software including Gateway units at Centralized Monitoring Station to receive data from the Remote Terminal Unit/ Battery or UPS Powered Flow Meter.

1.2.11. Static IP/ Lease Line at Department Premises wherever necessary to be provided by the contractor at no extra capital or recurring cost.

1.2.12. In order to Forecast total requirement**,** identify constraints**,** regulate flow as per requirement**,** Oversee quantity of water, the system should be designed to generate uninterrupted customized system reports (PDF, XLS, WORD) as per the requirements of the department for hourly , daily , weekly , monthly reporting followed by tracking events for operations and failures as and when they occur, show trends of consumption in order to facilitate better & cost effective service.

1.2.13. The Entire network Mimic/Graphical Representation should be displayed with real time mapping of all pumping station and flow meters with respective servers to display real time flow parameters on the Mimic Screen for authorities to see and respond real time in event of failures at Web Based Monitoring System. GPS Location of flow meter shall also be indicated on Web Based Monitoring System.

1.2.14. All networks should also be separately visible and maped with respective pumping station, each zone and flow meters to see flow data real time at Web Based Monitoring System.

1.2.15. Provision of memory in Cloud based Server should be made to accommodate and store Data for the entire contract period in addition to the local servers installed.

1.2.16. Daily consumption should be conveyed by SMS to both consumer and department.

1.2.17. Mobile Application to be provided to all the users for communication of all the parameters within the department and with consumers. This mobile application should incorporate necessary interactive platform for alarms and events to respond.

1.2.18. Events related to System and operational failures should be generated at Web Based Monitoring System level and communicated to respective users and consumers.

1.2.19. System generated untempered bills to be generated on monthly basis for consumers and department.

1.2.20. Electronic earth pits as and where required, as per applicable standard & also meeting Instrumentation system requirement and including supply & laying of earthing cables with required accessories shall be under Contractor's scope.

1.2.21. Contractor's scope shall also include supply of spares & consumables for successful commissioning and establishment of performance guarantee of the offered plant equipment & system.

1.2.22. Submission of drawings & documentation as specified in this bid document.

1.2.23. Provision of any other Instrumentation and control equipment, not specifically mentioned in this document, but required for trouble free and safe operation of the system, is also included under Contractor's scope.

1.2.24. Contractor shall include & arrange for training of Client's personnel for automation & special instrumentation items at manufacturer's works and also at site in his scope, details & modalities of which will be mutually discussed and finalised later.

1.2.25. Contractor's scope also includes arranging visits by respective instrumentation, control & automation equipment manufacturer's competent representatives at site, as & when required, during erection & commissioning.

1.2.26. Shut down Time has to be strictly followed by the contractor as per scheduled given below in consultation with Engineer In-charge. Any Deviation or Time Constraint, Contractor has to bring to the notice of the department.

- Maximum of 7 Days should be allotted for Installation of each flow meter without any shut down, the contractor has to deploy multiple team for installation so as to finish the job in Time. In case the department is not in a position to give shut down in maximum of 30 days from the written demand by the contractor then the time limit deduction will not be applicable and the engineer in charge will have to give explanation for the same.

1.2.27. Provision for supply and installation of pipes/expander-reducer of required dia and length, wherever required is to be made by the contractor without any cost implication.

1.2.28. Inspection Vehicle (1 No Minimum) based survey to be carried out on monthly basis and as when required or demanded by the department should be conducted. Over and above regular inspection all complaints/ faults will have to be attended within 48 hours for repairs (excluding of minimum travel time and shut down period if any).

1.2.29. Work Station, Laptop & Printer (1 Nos Minimum) with Installed software to be procured and kept on site/ control room.

1.2.30. PLC communication wherever available should be repaired/ upgraded by providing and fitting missing links or equipment's if necessary after detailed survey and integrated with web based system to provide required data at Web Based Monitoring System.

1.2.31. It is not the intent to completely specify all details of design and construction herein. Nevertheless, the Instrumentation & Control system shall confirm to high standard of engineering, design and workmanship in all respects and shall be capable of performing satisfactorily in continuous operation under the specified environmental conditions.

1.2.32. Contractor shall include all necessary and supplementary items & equipment in his proposal required for completeness, safe & efficient operation of the offered system, even though

these may not have been mentioned in this specification.

1.2.33. Employer reserves the right to issue addendum to the technical specification to indicate modification/ changes in the requirements, if so required at a later date prior to bid submission.

1.3. **Specific Requirements:**

1.3.1. All the Instruments irrespective of diameters should be supplied within 6 months from the date of work order.

1.3.2. Standard installation/ Calibration norms as per ISO/ IEC: 17025 are to be followed strictly.

1.3.3. An installation of the central server, and central control and command centre with activation should be done on priority within first month of contract agreement or on allotment of site by department, so that the installation work can be seen and monitored on this platform.

1.3.4. The communication technology adopted based on GSM/ GPRS for real time web based monitoring should be based on push-pull protocol for polling the data as per scheduled but whenever any data is required at any given point of time that can be polled manually.

1.3.5. The frequency of data transmission to the department should be as per scheduled mentioned below.

Daily Measured data – Every 12 Hours (Twice in 24 Hours)

Real Time Instant Measured Data- Instant at any given point of time as & when required

Alarms & Events – Instant

Data & Reports Transmission via e-mail and SMS by integrated GSM/GPRS modem.

Reliable data storage facility through integrated SD card.

1.3.6. At time of entering in to a contract and signing the agreement, in the kick-off meeting the contractor shall have to display all information with presentation regarding, the system architecture, specifications, makes, models, manufacturing & delivery schedules , statutory clearances if any, involvement of other departments, sequence of operations to be observed, work schedule projections as per the timeline laid in the tender etc. before the start of execution work in the presence of all his JV and consortium members, the counterpart and original manufacturers from whom he is going to purchase all equipment's so that the project monitoring of actual performance against the projection laid down can be monitored and followed.

1.3.7. The required Daily, Weekly, fortnightly, Monthly report formats and trending graphs shall have to be endorsed by Client before implementation or incorporation in to the system

1.3.8. The sequence of supply of material and its installation should be carried out as per the priority laid down by the Client. Installation of the communication device and its connectivity to the central monitoring unit is supposed to be carried out in parallel by deploying multiple gangs, so that the DATA of connecting Instruments is monitored by Client while work in progress.

1.3.9. The installation of Instruments is to be carried out as per the installation procedure mentioned in the tender specifications and is to be done in supervision of the concerned in-

charge Engineer.

1.3.10. The installation of Instruments is to be carried out in presence of representative of original equipment manufacturer. It will be joint responsibility of the contractor and manufacturer to carry out installation and its functions which after completion of work should be certified by both the agencies with respect to specifications, correctness of Installation, calibration etc. The installation of Instruments is the site-specific subject. In order to have a correct and accurate reading consistently, the scientific and technically acceptable installation is to be jointly be certified by the owner in-charge Executive Engineer.

1.3.11. The Size wise quantity of Instruments decided in the tender is indicative only. There may be an additions or subtractions or alteration of the placement of installation of Instruments size will be decided on the recommendation from the concern in-charge Executive Engineer.

1.3.12. Since Installation of flow meters might require shut down which might affect regular water supply in case of RWSS and Bulk pipe lines hence the priority of the installation will have decided as per the availability of shutdown by in-charge engineer in consultation with respective higher authorities.

1.3.13. The engineer in-charge will be totally responsible for the availability of site access (shutdown for installation) within a week from the written demand made by the agency/ contractor and in case of any hurdle or un-avoidable circumstances, the period should not be extended beyond 30 days.

1.3.14. Availability of shutdown will severely affect the time of completion of the job. This is required to be articulated date wise and submitted in case of time limit extension for approval.

1.3.15. The contractor must deploy enough number of team for the SITC, in order to execute the work simultaneously/parallel in all pumping station/ WTP.

1.3.16. Time limit delay proposal for any delay in execution shall have to be submitted through Concerned Engineer in Charge with proper justification.

1.3.17. Agency has to ensure and ascertain available velocity at the point of installation which should be within defined velocity range (0.3 to 4 m/sec) to attain required accuracy irrespective of seasonal demand and the flow meter size should be selected accordingly. Any additional expenditure towards expander-reducer or other modification charges shall have to be borne by the agency.

1.3.18. In order to maintain new/ existing flow meter chamber, agency has to make water tight arrangement of Flow Meter Chamber.

1.3.19. All Remote Terminal Unit (RTU)/ PLC Panel shall have Door Limit Switch and if door open at any time that event shall logged and updated on web based monitoring system.

1.3.20. Flow meter Reading verification/ validation to be done at site after installation of Flow Meter which shall be certified by engineer in-charge and agency (±2% in case of Ultrasonic flow meter and ±0.5% in case of Electromagnetic flow meter).

1.3.21. All flow meter reading shall be verified annually with highly accurate clamp on flow meter. Master Clamp on Flow Meter used for calibration shall be accredited by FCRI Lab.

1.3.22. In case of both type of flow meters the calibration/ verification/ validation should be carried out using flow simulator/ clamp on flow meter to ascertain required accuracy.

1.3.23. All Flow Meter and RTU Panel shall have dedicated Earthing Electrode for safety purpose.

1.3.24. In order to attain link redundancy dual sim data transmission system should be incorporated

(hot swappable). The technology should enable the second link in case of failure of first link automatically resulting in no loss of data any circumstances. (This should be ensured before installation by agency)

1.3.25. In order to ensure constant connectivity and signal strength across the network, agency should enter in to service level agreement with the service provider to ascertain better service and maximum up time (99.5% up time).

1.3.26. All 230 VAC operated flow meter shall have UPS facility with stabilizer facility to operate flow meter in the range of 85 VAC to 300 VAC.

1.3.27. Separate Report sheet for Total water lifted from source of water, Industrial consumption and domestic consumption to be reported as & when required.

1.3.28. Minimum 2 Time per day data shall be push from Flow Meter RTU Panel and Existing PLC System. This should include the facility to pull data from the field to central monitoring system at any given point of time as & when required.

1.3.29. All required software for central monitoring system and RTU/ PLC System shall be provided by agency and updated up to 10 year without any extra cost.

1.3.30. Soft Billing: Details of End User (Name & Email ID) provided by Department in order to generate automated billing system.

1.3.31. The Software created by bank for collection of tariff from industrial user will required to be incorporated with this system software.

1.3.32. Alarm Annunciation is required to be incorporated at central monitoring system as well as mobile application for the decided parameter's out of range performance (Range will be decided by Client).

1.3.33. Real Time System Generated Report as per requirement of Client (as & when) shall be provided.

1.3.34. In order to incorporate quality parameters of filtered water for distribution out of water treatment plant, enough scalability shall be provided in the system for future expansion in this area.

1.3.35. If biometrics system available & operational in pumping system and that data available in PLC system then the same data to be made available in central monitoring station.

1.3.36. Following documents required from OEM (Instruments & PLC System) along with bid for technical evaluation.

- Certificate of Incorporation
- license of OEM under factories Act
- Registration of quality management system ISO 9001:2015
- Scanned copy of PAN card
- Documentary Evidence as System Integrator
- LAB Certificate in accordance with ISO 17025 (In house Flow Test Lab accredited in accordance with ISO 17025 having accuracy 3 times better than flow meter accuracy, certificate to be submitted along with the bid. 100% flow meter to be tested. If in-house Lab is not available all 100% flow meter shall be calibrated at FCRI and inspection to be offered at FCRI only.

- IP 67/ IP 68/ National Electrical Manufacturers Association (NEMA) Type Test Certificate for Product Quality Assurance
- Welding Procedure Certificate in accordance with ISO 3834
- Digital Communication protocol i.e Hart communication, Registration Certificate to be submitted
- Conformité Européene (CE)/ Measurement Instrument Directive (MID)/ International Organization of Legal Metrology (OIML)/ equivalent Certification for Product to be submitted

2. Design Criteria for Instrumentation & Control Equipments:

2.1. Instrumentation, Control & Automation (ICA) system shall be designed, manufactured, installed and tested to ensure the high standards of operational reliability.

2.2. The instruments shall be designed to work at the ambient conditions of temperature, humidity, and chlorine contamination that may prevail.

2.3. The performance of all instruments shall be unaffected for the ±10% variation in supply voltage and ±5% variation in frequency simultaneously.

2.4. Unless otherwise stated, the normal working range of all indicating instruments shall be between 30% and 70% of the full scale range.

2.5. Unless otherwise stated, degree of protection for field mounted electrical and electronic instruments shall be IP 67. All instruments of submersible type shall be protected to IP 68. The Field Mounted RTU/ Modem Cabinets shall be IP66 as a minimum.

2.6. Unless otherwise stated, overall accuracy of all measurement systems shall be ±2% for ultrasonic flow meter and ±0.5% for electromagnetic flow meter or better of the measured value.

2.7. Unless otherwise stated, all displays shall be of the digital type with no moving parts.

2.8. Unless otherwise stated, zero and span adjustments shall be provided for all instruments.

2.9. The velocity of fluid should not be less than 0.3 m/s and not generally exceed 4.0 m/s. For Underground installation, Flow Meter chamber shall be provided. Necessary Inlet and Outlet Straight Runs to be ensured as per manufacturer's recommendation and Site Situations.

2.9.1. All the field-mounted transmitters shall be 'Smart' type. The instrumentation system shall be based on 4-20 mA DC signals, generally working on two-wire/ four-wire signal system with superimposed digital signal as per HART(Version 5 or above)/ RS 485 protocol. The instrumentation & control equipment to be provided shall be suitable for continuous duty & for round-the-clock operation of the plant throughout the year.

2.10. Electronic instruments shall be of proven design and shall utilize solid state electronic components, integrated circuits, microprocessors, etc.

2.11. All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect plant operation.

2.12. The instruments shall be designed to permit maximum inter-changeability of parts and ease of access during inspection and maintenance.

2.13. The relay/switch contacts shall be rated for the voltage of the circuit in which they are to be wired.

2.14. After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.

2.15. Dual redundant SMPS shall be used for powering 24 V DC Instrumentation, Control & Automation equipments.

2.16. Inlet-outlet parameter measuring instruments of plant shall be compatible to GSM/ GPRS module interface.

2.17. Instruments offered shall be complete with all the necessary mounting accessories.

2.18. The outdoor equipment shall be designed to withstand tropical rain. Wherever necessary, space heaters, dust and water proof cabinets shall be provided. Unless otherwise specified, all instruments shall be tropicalised.

2.19. The instruments shall be given enough protection against corrosion and all the wetted parts of the instruments shall be non-corrosive. Lockable & tamperproof enclosure shall be provided for all the field mounted instruments.

2.20. All field instruments and cabinets/panel mounted instruments shall have tag plates/name plates permanently attached to them. The tagging, numbering & colour philosophy shall be as per ISA standard.

2.21. Unless otherwise specified, double compression glands shall be used for glanding the cable in field instruments and instrument control panel.

2.22. The field instruments i.e. the instruments mounted outside the control panel shall be mounted at a convenient height of approximately 1.2 meters above ground platform.

2.23. The monitoring system for the proposed project shall be designed & implemented through a Web Based Monitoring System covering the total functional & monitoring requirements of the system.

2.24. Web Based Monitoring System, Remote Terminal Unit / PLC system selected shall be **Open Platform Communications** (OPC) compatible to accommodate different makes to communicate through common interface.

2.25. A Centralized Control Room (CCR) shall be provided by the Department to installed Dash Board Type LED Display, in which the automation equipment will be installed for Monitoring of the Water Transmission and Distribution network.

2.26. On line PLC programme modification wherever essential to communicate with web based monitoring system by providing necessary interface (OPC Layer).

2.27. Separate electronic earthing system with dedicated earth pit shall be provided by the bidder for I&C equipment.

2.28. All equipment shall be suitable for continuous operation. Instruments mounted in field and on panels shall be suitable for continuous operation of plant.

2.29. The equipment offered shall be type tested at recognized laboratory or institute during the last 5 years to meet all the technical requirements laid down under this specification. A proof of such testing shall be submitted.

2.30. Unless & until specify, all electronics equipment shall have minimum 3 years of warranty from the original manufacturer.

2.31. Bidder shall also be responsible for the laying of the network of electronic earthing cables including all the applicable accessories.

2.32. Bidder shall be responsible for engineering, selection and connection of all components and sub systems to form a fully complete system whose performance is in accordance with functional, parametric and other requirements of this specification.

2.33. All the instrumentation & automation equipment and their accessories shall be supplied from approved manufacturers, whose successful performance has been established by record of satisfactory operation in plants.

2.34. It is not the intent to specify all individual system components since the bidder has full

responsibility for engineering and furnishing of a complete system meeting the monitoring and control requirements of all equipment associated with the system.

3. General Technical & Particular Requirements for Instrumentation & Control Equipments/ Systems :

3.1. List of Measurements and Control:

3.1.1. The Instrumentation-SCADA System and Domestic Water Metering System shall be provided with required instrumentation equipment for measurement & control functions, indicated below as a minimum, but not limited to the following:

a) Flow measurement at inlet and outlet of pumping system/ WTP, at common header of pumps and at off take

b) Level Measurement at sump/ Tank

c) Pressure Measurement at Pump/ Blower Discharge/ Common Header

d) Loss of Head Measurement & Rate of Flow Measurement at Filter Bed

e) pH, Turbidity and Chlorine Measurement at Water Treatment Plant

f) Automation System at various water works

g) UPS at each station

h) Contractor may propose additional instruments & control equipments for safe, reliable & efficient operation of Web Based Monitoring System proposed by him.

i) Required quantities and application of the above instruments shall be provided as per Price Schedule B

j) Necessary alarms, status signals along with the measurements of Web Based Monitoring System parameters etc. shall be displayed on HMI/ Dash Board.

3.2. Fields Instruments

3.2.1. Full bore Electromagnetic flow meter (EFM) (Applicable if available in Price Schedule B):

a) Full bore type Electromagnetic flow meter quantities shall be considered as per price schedule.

b) The flow meter shall consist of flow sensor (i.e., flow tube), flow transmitter/ flow computing unit and remote flow indicator cum integrator.

c) Following shall be considered as a general guideline for installation of EFM.

For pipelines ≤ 1400mm- Full Bore Electromagnetic Flow meter

d) The electromagnetic flow meter shall be manufactured as per BS EN ISO 6817 standard- measurement of conductive liquid flow in closed conduits, method using electromagnetic flow meters.

e) The flow tube flanges and transmitter housing shall be properly earthed.

f) Flow tube shall have waterproof construction (IP68) and shall be suitable for installation on underground pipe lines buried directly in the soil and also suitable for above ground pipelines.

g) The transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flow range and features of memory and self diagnosis.

h) The transmitter shall be mounted separate from the flow tube, connected by a cable.

i) The flow transmitter and flow computation/ evaluation unit shall be mounted in a field mounted field enclosure / cabinet.

j) The electromagnetic flow meter shall have bi-directional measurement feature and with accuracy better or equal to ± 0.5% of measured value inclusive of linearity, repeatability, pressure effect etc.

k) Flow transmitter/ flow computing unit should be microprocessor based having digital display with flow-rate indications and integrated flow values with the configuration facility from the front face.

l) Material of construction of the wetted parts of flow meters shall be suitable for functioning on raw / treated and chlorinated water applications.

m) Flow tube shall be rugged in construction and shall be suitable for continuous operation.

n) Flow meters shall be suitable for the water turbidity at site during various seasons.

o) The flow meter shall be installed in such a way that it always remains filled with water. If required, contractor to modify the piping to achieve this.

p) To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter shall be provided, as required by the flow meter manufacturer.

q) The flow tube shall be installed at a location free from flow turbulence. In order to achieve the same, the flow tubes shall be installed in the pipe section such that straight lengths of pipe without bends or tee connection shall be minimum 5 diameters on upstream and 2 diameters on downstream side.

r) The Contractor shall finalize the exact location of flow transducers in consultation with Purchaser/ Engineer In-Charge.

s) The flow meter output signals shall contain the data for flow-rate and integrated flow readings. The output signal of the flow meter will be connected to RTU/ PLC.

t) Technical Particulars- Full Bore Electromagnetic Flow Transmitter (Regular Power Operated):

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	makes mentioned in this tender (Volume-2, Clause No.6)
1.2	Item	Full Bore Electromagnetic Flow Meter (Regular Power Operated)
1.3	Service	Water Transmission and Distribution Network
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Flow Sensor**	
2.1	Type	DC pulsed
2.2	Electrode / Sensor MOC	SS316
2.3	Flow Tube MOC	SS304
2.4	Coil Housing MOC	SS 304/ SS316/ As per manufacturer standard (since meter are going to be buried underground or submerged in water during rainy season)
2.5	Grounding Ring/ Electrode MOC	SS 304
2.6	Liner MOC	Neoprene/ Hard Rubber/ Polyurethane or equiv.
2.7	Process Connection	Flanged
2.8	Flange MOC	CS
2.9	Housing Protection	IP 68
2.10	Pressure Rating	PN 1.6 (16 Kg/cm2)
2.11	Temperature	60 ℃ Ambient
2.12	Size(mm)	To suit mains flow parameters, with pipe reducer / expander provided to ensure full bore condition
3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC (UPS Power)
3.3	Accuracy	± 0.5 % of measured value
3.4	Repeatability	+/-0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate or Manufacturer standard
3.7	Output	• One Current – 4 to 20 mA (isolated) proportional to flow rate

Sr. No.	Description	Particulars
		• Hart/ Modbus • One Scalable Pulse • One Status Output
3.8	Communication	Flow Meter will communicate to Data Logger/ PLC based RTU through Modbus Output
3.9	Display	Min. 2 Line LCD, Programmable
3.10	Maximum Digit Display	Min 8 Digit or as per manufacturer standard
3.11	Indication on Display	• Actual Flow Rate / Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow / Sum / Totalizers • Alarm
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following:
		Diagnostic • Continuous self test shall include • Error message Coil Error • Error message Signal input circuit Break • Error message for Electrode impedance • Empty Pipe Detection
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
3.16	Data Protection:	All data shall be stored in an EEPROM.
4	**UPS (In case of Regular Power Supply)**	
4.1	UPS Type	Online Industrial Type
4.2	UPS Input Supply	230 VAC
4.3	UPS Output supply	230 VAC
4.4	Battery Back up	2 Hours
4.5	Minimum VA	1000 VA
4.6	Battery Type	SMF VRLA
5	Drawing & Document	
5.1	Datasheet along with OEM	Required

Sr. No.	Description	Particulars
	Catalogue	
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	Inspection	
6.1	3 Point Wet Calibration	Required
6.2	Megger Test/ Insulation Resistance Test	Required
6.3	Hydro Test	Required
6.4	Dimension Test	Required
6.5	LAB Certificate in accordance with ISO 17025	In house Flow Test Lab accrediated in accordance with ISO 17025 having accuracy 3 times better than flow meter accuracy, certificate to be submitted along with the bid. 100% flow meter to be tested. If in-house Lab is not available all 100% flow meter shall be calibrated at FCRI and inspection to be offered at FCRI only. No additional cost shall be provided for the same.
6.6	Witness of Flow Meter Testing	10% or 1 no of each size whichever is higher
6.7	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.8	Country of Origin Certificate	Required
6.9	Welding Standard	ISO 3834
7	**GPRS MODEM and Data Logger along with Battery (External/ Internal)/ Regular Power**	
7.1	Type	Battery Operated/ Regular Power
7.2	Battery Type	Lithium or as per manufacturer standard
7.3	Battery Life	Minimum 5 Year (Data Transmission minimum Twice a Day)

Sr. No.	Description	Particulars
7.4	Communication	GPRS wireless communication with centralized server located at Gandhinagar
7.5	Input to Data Logger	Minimum 1 X Flow Input & Pressure Input, 1 X Door Open Feedback
7.6	Primary Recording	As per Manufacturer Standard
7.7	Scheduled Data Transfer and Event Triggered Transfer	Required
7.8	Facility for on line diagnosis	• Alarm statistics and logging for fault analyzing • Data calculation, handling and storing(Data Logger) • Totalized statistic shall be backed up every 10 min • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
7.9	Installation of GPRS Modem/ Data logger	In weatherproof Cabinet

3.2.2. Technical Particulars- Full Bore Electromagnetic Flow Transmitter (Battery Power Operated): (**Applicable if available in Price Schedule B**)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	makes mentioned in this tender (Volume-2, Clause No.6)
1.2	Item	Battery powered Electromagnetic Flow Meter
1.3	Service	Water Transmission and Distribution Network
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Flow Sensor**	
2.1	Type	DC pulsed
2.2	Electrode / Sensor MOC	SS316 or Manufacturer Standard
2.3	Flow Tube MOC	SS304 or Manufacturer Standard
2.4	Coil Housing MOC	SS304 or Manufacturer Standard
2.5	Grounding Ring/ Electrode MOC	SS 304 or Manufacturer Standard

Sr. No.	Description	Particulars
2.6	Liner MOC	Neoprene/ Hard Rubber/ Rilsan/ Polyurethane or equiv.
2.7	Process Connection with Companion Flange	Flanged
2.8	Flange MOC	CS
2.9	Housing Protection	IP 68
2.10	Pressure Rating	PN 1.6 (16 Kg/cm2)
2.11	Temperature	60 ℃ Ambient
2.12	Size(mm)	To suit mains flow parameters, with pipe reducer / expander provided to ensure full bore condition
3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	Battery Powered (Minimum 5 Years Battery Life)
3.3	Accuracy	± 0.5 % of measured value
3.4	Repeatability	+/-0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	Pulse Output Modbus Output
3.8	Communication	Flow Meter will communicate to Data Logger/ PLC based RTU
3.9	Display	Min. 2 Line LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	• Totalized Flow • Battery Indication
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following:
		Diagnostic • Continuous self test shall include • Battery Status
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
3.16	Data Protection:	• All data shall be stored in an EEPROM.

Sr. No.	Description	Particulars
4	**GPRS MODEM and Data Logger along with Battery (External/ Internal)**	
4.1	Type	Battery Operated
4.2	Battery Type	Lithium or as per manufacturer standard
4.3	Battery Life	Minimum 5 Year (Data Transmission minimum Twice a Day)
4.4	Communication	GPRS wireless communication with centralized server located at Gandhinagar
4.5	Input to Data Logger	Minimum 1 X Flow Input & Pressure Input, 1 X Door Open Feedback
4.6	Primary Recording	As per Manufacturer Standard
4.7	Scheduled Data Transfer and Event Triggered Transfer	Required
4.8	Facility for on line diagnosis	• Alarm statistics and logging for fault analyzing • Data calculation, handling and storing(Data Logger) • Totalized statistic shall be backed up every 10 min • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
4.9	Installation of GPRS Modem/ Data logger	In weatherproof Cabinet
5	Drawing & Document	
5.1	Datasheet along with OEM Catalogue	Required
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	Inspection	
6.1	3 Point Wet Calibration	Required
6.2	Megger Test/ Insulation Resistance Test	Required
6.3	Hydro Test	Required

Sr. No.	Description	Particulars
6.4	Dimension Test	Required
6.5	LAB Certificate in accordance with ISO 17025	In house Flow Test Lab accrediated in accordance with ISO 17025 having accuracy 3 times better than flow meter accuracy, certificate to be submitted along with the bid. 100% flow meter to be tested. If in-house Lab is not available all 100% flow meter shall be calibrated at FCRI and inspection to be offered at FCRI only. No additional cost shall be provided for the same.
6.6	Witness of Flow Meter Testing	10% or 1 no of each size whichever is higher
6.7	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.8	Country of Origin Certificate	Required
6.9	Welding Standard	ISO 3834
6.10	Installation of GPRS Modem/ Data logger	In weatherproof Cabinet

3.2.3. **Multi Path (2/ 4) Insertion Type Ultrasonic flow meter(UFM) (Applicable if available in Price Schedule B) :**

a) Multi Path Insertion Type Ultrasonic Flow Meter quantities shall be considered as per price schedule.

b) Flow meter shall be of multi-path. Ultrasonic Transducers shall work on transit-time (time of flight) principle. The transducer probe shall be of the wet insertion type with facility for online insertion and retraction. The desired installed accuracy of flow measurement loop +/-2% shall be achieved.

c) Following shall be considered as a general guideline for installation of UFM.

For pipelines > 500mm- Multi path UFM

d) The Contractor shall identify a section of pipe having uniform diameter and adequate straight length (10D upstream & 5D downstream or as per manufacturer standard), for installation of flow probes/sensors at the site, so as to configure a flow meter. The exact inside diameter of the pipe at the location of flow transducer shall be used for flow computation so that desired system accuracy of +/- 2% can be achieved

e) Contractor shall construct a suitable concrete chamber for enclosing flow transducers to be mounted on underground pipe lines. A tamperproof & lockable enclosure shall be provided for the flow transmitter cum computing unit.

f) In order to facilitate the removal / reinsertion of the flow transducers when the pipe-line is pressurized, the Contractor shall provide arrangement of isolation valve and an insertion-retraction tool assembly, which shall be leak proof at 1.5 times the working pressure. The same shall be made of anti corrosive material.

g) The flow computer shall be microprocessor based and shall have diagnosis facilities.

h) The range of the Flow meter shall be adjustable.

i) Each flow meter shall be such that it can be configured using a laptop computer. All necessary laptop, software and software licenses needed to configure the flow meters shall be provided by contractor to client.

j) The Contractor shall make available a clamp-on flow meter with suitable transducers for initial assessment of the flow meter and based on the measured flow, the range of the instrument shall be configured. Instrument accuracy of this clamp on type flow meter shall be better than the installed flow meter and should be certified by FCRI accreditation. On site calibration in consultation with TPI dually certified by them at regular intervals should be carried out and reported annually/ as when required by the department.

k) Each laptop computer shall be of the latest configuration and incorporate:

   i Min. 2 GHz dual core processor or better

   ii 4 Gigabyte (GB) DDR2 Random Access Memory (RAM), or better

   iii Hard disc with 1000 Gigabyte memory, or better

   iv 15.4” TFT display

   v DVD RW drive

   vi keyboard with English letters

   vii Ports to enable the computer to be connected to a water meter electronic display unit, an external mouse, a printer, another computer and to a CD writer.

   viii Minimum two USB ports

   ix Wi-Fi (WIRELESS)

l) The following items shall be provided with each laptop computer:

i Mains power supply unit, complete with an appropriate mains plug and leads, suitable for use with a 240V 50Hz single phase & neutral electricity supply

ii Cordless mouse

iii Carrying bag.

m) User friendly latest available industrially operating system shall be installed on each lap-top computer, together with any other software (licensed version) needed for the configuration of the water meter electronic display units. Two further copies of this software shall be supplied on CD-ROM.

n) The Contractor shall obtain software licenses permitting the software supplied to be used simultaneously on two computers.

o) The above specification for computer hardware and software is indicative only. The contractor should take the approval of the engineer before commencing any design or purchase of the above mentioned hardware and software. The above specifications shall be an integral part of the FDS submittal.

p) The Contractor shall finalize the exact location of flow transducers in consultation with Employer/ Engineer In-Charge.

q) The flow meter output signals shall contain the data for flow-rate and integrated flow readings. The output signal of the flow meter will be connected to RTU/ PLC/ Data Logger.

r) Technical Particulars- Multi Path Insertion Type Ultrasonic Flow Transmitter:

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	makes mentioned in this tender (Volume-2, Clause No.6)
1.2	Item	Ultrasonic Insertion Flow Meter
1.3	Service	Water Transmission and Distribution Network, Should be suitable for all types (MOC) of pipes
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Flow Sensor**	
2.1	Type	Insertion type (Clamp-on type not acceptable)
2.2	Measuring principle	Transit time
2.3	Electrode / Sensor MOC	SS316
2.4	No. of paths	Multi path (Two/ four paths)

Sr. No.	Description	Particulars
2.5	No. of Sensor	4/ 8 Nos
2.6	Retraction Tool for online removal / insertion of flow sensors without depressurization of the line	Retraction tool shall be provided with individual meter.
2.7	Accessories	Prefabricated integral cables for connecting sensors and transmitter, Isolation valves
2.8	Housing Protection (Sensor)	IP 68
2.9	Pressure Rating	16 Kg/cm2
2.10	Temperature	60 ℃ Ambient
3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC (UPS Power)/ 24 VDC/ Self Battery Powered
3.3	Accuracy	± 2 % of measured value
3.4	Repeatability	+/-0.3%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	• One Current – 4 to 20 mA (isolated) proposanal to flow rate • Hart/ RS 485 • One Status Output
3.8	Communication	Flow Meter will communicate to Data Logger/ PLC based RTU
3.9	Display	Min. 2 Line LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	• Actual Flow Rate / Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow / Sum / Totalizers • Alarm
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following:
		Diagnostic

Sr. No.	Description	Particulars
		• Continuous self test shall include • Error message- Signal Input Circuit Break • Error message- Sensor Clean, Empty Pipe
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	as per site requirement
3.16	Data Protection:	• All data shall be stored in an EEPROM.
4	**UPS (In case of Regular Power Supply)**	
4.1	UPS Type	Online Industrial Type
4.2	UPS Input Supply	230 VAC
4.3	UPS Output supply	230 VAC
4.4	Battery Back up	2 Hours
4.5	Minimum VA	1000 VA
4.6	Battery Type	SMF
5	**Drawing & Document**	
5.1	Datasheet along with OEM Catalogue	Required
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	**Inspection**	
6.1	3 Point Wet Calibration	Required (100 % Site Calibration & 10% Factory Calibration before supply of Instruments)
6.2	Megger Test/ Insulation Resistance Test	Required
6.3	Hydro Test	Required
6.4	Dimension Test	Required
6.5	LAB Certificate in accordance with ISO 17025	In house Flow Test Lab accredited in accordance with ISO 17025 having accuracy 3 times better than flow meter accuracy, certificate to be submitted

Sr. No.	Description	Particulars
		along with the bid. 100% flow meter to be tested. If in-house Lab is not available all 100% flow meter shall be calibrated at FCRI and inspection to be offered at FCRI only. No additional cost shall be provided for the same.
6.6	Witness of Flow Meter Testing	10% or 1 no of each size whichever is higher
6.7	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.8	Country of Origin Certificate	Required
6.9	Welding Standard	ISO 3834
7	**GPRS MODEM and Data Logger along with Battery (External/ Internal)/ Regular Power**	
7.1	Type	Battery Operated/ Regular Power
7.2	Battery Type	Lithium or as per manufacturer standard
7.3	Battery Life	Minimum 5 Year (Data Transmission minimum Twice a Day)
7.4	Communication	GPRS wireless communication with centralized server located at Gandhinagar
7.5	Input to Data Logger	Minimum 1 X Flow Input & Pressure Input, 1 X Door Open Feedback
7.6	Primary Recording	As per Manufacturer Standard
7.7	Scheduled Data Transfer and Event Triggered Transfer	Required
7.8	Facility for on line diagnosis	• Alarm statistics and logging for fault analyzing • Data calculation, handling and storing(Data Logger) • Totalized statistic shall be backed up every 10 min • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
7.9	Installation of GPRS Modem/ Data logger	In weatherproof Cabinet

3.2.4. **In Line Ultrasonic Flow Meter (Applicable if available in Price Schedule B)**

a) Full Bore Inline Ultrasonic Flow Meter- Inbuilt Battery Power/ Self Power operated (PN 16) shall be considered as per price schedule.

b) Full Bore Inline Ultrasonic flow meter shall be factory calibrated, Inbuilt Battery Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz. surge arrestor, associated cables, cabinets, hardwares, etc complete as per following specifications:

c) Flow Meter/ Sensor: Ultrasonic type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding Electrode, Neoprene/Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges.

d) Flow Transmitter/ Converter (Remote Field Mounted): Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display, ±0.5% accuracy at 0.3 to 4 m/sec velocity, one scalable pulse, one status, one GPRS/ GSM output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger,20 meters cable length for sensor to transmitter communication, Minimum 5 years battery life time, 3.6 VDC Non Rechargeable Lithium-thionyl chloride/ Ni-Cd high power batteries,

e) The frequency of data transmission to the department should be as per scheduled mentioned below.

Daily Measured data – Every 12 Hours (Twice in 24 Hours)

Real Time Instant Measured Data- Instant at any given point of time as & when required

Alarms & Events – Instant

Data & Reports Transmission via e-mail and SMS by integrated GSM/GPRS modem.

Reliable data storage facility through integrated SD card.

f) RTU Panel shall be provided for Field Mounted Transmitter Installation.

g) Necessary pipe/ elbow for Making Flow Meter in full bore condition is in Bidders Scope.

h) The flow meter shall consist of flow sensor, flow transmitter/ flow computing unit and remote flow indicator cum integrator.

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	makes mentioned in this tender

Sr. No.	Description	Particulars
		(Volume-2, Clause No.6)
1.2	Item	Ultrasonic Inline Flow Meter complete with Spool piece
1.3	Service	Water Transmission and Distribution Network
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Flow Sensor**	
2.1	Type	Inline
2.2	Measuring principle	Transit time
2.3	Electrode / Sensor MOC	SS316
2.4	Process Connection with companion flange	Flanged
2.8	Housing Protection (Sensor)	IP 68
2.9	Pressure Rating	16 Kg/cm2
2.10	Temperature	60 ℃ Ambient
3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC (UPS Power)/ 24 VDC/ Self Battery Powered
3.3	Accuracy	± 2 % of measured value
3.4	Repeatability	+/-0.3%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	• One Current – 4 to 20 mA (isolated) proposanal to flow rate • Hart/ RS 485 • One Status Output
3.8	Communication	Flow Meter will communicate to Data Logger/ PLC based RTU
3.9	Display	Min. 2 Line LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	• Actual Flow Rate / Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow / Sum / Totalizers • Alarm
3.12	Zero and Span adjustment	Factory set Password protection of all

Sr. No.	Description	Particulars
		parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following:
		Diagnostic • Continuous self-test shall include • Error message- Signal Input Circuit Break • Error message- Sensor Clean
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	as per site requirement
3.16	Data Protection:	• All data shall be stored in an EEPROM.
4	**UPS (In case of Regular Power Supply)**	
4.1	UPS Type	Online Industrial Type
4.2	UPS Input Supply	230 VAC
4.3	UPS Output supply	230 VAC
4.4	Battery Back up	2 Hours
4.5	Minimum VA	1000 VA
4.6	Battery Type	SMF
5	**Drawing & Document**	
5.1	Datasheet along with OEM Catalogue	Required
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	**Inspection**	
6.1	3 Point Wet Calibration	Required (100 % Site Calibration & 10% Factory Calibration before supply of Instruments)
6.2	Megger Test/ Insulation Resistance Test	Required
6.3	Hydro Test	Required

Sr. No.	Description	Particulars
6.4	Dimension Test	Required
6.5	LAB Certificate in accordance with ISO 17025	In house Flow Test Lab accredited in accordance with ISO 17025 having accuracy 3 times better than flow meter accuracy, certificate to be submitted along with the bid. 100% flow meter to be tested. If in-house Lab is not available all 100% flow meter shall be calibrated at FCRI and inspection to be offered at FCRI only. No additional cost shall be provided for the same.
6.6	Witness of Flow Meter Testing	10% or 1 no of each size whichever is higher
6.7	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.8	Country of Origin Certificate	Required
6.9	Welding Standard	ISO 3834
7	**GPRS MODEM and Data Logger along with Battery (External/ Internal)/ Regular Power**	
7.1	Type	Battery Operated/ Regular Power
7.2	Battery Type	Lithium or as per manufacturer standard
7.3	Battery Life	Minimum 5 Year (Data Transmission minimum Twice a Day)
7.4	Communication	GPRS wireless communication with centralized server located at Gandhinagar
7.5	Input to Data Logger	Minimum 1 X Flow Input & Pressure Input, 1 X Door Open Feedback
7.6	Primary Recording	As per Manufacturer Standard
7.7	Scheduled Data Transfer and Event Triggered Transfer	Required
7.8	Facility for on line diagnosis	• Alarm statistics and logging for fault analyzing • Data calculation, handling and storing(Data Logger) • Totalized statistic shall be backed up every 10 min • Minimum 30 days of data shall be stored

Sr. No.	Description	Particulars
		in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
7.9	Installation of GPRS Modem/ Data logger	In weatherproof Cabinet

3.2.5. **Acoustic Doppler Type Flow Meter(ADFM(Applicable if available in Price Schedule B)**

a) Acoustic Doppler Type Flow Meter shall be considered as per price schedule.

b) The flow meter shall consist of flow sensor, flow transmitter/ flow computing unit and remote flow indicator cum integrator.

c) Following shall be considered as a general guideline for installation of ADFM.

For Open Channel- Acoustic Doppler Type Flow meter

d) The instrument should be based on Acoustic Doppler technology (ADFM) and should be easy to install in open channels with width of 5m.

e) Flow sensor shall have waterproof construction (IP68) and shall be suitable for installation underwater.

f) The Transducer/ transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flow range and features of memory and self-diagnosis.

g) The flow meter shall consist of integrated flow sensor, flow transmitter/ flow computing unit and remote flow display. The Flow Display shall have outputs for RS232 Output, SDI-12 Output, ModBus Output and 4-20mA output

h) The Instrument shall have minimum 10 meter cable from the ADFM instrument to the Flow Display/Transmitter.

i) The instruments shall be factory calibrated and no periodic recalibration shall require for life time of the instrument.

j) The instrument shall be used for raw applications and shall be able to operate in minimum available scattering material.

k) The Acoustic Doppler technology instrument shall have minimum five beams with one acoustic beam for Level measurement and four beams for velocity measurement. In addition the instrument shall also have an inbuilt high resolution pressure sensor for water level measurement.

l) The four acoustic beams shall measure velocity and shall also be capable of velocity profiling in vertical section of the channel and shall measure the horizontal and vertical distribution of velocities in the channel.

m) ADFM shall measure the velocity in 3 dimensions to provide complete coverage of the velocity field and allow for operation in reversing flows. Velocity measurements shall be all the way to the water surface. Instrument shall have facility of automatically adjust velocity measurement cell size with changing water depth

n) Accuracy of the instruments shall be 1% of measured velocity.

o) Instrument shall have built-in temperature sensor & Tilt Sensor.

p) The instrument shall use Pulse incoherent and Smart pulse acoustic technology and shall have built in algorithms to measure accurately flow in open channel either partial or full. Instrument shall automatically determine if the channel is full or partially full, and identifies the best technique to use to measure the velocity of the water.

q) The instrument shall be capable of measuring velocities in minimum 8cm to 9 cm of water.

r) The flow instrument shall measure water velocities from ±0.001 to 10 m/s. should also measures flow direction and also determines and report reversing flow.

s) If one transducer is buried or blocked, the instrument shall have intelligent feature to automatically switch to a one-beam solution for velocity.

t) The instrument shall be included/ connected to a flow display. Instrument shall have Data Storage capacity (minimum 4 GB)

u) All flow computations shall be internal part of the instrument. The instrument shall not require any additional external instrument or a computer to compute the flow.

v) Entire ADFM System can be communicated with other system (PC/ RTU/ PLC etc) and data can be downloaded without interrupting data collection.

w) ADFM system shall be supplied with accessories like appropriate mounting arrangements, convert for power supply if any required, a suitable weather proof enclosure which shall have enough space for Flow display/ transmitter, UPS and Surge arrestor.

x) The Contractor shall finalize the exact location of flow transducers in consultation with Purchaser/ Engineer In-Charge.

y) The flow meter output signals shall contain the data for flow-rate and integrated flow readings. The output signal of the flow meter will be connected to RTU/ PLC.

z) Technical Particulars- Acoustic Doppler Type Flow Meter:

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	makes mentioned in this tender (Volume-2, Clause No.6)
1.2	Item	Acoustic Doppler Type Flow Meter
1.3	Service	Open channel/ off take
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Flow Sensor**	
2.1	Type	Acoustic Doppler
2.2	Velocity — Sampling Range	0.08 – 5.0 m | 0.3 - 16 ft
2.3	Acoustics Beams — Along-Axis (2)	25° off vertical axis, along axis of channel
2.4	Acoustics Beams — Skew (2)	37° off vertical and 45° off centre axis of channel
2.5	Number of cells	Up to 100
2.6	Cell Size	2 cm – 10 cm
2.7	Velocity — Range	±5 m/s | 16 ft/s
2.8	Velocity — Resolution	0.0001 m/s | 0.0003 ft/s
2.9	Velocity — Accuracy	±1% of measured velocity, ±0.5 cm/s | 0.2 in/s
2.10	Vertical Beam Range	0.05 - 5.0 m | 0.2 - 16 ft
2.11	Water Level Accuracy	0.1% of measured depth or ±0.003 m (0.01 ft), whichever is greater
2.12	Pressure Sensor Range	10 m
2.13	Pressure — Accuracy	0.1% of full scale
2.14	Operating Temperature	0 to 60℃
2.15	Communication between sensor to transmitter	RS 232/ SDI-12/ Modbus
2.16	Temperature sensor	Required inbuilt
2.17	Pressure sensor	Required inbuilt
2.18	Operating Temperature	-5˚C to 60˚C
2.19	Size(mm)	Up to 5 meter
3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC (UPS Power)
3.3	Accuracy	± 1 % of measured value

Sr. No.	Description	Particulars
3.4	Repeatability	+/-0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	• One Current – 4 to 20 mA (isolated) proposanal to flow rate • Hart (version 5 or above) • One Scalable Pulse • One Status Output
3.8	Communication	Flow Meter will communicate to Data Logger/ PLC based RTU
3.9	Display	Min. 2 Line Backlit LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	• Actual Flow Rate / Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow / Sum / Totalizers • Alarm
		• Five (5) digit backlit/Normal LCD, for flow rate in m3/hr. • Eight (8) digit backlit/Normal LCD for totalized flow in ML
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following:
		Diagnostic • Continuous self test shall include • Signal input circuit • Flow alarm when defined high flow exceeds • Flow simulation to check pulse and communication signal chain for correct scaling • Alarm statistics and logging for fault analyzing • Data calculation, handling and storing(Data Logger)
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
3.16	Data Protection:	• All data shall be stored in an EEPROM. • Totalized statistic shall be backed up every 10 min • Power consumption and temperature

Sr. No.	Description	Particulars
		Measurement statistic at every 4 hour • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
4	**UPS (In case of Regular Power Supply)**	
4.1	UPS Type	Online Industrial Type
4.2	UPS Input Supply	230 VAC
4.3	UPS Output supply	230 VAC
4.4	Battery Back up	2 Hours
4.5	Minimum VA	1000 VA
4.6	Battery Type	Ni-Cd/ Two (2) Volt VRLA
5	**Drawing & Document**	
5.1	Datasheet along with OEM Catalogue	Required
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	**Inspection**	
6.1	3 Point Wet Calibration	Required
6.2	Megger Test/ Insulation Resistance Test	Required
6.3	Hydro Test	Required
6.4	Dimension Test	Required
6.5	NABL LAB Certificate	Required
6.6	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.7	Country of Origin Certificate	Required

3.2.6. **Pressure Transmitter (Applicable if available in Price Schedule B)**

a) Pressure Transmitter quantities shall be considered as per price schedule.

b) Pressure Transmitter shall be SMART type.

c) Pressure Transmitter shall consist of a pressure sensor/transducer/ transmitter and panel mounted digital pressure indicator and any other items required for completing the measuring system. Where the transmitter is subject to pressure pulsations and/or vibration, it shall be provided with snubber.

d) The pressure transmitters shall be designed for operation over 130 % of full range.

e) Pressure Transmitters shall be of micro-processor based indicating type (LCD display), rack mounted with accuracy of ± 0.1% of span, external zero and span adjustment, self diagnostics, temperature sensor for compensation. 24 V DC power supply, output signal of 4-20 mA DC with HART (version 5 or above). IP 67 or equivalent degree of protection. Aluminium housing with epoxy coating, Accessories like snubber, three way manifold, mounting brackets, name plate etc. Material for accessories shall be SS. Protection Box/Canopy shall be provided for outside installed transmitters.

f) Technical Particulars- Pressure Transmitter:

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Pressure Transmitter
1.3	Service	Water Transmission and Distribution Network
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Pressure Sensor**	
2.1	Type	Diaphragm / piezoelectric
2.2	Sensor and other wetted parts M.O.C	SS 316
2.3	Process connection	½" NPT (F)
2.4	Sensor Fill Fluid	Silicon Oil
2.5	Temperature	60 ℃ Ambient
2.6	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)
3	**Pressure Transmitter**	
3.1	Type	SMART Type / Microprocessor Based, Head Mounted
3.2	Power Supply	24 VDC
3.3	Accuracy	± 0.1 % of measured value

Sr. No.	Description	Particulars
3.4	Response Time	100 ms
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	SS316 /Diacast Aluminium with PU finish
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to pressure Hart (version 5 or above)
3.8	Display	Alphanumeric LCD Type, Programmable
3.9	Over range protection	130% of maximum pressure
3.10	Zero and span adjustment	Required
3.11	Cable Gland	Required
3.12	Accessories	• Snubber • 3 way isolation valve • Impulse tubing, fittings • Mounting Bracket • Tag Plate • All other installation hardware
3.13	Diaphragm Seal M.O.C	SS316
3.14	3 Way Isolation Valve M.O.C	SS304
3.15	Impulse Tube Fitting M.O.C	SS304
5	**Drawing & Document**	
5.1	Datasheet along with OEM Catalogue	Required
5.2	Dimension Drawing	Required
5.3	Hook Up/ Installation Drawing	Required
5.4	Quality Assurance Plan	Required
6	**Inspection**	
6.1	3 Point Calibration	Required
6.2	Hydro Test/ Over Pressure Test	Required
6.3	Dimension Test	Required
6.4	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
6.5	Country of Origin Certificate	Required

3.2.7. **Ultrasonic Type Level Transmitter (Applicable if available in Price Schedule B)**

a) Ultrasonic Level Transmitter shall consist of a level sensor, level transmitter cum computing unit, prefabricated cable connecting the sensor and transmitter, panel mounted digital level indicator and any other item required for completing the level measurement system.

b) The level sensor shall be suitable for flange or bracket mounting as required and have a minimum protection conforming to IP-67. It shall have ambient temperature compensation and adjustable datum setting facilities.

c) The level transmitter cum computing unit shall be provided in an enclosure conforming to IP-67. It shall be programmable with an integral programming keyboard, LCD display, relays for alarm, control and system fault and shall provide an isolated 4 to 20mA DC output signal proportional to the level.

d) The design and application of ultrasonic level meters shall take into account the vessel or channel construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

e) The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

f) If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

g) Technical Particulars- Ultrasonic type Level Transmitter:

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Level Transmitter
1.3	Service	Sump / Tank
1.4	Fluid	Raw Water / Treated Water
1.5	Area Classification	Non Hazardous
2	**Level Sensor**	
2.1	Type	Ultrasonic
2.2	Sensor MOC	PP / PVDF
2.3	Seal MOC	EPDM
2.4	Sensor Housing MOC	Diacast Aluminium with PU finish/

Sr. No.	Description	Particulars
		Polycarbonate
2.5	Process Connection with Companion Flange	Flanged
2.6	Flange MOC	PP / CS
2.7	Housing Protection	IP 68
2.8	Temperature compensation	Required
2.9	Swirling arm arrangement for mounting of sensor	Required for access during maintenance
2.10	Size(mm)	To suit Sump/ Tank Height
2.11	Pressure Rating (Kg/cm2)	Atmospheric
2.12	Temperature	50 ℃ Ambient
3	**Level Transmitter (remote/ integral)**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC Line Power
3.3	Accuracy	± 0.1% of measured value
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Diacast Aluminium with PU finish / Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proportional to Level Hart (version 5 or above)
3.8	Display	2 Line Backlit LCD, Programmable
3.9	Maximum Digit Display	8 Digit
3.10	Indication on Display	Actual Sump/ Tank Level Alarm

Sr. No.	Description	Particulars
3.11	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.12	Cable Gland	Required
3.13	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
4	**Drawing & Document**	
4.1	Datasheet along with OEM Catalogue	Required
4.2	Dimension Drawing	Required
4.3	Hook Up/ Installation Drawing	Required
4.4	Quality Assurance Plan	Required
5	**Inspection**	
5.1	3 Point Calibration	Required
5.2	Dimension Test	Required
5.3	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
5.4	Country of Origin Certificate	Required

3.2.8. **Digital Process Indicator Panel Mounted (Applicable if available in Price Schedule B)**

a) Digital Process Indicator quantities shall be considered as per price schedule.

b) Technical particulars for Digital Process Indicator (Panel Mounted)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Process Indicator
1.3	Service	Panel Mounted
1.4	Area Classification	Non Hazardous
2	**Process Indicator**	

Sr. No.	Description	Particulars
2.1	Type	Microprocessor based
2.2	Display	Digital LED display
2.3	Digit Height	14 mm or higher
2.4	No. of Digits	3 ½
2.5	Input	4-20 mA
2.6	Zero & Span Adjustment	Required
2.7	Engineering Units for display	Required (User Defined)
2.8	Accuracy	±0.1 % of span
2.9	Enclosure Material	Non corrosive Polycarbonate or better
2.10	Retransmission output	Isolated 4-20 mA DC-2 nos
2.11	Power supply to Transmitter	230VAC / 24 V DC
2.12	Alarm outputs	1NO+1NC for high and Low alarms (adjustable)
4	**Drawing & Document**	
4.1	Datasheet along with OEM Catalogue	Required
4.2	Dimension Drawing	Required
4.3	Hook Up/ Installation Drawing	Required
4.4	Quality Assurance Plan	Required
5	**Inspection**	
5.1	3 Point Calibration	Required
5.2	Hydro Test	Required
5.3	Dimension Test	Required
5.4	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
5.5	Country of Origin Certificate	Required

3.2.9. PH MEASUREMENT: (Where Applicable)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	pH Sensor & Transmitter
1.3	Service	At WTP
1.4	Fluid	Raw Water / Treated Water
1.5	Area Classification	Non Hazardous
2	**pH Sensor**	
2.1	Type	Electrode
2.2	Principle	Potentiometric measurement
2.3	Range	0 to 14 pH
2.4	Material	Glass
2.5	Max Process temperature	50℃
2.6	Max Process pressure	6bar
2.7	temperature sensor	Pt100
2.8	Connection	Analog / digital connection with Transmitter
2.9	Ingres protection	IP68
2.10	Resolution	0.01pH, Temp 0.1℃
2.11	Calibration data	Inbuilt calibration & application data storage in sensor / Transmitter
2.12	Sensor capability	The sensor connection should be able to withstand corrosion , moisture , and can be also connected under water
2.13	Data safety	The sensor / transmitter should store on-board calibration data , diagnostics information
3	**pH Transmitter**	

Sr. No.	Description	Particulars
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Output	4-20 mA analog outputs
3.3	Supply voltage	230 V AC, 50Hz
3.4	Material	Field Housing : ABS PC
3.5	Display	LC display with backlight, two lines, with status indicators
3.6	Electromagnetic compatibility	interference emission and interference immunity acc. to EN 61326-1:2006
3.7	Protection class of field housing	≥ IP 65
3.8	Ambient temperature	–20 ... +60 °C
3.9	Self-Diagnostic feature	Required
3.10	Transmitter channels	Two channel minimum required

3.2.10. TURBIDITY MEASUREMENT: (Where Applicable)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Turbidity Sensor & Transmitter
1.3	Service	at WTP
1.4	Fluid	Raw Water / Treated Water
1.5	Area Classification	Non Hazardous
2	**Turbidity Sensor**	
2.1	Principle	Nephelometric measuring principle 90° NIR scattered light according to ISO 7027. Measurement at wavelength of 860nm

Sr. No.	Description	Particulars
2.2	Measurement range	0.000 – 4000 display range up-to 9999 FNU/NTU
2.3	Material	Sensor shaft : Stainless steel 1.4404 (AISI 316 L) Optical window : sapphire O-rings : EPDM
2.4	Max Process temperature	50℃
2.5	Max Process pressure	10bar
2.6	Connection	Fixed cable connection
2.7	Ingres protection	IP68
2.8	Additional Certifications	Calibration certification
2.9	Resolution	0.0015 FNU
2.10	Inaccuracy	2% ± 0.01 FNU
2.11	Repeatability	< 0.5% of measured value (range 0 to 10 NTU/FNU)
3	**Turbidity Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Transmitter system	4 wire with analog outputs
3.3	Supply voltage	230 V AC, 50Hz
3.4	Material	Field Housing : ABS PC
3.5	Display	LC display with backlight, two lines, with status indicators
3.6	Electromagnetic compatibility	interference emission and interference immunity acc. to EN 61326-1:2006
3.7	Protection class of field housing	≥ IP 65
3.8	Ambient temperature	–20 ... +60 ℃
3.9	Self-Diagnostic feature	Required

Sr. No.	Description	Particulars
3.10	Transmitter channels	Two channel minimum required

3.2.11. RESIDUAL CHLORINE MEASUREMENT: (Where Applicable)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Residual Chlorine Sensor & Transmitter
1.3	Service	Chlorine Contact Tank
1.4	Fluid	Treated Water
1.5	Area Classification	Non Hazardous
2	**Residual Chlorine Sensor**	
2.1	Type	Free Chlorine
2.2	Principle	Amperometric measurement of free chlorine.
2.3	Measurement range	0,01 - 5ppm free chlorine
2.4	pH Compensation	Required , add on pH sensor for compensation
2.5	Material	Sensor shaft : PVC
		Membrane : PTFE
		Membrane cap :PBT (GF30); PVDF
2.6	Process temperature	2℃ - 45℃
2.7	Max Process pressure	1 bar
2.8	temperature sensor	Pt100
2.9	Connection	Analog / digital connection with Transmitter
2.10	Ingres protection	IP68
2.11	Resolution	0.01mg/l
2.12	Inaccuracy	1% of measured value

Sr. No.	Description	Particulars
2.13	Sensor capability	The sensor connection should be able to withstand corrosion , moisture without loss of any data
3	**Residual Chlorine Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Output	4-20 mA analog outputs
3.3	Supply voltage	230 V AC 50Hz
3.4	Material	Field Housing : ABS PC
3.5	Display	LC display with backlight, two lines, with status indicators
3.6	Electromagnetic compatibility	interference emission and interference immunity acc. to EN 61326-1:2006
3.7	Protection class of field housing	≥ IP 65
3.8	Ambient temperature	–20 ... +60 ℃
3.9	Self-Diagnostic feature	Required
3.10	Transmitter channels	Two channel minimum required (Chlorine +pH)

3.2.12. Rate of Flow/ LOSS OF HEAD TRANSMITTER:

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Rate of Flow / Loss of Head Transmitter
1.3	Service	At WTP
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Level Sensor**	
2.1	Type	Ultrasonic
2.2	Sensor MOC	PP/ PVDF
2.3	Seal MOC	EPDM
2.4	Sensor Housing MOC	Diacast Aluminium with PU finish/ Polycarbonate
2.5	Process Connection	Flanged

Sr. No.	Description	Particulars
2.6	Flange MOC	PP/ CS
2.7	Housing Protection	IP 68
2.8	Temperature compensation	Required
2.9	Swirling arm arrangement for mounting of sensor	Required for access during maintenance
2.10	Size(mm)	To suit Sump/ Tank Height
2.11	Pressure Rating (Kg/cm2)	Atmospheric
2.12	Temperature	50 ℃ Ambient
2.13	Sensor Quantity	2 No
3	**Level Transmitter**	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC Line Power
3.3	Accuracy	± 0.1% of measured value
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Diacast Aluminium with PU finish/ Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proportional to Level Hart (version 5 or above)
3.8	Display	2 Line Backlit LCD, Programmable
3.9	Maximum Digit Display	8 Digit
3.10	Indication on Display	Loss of Head Alarm
3.11	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.12	Cable Gland	Required
3.13	Cable Length (sensor to transmitter)	20 Meter minimum or suit to site
3.14	Transmitter Quantity	1 No

3.2.13. **AMR Domestic Water Meter**

The meters shall be suitable to operate in ambient temperature 50 deg. C. Meters shall be duly sealed against tampering with couplings at both ends. Meters shall be approved by OIML R49 / MID/ IS 779 and approved test certificate from FCRI or NABL accredited labs confirming to ISO: 4064-2005. Also Meter shall have the endurance /Life cycle test certificate from FCRI.

Scope of Application: The meter will be used for the measurement of cold, chlorinated potable water.

Technical Specification for AMR Water Meter: The meters shall be

supplied complete with brass nuts and brass nipples

Sr No.	ITEM	SPECIFICATION
A	Measuring principle	An AMR battery operated inline water meter.
B	Power supply	Battery operated for the sensor and calculator with a battery life of minimum 10 years to ensure recording at all times.
C	Meter lifetime	Minimum 10 years
D	Protection class	Meters comply with IP 68 standard for indoor and outdoor operation, including fully submerged conditions.
E	Approvals and certifications	The meter should be type approved and verified according to international water meter standard OIML R 49 and or ISO 4064. The meter shall also be MID approved.
F	Accuracy	Accordance with ISO-4064-2005, Class- 2.
G	Calibration	3-point calibration with calibration certificate
h	Dynamic ratio (Q3/Q1)	Minimum of 100:1
i	Material	The water meter body shall be made of corrosion resistant material like brass, bronze, stainless steel, carbon steel or Engineered plastic.
J	Pressure rating	Working pressure upto16 bars
K	Environmental temperature	0 degree C to 50 degree C
L	Lockable cabinet	Weather proof mountable cabinet for electronics that should not cause obstruction to the communication signal.
M	Connectors	The meter body-casing nipple shall have an external straight BSP threads and should include 2 No. coupling nuts with internal BSP threads of the same nominal pitch and diameter as those on the meter body and 2 No. rubber gaskets of equal diameter with the meter connectors.
N	Data protection and tamper proof	The meter should be tamper proof with suitable data protection of calibration and revenue parameters.
O	Self diagnostics for error detection	The smart meter shall have advanced diagnostics with active alarm(s) indicated on display

P	Access to information	Display with >=8 digits for main information index, menu and status symbols for dedicated information
Q	Measuring units	The measuring units should be m3 for volume.
R	Facility for Remote Communication interface	The AMR water meter should be configuredwith battery operated remote reading capability by any wired/wireless secured and reliable communication medium (such as GSM/GPRS, LoRA, Zigbee, Walk by/Drive by, etc).
S	Indicators /alarms	Tampering, Burst, Reverse Flow, Leakage etc.
T	Meter markings	The AMR compatible Water Meter shall be marked with the following identifications: 1) Ratio (R=Q3/Q1) 2) Model Name & Make 3) MID Mark and approval no. 4) Sl. No. / Year of Manufacture. 5) Size 6) Direction of flow of water on both sides of the body of meter. 7) Unit of measurement. 8) Pressure rating.
U	Accessories	Two threaded tailpieces, which shall conform to IS: 8521 for threaded end. Meters with sealing arrangement to seal with meter body. Up to 20 mm Inbuilt Strainer & Internal/External non-return-valve. External dirt box

AMR System Functional requirement: All rights, interest and ownership of all the components of automatic meter reading system (i.e. Software for reading meter, software to analyse the readings, alarms and to transfer reading to billing software of Nagar palika) shall be with the Nagar Palika.

a. The remote readings of AMR water meter shall be obtainable by wired / wireless secured and reliable communication medium (such as GSM/GPRS, LoRA, Zigbee, Walk by/Drive by, etc).

b. The data Communication from the meters shall comply with the European standard on wireless Communication EN13757-4 Mode C1.

c. The AMR trans-receivers shall be wireless and shall have IP 68 protection category.

d. The remote Meter reading device shall have instant reading facility. The remote readings and physical meter readings of water meters shall match at all the times.

e. AMR shall have the facility to collect the readings from individual meters at prescribed time or on request.

f. All AMR readings shall show the date and time of the reading recorded.

g. The AMR system shall have facility to record the reverse flow in water meters readings and it shall show the quantum of reverse flow on the Meter Reading device i.e. AMR reading device as well as computer system.

h. The AMR system shall have the facility to record the abnormalities like application of external magnetic effect, very high consumptions, water leakages, tampering, and removal of AMR unit from the meter body, etc. Along with necessary alarms in meter readi ng device and in software.

i. The AMR device of the water meter shall be tamper proof.

j. The AMR water meter shall not get affected for its AMR functioning due to High Tension or High Voltage line concentration.

k. The AMR water meter shall have the facility to transmit reading in submerged

l. All the time electronic index of the water meter shall match with the physical reading, available on water meter.

m. All following Critical Alarms should be with date and time stamp.

- Peak flow
- Reverse Flow
- Meter not working.
- Meter Dry
- Leakage/Burst
- Meter Tampered

Software details

a. The software shall give output, at least in the CSV (Comma Separated Value)/ txt/ xls format.

b. The Route Management software shall be capable of running on a standard PC compatible with minimum Pentium processor; in addition the software must run under Windows95, Windows XP Professional, Windows Vista, Windows 7 and latest version of windows operating system.

c. The Route Management software should be cloud base and should have web portal access so that user can view customer data through browser. In addition to above the software may have option for individual customer to view their meter consumption data through Web portal d. The software shall allow the PC operator to review and edit any account in Route Management/ AMR software database. Also, the PC operator shall be able to generate routes/ groups as per zones or areas and activity

reports.

e. The software shall provide database backup / restore functions and must have real -time data access. The software shall be web-enabled and alerts to be provided

f. The software shall select the routes to be read, and assignment of routes to a reading device and dynamic updating of routes and sub-routes to be enabled.

g. The software shall upload routes from the reading device.

h. The software shall post the reading from the reading device onto appropriate accounts within the database.

i. The software shall make a backup copy of the routes within the database.

j. Software shall be able to set meter status on the fly like, meter not okay, reading not reliable, meter maintenance required etc

k. The software shall be able to display reading data on screen.

l. The software shall have capability to add additional customer information and create customizable data fields.

m. The software shall manage GPS data of AMR Meters.

n. The software shall manage customizable list of message codes for Meter Reader.

Proposed solutions features Water Billing Software

a. Meter Reading Process (Integration with AMR Water Meter)

b. Water Meter Billing Supported for 50000 users and scalable up to 300000 users.

c. Billing Process

d. Collections

e. Supplementary Bill Generation (Challans)

f. Dispute Registration and Settlements

g. Connection Cut-off and Restoration

h. New Tap Connection

i. Regularisation of illegal Connection

j. Disconnection/Reconnection Process

k. Grievance and redressal Process

l. Bill Amendment

m. Bill Cancellation

n. On-line Payment gateway

o. Deposit Refund

p. Portal Integration

q. SCADA Integration

r. AMR Integration

s. Demand / Collection / Outstanding Graphical reports.

t. Individual Group Code wise Demand and Recovery.

u. Meter Care Report.

v. Bill / Receipt register

w. Top 500 Defaulters List (Amount /bill wise).

x. Payment Gateway Reconciliation Report, etc.

Proposed Implementation Strategy

The basic philosophy for implementation of Domestic water meter is to provide required quantity of water to the residents, Improves revenue collection, Reduce wastage, Effective water management, control over unaccounted for water (UFW) and Non revenue of water (NRW).

It is proposed to implement this project in this financial year. It is also proposed that the contractor will bear the responsibility of the operation and maintenance of this work for the period of 10 years after commissioning of the works to ensure the sole responsibility of the entire domestic meter work.

The primary activity shall be consumer survey and shall be undertaken prior to the actual implementation of the works. This includes verification of authorized domestic/commercial and industrial connection members, DMA wise and members of respective water meters accordingly.

The work of O&M will consist of operation and maintenance of water meter. The firms have to repair or replace water meter and its accessories.

Scope for Maintenance Work:

a. On receipt of the complaint, the representative of the firm shall go to the site, of the work with all spares, necessary tools and tackles, tested meter and remove the defective water meter and replace the same with tested working water meter. Any works like replacement of MDPE pipes / Specials, cutting gland and breaking of the concrete, etc., shall be carried by the firms at their cost.

b. The removed water meters shall be preferably inspected at site and all minor repairs/replacement of parts, strainer, etc. which shall not affect the performance of water meter will be done at the site itself.

c. The defective water meters shall be removed and new tested water meter shall be installed immediately after receipt of intimation from Valsad nagar palika.

d. Complaints regarding abnormal/subnormal readings will also be treated as defective meter. The firm has to arrange for the replacement of such water meters with duly tested meters.

e. If the factory seal of the company seal is found tampered with water meter, then the signature of the departmental personal and the consumer shall be

obtained on the complained sheet and cost of such repairs will be charged to the consumer and paid to the firm directly by the consumer.

f. Minimum team for maintenance: One mobile unit equipped with minimum 10% tested spare meters, seals, tools, fitter, valves, strep saddles, MDPE pipe, ferrule and necessary manpower shall be available.

g The item also includes all necessary material, tools- tackles, along with skilled/ unskilled labour, supervisor etc complete for the maintenance of installed Water meter.

h The item also includes the periodic preventive maintenance, if required of the installed connection with water meters to avoid any defect during its working and for t he better performance of the connections.

Taking reading monthly from all the water meter connections preparation, printing and distribution & Collection of bills to all consumers

This includes taking the monthly reading of groups of consumer meters, pre parathion and printing the bills and distribution of bills and collection. Firm shall submit the program of meter reading and details of method proposed to be used. The details shall be exhaustive and distinctive, elaborating about the instrument/gadgets and all other paraphernalia and methodology adopted, which shall be compatible for any type, size and make of meter

3.3. Mechanical Equipments

3.3.1. Metallic Expansion Bellow (Applicable if available in Price Schedule B)

a) General

- Metallic Expansion Bellow quantities shall be considered as per price schedule.
- Design, fabrication, testing and installation of metallic expansion bellows with necessary hardware have to be provided at delivery side of each Flow Meter.
- Expansion joint shall be a metallic flexible connector fabricated of plies of metal corrugation to provide stress relief in piping systems due to thermal, mechanical and other moments and movements.
- It provides flexibility and concurrent movements.
- Expansion bellows shall be designed as per the details furnished in the data sheet and shall be in accordance with the EJMA standard. All expansion bellows shall be free from dirt, moisture, grease, oil, etc. and all reports for hydrostatic test shall be furnished. Fatigue life expectancy to be considered for bellows is minimum 7000 cycles.
- The bellows shall be metallic corrugated design and shall have double flange. The material for Bellows shall be SS 304.

- In order to avoid pipe buckling, guide collars must be provided regularly along the pipe length. A guide collar must also be provided on either side of the SS Expansion Joint.

- Maximum service life depends on careful and correct installation. Transport Expansion Joints to area of installation in packed condition. Flange face of companion flanges in pipeline should be smooth and without any sharp edges. For large size of Expansion Joints installed in horizontal ducts, lifting lugs welded to flanges should be used to hoist joint in position. Joints should only be fitted after all work on the pipeline and flanges have been complete and anchors and supports have been established. This is to avoid any accidental damage due to welding splatter or sharp objects and to ensure that the joints are not overstressed.

- The bolts on the flanges must be tightened evenly. Uneven tightening may lead to hazardous leakage. Faulty fitting may lead to failure of the expansion joints.

b) Operating Principal

- Expansion Joints are flexible, reinforced bellows which are used in piping systems to meet the following major needs

- To protect piping by absorbing any difference in dimension due to temperature variation or line movement.

- To protect piping by absorbing any difference in dimension due to temperature variation or line movement.

- It shall be protect equipment such as supports & anchors, pumps & valves etc., other equipment.

- It shall be useful for simple connection of misaligned pipes.

- Movement Accommodation

- Expansion and contraction, as well as rapid movements (dynamic stresses), are absorbed multidirectional and often simultaneous deflections:

c) Tests and Inspection

- Bellows shall be tested as per the relevant Standards with latest revisions.

- Bellows shall be offered for visual inspection and dimensional checks.

- The hydrostatic and water tightness testing of one of each size shall be witnessed by the Owner.

- Compression and expansion test shall be offered for one no. for each size and to be witnessed by the Owner.

- Following test shall be carried out during test and inspection.

i. UTS

ii. Radiographic test

iii. Liquid Penetration test

iv. Deflection

v. Heat build-up

vi. Life Cycle Test with load

vii. Vacuum test

viii. Hydraulic test

ix. Stiffness test

x. Vibration test.

d) Mechanical Data

- M.O.C. of Tie Rods & Nuts shall be as per IS 1367.
- M.O.C. of Weld ends & Lugs shall be as per IS 2062.
- Piping Stress Analysis shall be carried out by successful Contractor with expansion joints of the complete pump house pumps, valves and complete piping loops. The vendor shall revise the thrust blocks as per the requirement of the flexibility output.

e) Cleaning

- Prior to factory inspection, all manufacturing waste such as metal chips debris and all other foreign material shall be removed from interior of bellows. All mill scale, rust, oil, grease, chalk and all other deleterious material shall be removed from the interior and exterior surfaces.

f) Painting

- Bellows shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.
- Bellows used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could import any taste or odour to the water.

g) Tender Drawings

- The Dimensional drawings with material of construction shall be submitted by Contractor along with their offer.

h) Technical Particulars- Expansion Bellow

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Corrugation Design Metallic Expansion Bellow
1.3	Service	Water Transmission and Distribution Network
1.4	Fluid	Raw Water
1.5	Area Classification	Non Hazardous
2	**Expansion Bellow**	
2.1	Pressure Rating	16 Kg/cm2
2.2	Temperature	60 ℃ Ambient
2.3	End Connection	Flanged. Flanges shall be flat faced.(As per IS 1538)
2.4	Material of Flange	C.S
2.5	Material of Bellows	Stainless Steel 304
2.6	Material of Hardware	Alloy Steel (As per IS 1367)
2.7	(To be revised during detail engineering as per pump vendor data) Axial expansion (mm)	5(Min.)
2.8	(To be revised during detail engineering as per pump vendor data) Axial compression(mm)	15(Min.)
2.9	(To be revised during detail engineering as per pump vendor data) Lateral Movement (mm)	+/- 1(Min.)
2.10	Hydrostatic Test Pressure (Kg/cm2)	24 (Min.)- Hold Time 30 Min.
2.11	Mode of Installation	Horizontal
2.12	No. of Tie rods	Three no.(120 deg. Orientation)
3	**Drawing & Document**	
3.1	Datasheet along with OEM Catalogue	Required
3.2	Dimension Drawing	Required
3.3	Hook Up/ Installation Drawing	Required
3.4	Quality Assurance Plan	Required
4	**Inspection**	

Sr. No.	Description	Particulars
4.1	3 Point Calibration	Required
4.2	Hydro Test	Required
4.3	Dimension Test	Required
4.4	Type Test Certificate (IP 67 for Transmitter & IP 68 for Sensor)	Required
4.5	Country of Origin Certificate	Required

3.3.2. **Butterfly Control Valve (Applicable if available in Price Schedule B)**

a) General Specification:

- The Butterfly Control Valves shall be double flanged long body conforming to IS 13095/ BS EN 593. Valve shall be suitable for mounting in any position.
- The valve seat shall be of replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal.
- All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
- Valve shall be suitable for throttling application.
- Each Butterfly control valve shall be provided with suitable by-pass arrangement, isolation valves & by-pass valve.
- All valve, spindles and hand wheels shall be positioned to give good access for operational personnel. Suitable elevated concrete platform shall be provided on mounting floor for easy access to hand wheel for operation.
- Hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

b) **Material of Construction:**

Sr. No.	Component	Material
1	Body	SG Iron IS 1865 Gr. 500/7
2	Disc	SG Iron IS 1865 Gr. 500/7
3	Shaft	Stainless Steel; BS 970 Gr. 431 S29
4	Seal retaining ring	Stainless Steel; ASTM A743 CF8/ BS 970 Gr 304 S 11
5	Bearing	Stainless Steel backed Teflon
6	Disc seal	EPDM

Sr. No.	Component	Material
7	Body seat	Stainless Steel; ASTM A 743 CF8M
8	Internal Fasteners	SS 316
9	External Fasteners	High Tensile steel hot dipped galvanised

3.3.3. **Electrical Operated (Applicable if available in Price Schedule B)**

Sr. No.	Component	Material
1	Manufacturer	As per approved make list
2	Motor Type	3 Phase squirrel cage induction type with high torque low inertia characteristics
3	Actuator type	With integral starter & non intrusive
4	Duty Cycle / Designation	S2-15 minutes at 1/3 rd rated torque
5	Application	On-Off Duty ,60 starts per hour
6	Starting Torque	Minimum 130% of the rated torque
7	Torque range	Adjustable between 40% -100% of rated torque
8	Class of Insulation	CLASS-F with temperature rise limited to B.
9	Admissible ambient temperature rise over ambient	80℃ over an ambient of 40℃.
10	Whether motor is suitable for inching control	Yes
11	No. of starts per hour	60 starts in an hour.
12	Suitable for Starter	RDOL
13	Winding terminal connection	Star
14	Type of Mounting	Face flange mounting.Suitable for mounting in any positions
15	Type and No. of bearing provided.	Deep grooved sealed ball bearing lubricated for life
16	Protection motor	Protection provided by direct sensing of motor temperature by a thermostat embedded in the stator winding of the motor
	Enclosure:	
	a) Type	Safe area application
	b) Degree of Protection	Watertight to IP68 as per IEC 60529
	c) Ventilation	Totally Enclosed Naturally cooled (TENV)
17	Motor Data:	

Sr. No.	Component	Material
	a) Voltage/ Phase /Frequency	415V , 3 Phase , 50 Hz
	b) Admissible voltage fluctuation	± 10%
	c) Admissible frequency fluctuation	± 5%
	d) Admissible voltage & frequency fluctuation	± 10% absolute
18	Actuator Paint	Polyster powder coating Silver Grey
19	Cable Entry	3 nos M25 & 1nos M40
20	Manual Override	Padlockable clutch lever with handwheel provided
21	Actuator Model /Rated Torque	*To be filled By Bidder
22	Actuator RPM	*To be filled By Bidder
23	Travel time (Sec)	*To be filled By Bidder
24	Starting Current (Locked rotor current ,Amp)	*To be filled By Bidder
25	Rated Torque Current (Full load Current ,Amp)	*To be filled By Bidder
26	Average Load Current (Amp)	*To be filled By Bidder
27	Kilowatt output at average load (KW)	*To be filled By Bidder
28	Power factor at average load	*To be filled By Bidder
29	Efficiency at average load	*To be filled By Bidder
30	No. of motor poles	*To be filled By Bidder
31	Wiring Diagram	*To be filled By Bidder
32	Contact Type	*To be filled By Bidder
33	Contact Rating	5mA to 5A, 120VAC, 30V DC
34	Local position indicator	Position display & text display provided
35	2 wire control through MODBUS	Required
36	Dual Redunancy	Required

Sr. No.	Component	Material
37	Integral Datalogger	Required
38	Infrared setting tool	Required , 1 per site.
39	Approx weight of Actuator (Kg)	To be filled By Biider

3.4. **Flow Meter/ Valve Chamber (Applicable if available in Price Schedule B)**

a) All RCC chambers are to be of an adequate size to facilitate maintenance and operation. The base slab of chambers shall slope towards a sump pit from which water can be pumped to keep the chamber dry. All chambers shall be constructed in M20 grade reinforced concrete and TMT Fe-500 steel grade. Chambers shall have removable cast iron/ reinforced concrete covers, as appropriate, approach ladders and valve supports.

b) Construction of RCC chambers as per design to satisfy all the necessary check given in the latest IS codes , 100mm thick P.C.C in M10 with Foundation concrete / base slab of concrete grade M20 as per the design , inside cement plaster in C. M. 1:3 and cement pointing outside in C. M. 1:3 and top cover of precast RCC slab 100 mm thick (with key hole in two parts, each with handles or MS Bar etc.) With cast in situ RCC slab in one with fixing of CI-MH Frame and cover

c) 12 mm thick cement plaster in CM 1:3 shall be provided on inside and outside of walls up to 20 cm below from G.L. Cement pointing in CM 1:3 shall be provided for outside below G.L. from 20 cm.

d) 20 mm dia MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. Chamber shall be covered with 100 mm thick RCC 1:2:4 pre cast or cast in situ slab in two parts with keyhole to insert key for operation.

e) Reinforcement for the cover slab shall be provided considering heavy traffic load.

f) Curing of concrete, RCC etc. shall be done using chemical or water for 14 days.

g) 12 mm dia MS bar handles minimum two nos. shall be provided to each piece of slab during the time of casting of slab.

h) Sides of chamber shall be refilled properly with selected excavated earth.

i) All the above items shall be carried out in workman like manner as per prevalent sound engineering practice and instruction of Engineer-in-charge.

j) Contractor to submit the valve chamber drawings based on site conditions to review and approval before execution.

3.5. Automation Equipments

3.5.1. **LED Dash Board consisting of 8 cubical display size 256*128 mm each and mounted in 4 X 2 array (Approximate Size of the complete screen should not be less than 16 ft x 5 ft)**

a) Dash Board quantities shall be considered as per price schedule

b) Dash Board shall be provided at the central control room.

c) Contractor has to demonstrate all graphical representation on Dash Board as developed on Web Based Monitoring System.

d) Dash Board shall be of reputed make and supply after prior approval of Client.

3.5.2. **Technical Specifications for Video Wall (Central Monitoring Station)**

Sr. No.	Description	Particulars
1	LED Lamp (2.0mm)	SMD1010 Copper wire (or better)
2	Module size	256*128mm
3	No. of modules	4 x horizontal, 2 x vertical
4	Module resolution	128*64
5	Brightness (nits)	>/= 700
6	Viewing Angle	Horizontal 140 deg. Vertical 140 deg.
7	Viewing Distance	>/= 2.0m
8	Operating power	AC 100~24050/60Hz
9	Defects Rate	</= 0.00001
10	MTBF	>35,000 hrs
11	Life Span	>/= 100,000 hours
12	Earth Leakage Current	<3mA
13	Operating Temperature	-30 ℃ to 60 ℃
14	Operating Humidity	10% to 95%
15	Controlling system	Linsn / Novastar
16	Operating System	Windows 10

3.5.3. **Printer:**

a) Printer quantities shall be considered as per price schedule

b) Printer shall be provided at the central control room.

c) Technical Particulars (Printer)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Printer
1.3	Service	Printing
1.4	Area Classification	Non Hazardous
2	**Printer**	
2.1	Type	Laser, Color, LAN Printer
2.2	Print Pages	A3, A4
2.3	Black Print Speed	17 Page Per Minute (PPM)
2.4	Color Print Speed	4 PPM
2.5	Print Resolution	600 x 600 dpi
2.6	Processor	264 MHz
2.7	Memory	128 MB
2.8	Keypad and Digital Display	Required
2.9	LAN Printing/ Time based printing	Required
2.10	Power Supply	230 VAC

3.5.4. **Uninterruptible Power Supply (UPS) for Centralized Monitoring System**

a) UPS quantities shall be considered as per price schedule.

b) A UPS with 480 minutes backup time shall be provided for the power supply of Instrumentation, Control & Automation system.

c) The UPS shall have sealed maintenance free batteries and AC distribution board.

d) The batteries shall be sized such that the maximum recharge time does not exceed 8 hours.

e) Contractor shall furnish UPS sizing calculations for review and approval.

f) Technical Particulars (UPS System)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	UPS
1.3	Service	Instrumentation & Automation System
1.4	Area Classification	Non Hazardous
2	**UPS**	
2.1	Input	415V, 3P / 240V 1P AC (to be decided during detailed engineering)
2.2	Output	230V AC, 50 Hz
2.3	UPS Capacity	*KVA (* KVA rating shall be finalized during detailed engineering)
2.4	UPS Battery back-up time	Minimum 480 min.(SMF NI-CD)
2.5	No of UPS feeders (outgoing)	As per system requirement.
2.6	UPS Type	Online, Double Conversion, Industrial
2.7	Rectifier Charger Type	SCR / IGBT Based
2.8	Static Inverter Type	SCR / IGBT Based
2.9	Static Transfer Switch Type	SCR-SCR Based
2.10	Bypass	Solid State Static Bypass with Isolation in matching cubical
2.11	Manual Bypass Switch Type	Change over
2.12	Battery Type	SMF NI-CD
2.13	Isolation Transformer	Required, Built in within UPS- Input Side & Output Side
2.14	Degree of Protection	IP41 or better
2.15	Cable Entry	Back Side Bottom
2.16	Communication - SNMP Card & MODBUS	Required
2.17	Potential Free Contacts	- Rectifier Trip - Inverter Trip - Load on Battery - Battery low Pre-alarm - Load on Static Bypass - One Relay contact for each, Rating – 1A/230 VAC OR 2A / 12 VDC

Sr. No.	Description	Particulars
2.18	Drawings / Documents	SLD, GA, Power & Control Wiring Diagram & Foundation Details, Type Test Certificate, FAT/SAT Procedure
2.19	Reference standard	IEC 62040-3 or equivalent

3.5.5. **Air Conditioner (AC): (Applicable if available in Price Schedule B)**

a) AC quantities shall be considered as per price schedule

b) AC shall be provided for each regional monitoring station and central monitoring station inside the control room.

c) Technical Particulars (AC)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	AC
1.3	Service	Cooling
1.4	Area Classification	Non Hazardous
2	**Air Conditioner**	
2.1	Type	Energy Efficient/ Precision
2.2	Suction	Top
2.3	Discharge	Bottom
2.4	Air Handling Unit	2 TR capacity
2.5	Compressor	Scroll/ Reciprocating
2.6	Energy efficiency ratio	EER 11.4
2.7	High Sensible Heat Ratio	0.92 to 0.95
2.8	Air Quantity (CFM/ TR)	600-750
2.9	Efficiency	90-95%
2.10	Cooling Coil Type	Dual circuit evaporator coil
2.11	Coil MOC	Copper
2.12	Built in Heaters	Required
2.13	Static Temperature Sensor	Required

2.14	Fan	Minimum 25 mm
2.15	Display cum controller	Microprocessor based, Required
2.16	Filters	Required
2.17	Damper	Required
2.18	Refrigerant Gas (Environment Friendly),	Required
2.19	Outdoor units with Copper piping	Required
2.20	PVC Drain Pipe	Required
2.21	Cables	Required
2.22	Electrical Panel	Required
2.23	Stands for outdoor unit	Required
2.24	Input Power Supply	230 VAC
Note: Bidder may propose integrated solution (package unit) which consist AC, UPS, Server and safety sensors. Entire set up can be monitor through integrated solutions LCD/ key video monitor (KVM).		

3.5.6. **Surge Protection Devices:**

a) Surge Protection Device quantities shall be considered as per price schedule.

b) Surge Protection Devices (SPDs) shall be provided for each signal and power loop for field instruments located outdoor.

c) One SPD shall be provided in the field near transmitter and the other SPD of the loop shall be mounted in the RTU panel.

d) SPDs shall be suitable for withstanding the surge arising out of high energy static discharge / lightning discharges and protect the instrument to which it is connected against damage.

e) SPDs shall provide protection through the use of quick acting semiconductors like Tranzorb, zener diodes; varistors and an automatic disconnect and reset circuit.

f) SPDs shall be passive and shall require negligible power for operation.

g) During the occurrence of a surge it shall clamp on the allowable voltage and pass the excess voltage to the ground.

h) The SPDs shall be self resetting to minimise the down time of the measurement loop. SPDs shall have minimum surge rating of 10 KA.

i) SPDs shall have a weather proof casing and shall be suitable for field / back of panel mounting as applicable.

j) There should be total isolation between input, output and ground terminals.

k) Surge protection devices (SPDs) shall be provided at the RTU panel end of all instrumentation cables for the instruments located outside the building, in addition to the SPD at the instrument end.

l) The SPD s shall be grouped in a specific area within instrument panel.

3.5.7. **Operator Console:**

a) Operator Console quantities shall be considered as per price schedule

b) Operator console with revolving chairs shall be provided for each regional monitoring station and central monitoring station inside the control room.

c) Technical Particulars (Operator Console)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Console & Chairs
1.3	Service	OWS, EOWS & Printers
1.4	Area Classification	Non Hazardous
2	**Console**	
2.1	Type	Indoor, Self Standing type
2.2	Height	maximum height of 2200 mm
2.3	MOC	CRCA
2.4	Thickness of Panel Wall	2.0 mm
2.5	Thickness of Gland Plate	3.0 mm
2.6	Color	Paint Finish as per RAL- 7032.
2.7	Enclosure Protection	IP 54
2.8	Anti-vibration Pad	Required, minimum 15 mm thickness
2.9	Panel Door Switch	Required
2.10	Fans & Louvers	Required
2.11	Panel Light	Required
2.12	Cable Entry	Back Side Bottom

2.13	Drawings / Documents	SLD, GA, Power & Control Wiring Diagram & Foundation Details, Routine Test Certificate, FAT/SAT Procedure
2.14	Chairs	Two (2) nos. operator chairs (revolving type)

3.5.8. **Managed Ethernet Switch:**

a) Managed Ethernet Switch quantities shall be considered as per price schedule

b) Technical Particulars (Managed Ethernet Switch)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	Managed Ethernet Switch
1.3	Service	
1.4	Area Classification	Non Hazardous
2	**Managed Ethernet Switch**	
2.1	Type	Industrial Ethernet Switch- Managed
2.2	No of Port	16 NO
2.3	Degree of Protection	IP 20
2.4	Ambient Temperature (operation)	-40˚C to 70˚C
2.5	Permissible Humidity (operation)	30% to 95% (non-condensing)
2.6	Interface	Ethernet (RJ45), Serial (RS-232)
2.7	Connection Method	RJ 45, RS 232
2.8	Transmission speed	10/ 100 Mbit/s
2.9	Transmission length	100 m (per segment)
2.10	Basic Function	stored & forward, port mirroring, integrated web server function, multicast filtering, DHCP server, PTCP filter, VLAN etc.
2.11	Management	Web Based management (HTTP), serial interface, SNMP v1/v2
2.12	Diagnostic function	1:1 port mirroring
2.13	Status and diagnostic indicators	LED for power supply, alarm contact,

		link/ activity and speed
2.14	Mounting Type	DIN Rail
2.15	Input Supply Voltage	24 VDC
2.16	Signal contact control voltage	24 VDC

3.5.9. **Operator Work Station(OWS) / Engineering Cum Operator Work Station(EOWS):**

a) OWS/ EOWS quantities shall be considered as per price schedule

b) OWS/ EOWS shall be provided for each regional monitoring station and central monitoring station inside the control room.

c) OWS/ EOWS shall be designed for 24x 7 operations. It shall be fully modular and easily expandable/ scalable as per the feature requirement. Electronics component shall have conformal coating to ensure reliable operation.

d) OWS/ EOWS shall be suitable for Open interfaces (Ethernet, Serial, and OPC) for Connectivity and Networking.

e) Technical Particulars (OWS/ EOWS)

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	OWS/ EOWS
1.3	Service	Monitoring & Reporting
1.4	Area Classification	Non Hazardous
2	**CPU**	
2.1	Operating System	64 bit, Windows based
2.2	Processor	Latest available industry standard
2.3	Chipset	Intel
2.4	Memory	4 DIMM slots, up to 32 gb, (2 GB Minimum)
2.5	Drive controllers	Integrated SATA Controller
2.6	Storage	1 TB/ 2TB
2.7	Graphics Card	Required
2.8	Ports	Minimum 4 USB Ports
2.9	Power Supply	230 VAC

2.10	Warranty	3 years
3	**Monitor**	
3.1	Type	LED Backlit LCD
3.2	Viewable Image area	21.5" minimum
3.3	Aspect ratio	16:9
3.4	Viewing angel	Up to 170˚ horizontal/ 160˚ vertical
3.5	Contrast Ratio	1000:1
3.6	Brightness	250 nits (cd/ m2)
3.7	Response time	5 ms
3.8	Pixel pitch	0.248 mm
3.9	Backlight lamp life	30,000 hours
3.10	Color support	16.7 million colors
3.11	Language	English
3.12	Buttons/ switch	Menu, minus, plus, ok, auto & power
3.13	Power	230 VAC
4	Keyboard, Mouse & Accessories	
4.1	Keyboard	Wired, Required
4.2	Mouse	Optical Wired, Required
4.3	Interconnecting Cables	Required

3.6. Web Based Monitoring System

3.6.1. The Web Based Monitoring System together with instrumentation system as specified elsewhere in these specification shall be designed, manufactured, installed, tested commissioned, operated and maintained to full- fill the following requirements in general;

a) Acquire and transmit data from Remote monitoring units installed at each pumping station to the Centralize Monitoring Station.

b) Carry out necessary performance analysis and displaying data on a number of operator screens.

c) Record keeping and report generation.

d) The cloud based server shall be capable of data acquisition for current requirements as well as future additions and providing data to all Station through Internet/ Intranet.

e) Obtain control over the system and ensure that required performance is always achieved

f) Store data on the behavior of a system and therefore achieve full compliance with mandatory reporting requirements for any regulatory agency

g) Provide information on the performance of the system and establish effective asset management procedures for the system

h) Provide an alarm system that will allow faults to be diagnosed from a central point, thus allowing field repair trips to be made by suitably qualified staff to correct the given fault condition and to avoid incidents that may be damaging to the environment

i) Of-the-shelf system, ready for field installation

j) System based on computerized control center, communication backbone and field interface units

k) Multiple point of access for data management

l) Comprehensive report generator including historical trends

m) Future capability for manual on/off operation or sensor based auto operation or schedule based operation for achieving energy savings through off-peak hour operations.

3.6.2. The Centralized Monitoring Station shall provide a management tool for monitoring the entire system. The major requested functions are:

a) Web Application for MIS/ Reporting/ Dashboard

i. MIS

- Pumping system
- Flow meter network

ii. Dashboard

- Group wise ➔ Overall water Transmission Network Wise
- Individual Water Transmission Network Wise
- Individual Pumping Station wise
- Pumping station Parameter Monitoring Dash Board
- Pumping station Operation Efficiency Dash Board

iii. Reports

- Running Hours Report

- Efficiency Report
- Flow Report
- Fault Analysis Report
- Daily Report (covered entire water transmission network)
- Monthly Report(covered entire water transmission network)
- Benchmark Parameter vs actual parameter Report
- Other customized reports as required by Client

3.6.3. Cloud Based server of reputed make shall be provided for MIS software.

3.6.4. Local intranet shall be formed and web clients shall be incorporated for access of MIS, Dashboard and various reports.

3.6.5. UPS of reputed make with eight hour backup time shall be provided for ensuring reliable power to the MIS server.

3.6.6. Central Monitoring Station (CMS):

Following Major functions shall be performed at CMS:

a) **System configuration:** The CMS shall provide the ability to configure system's parameters for optimal performance. The user shall be able to define all Remote monitoring units connected to the CMS servers and their associated configurations. The user will be able to define all software application functionality and download (send) the data to the RTU, in order for them to perform the on-site function. The Monitoring Station shall provide the ability for the user to "zoom in" to the level of single element characteristics (i.e. Input/ Sensor, Output/ Pump etc.) at each site.

b) **Application Server**: Following modules shall be installed in application server:

i. WEB SERVER :

- To host web application followings shall be required:
  - Web based Configuration Utility
  - Web based User Management
  - Web based Audit Trail
  - Web based Reporting Tool
  - Web based Alarm History Viewer
  - Web based History Trend Viewer

ii. IO SERVER :

- To perform :
  - Communication and data capturing from RTU

- Data verification/ validation and processing
- Alarm Processing (Alarm Server Module)
- Real Time Trend Processing (Real Time Trend Server Module)
- Notification and Alerts (Notification Server Module)

iii. Database Server: Following modules shall be installed in database server

- DATABASE SERVER: Database storage with Historian and Archiving Module for :
  - Reporter Tool
  - History Trends
  - Alarm History

iv. Operator stations (Computers) : Following modules shall be installed in Operator stations

- DISPLAY/ REMOTE CLIENT :
  - Operator station with MIMIC display for operations

c) UPS of reputed make with eight hour backup time shall be provided for ensuring reliable power to the servers.

d) **System monitoring:** Real-time graphical display of complete network, of respective zone, historical trends, Events/ Alarms logging. The Web Based Monitoring System shall provide cohesive monitoring and control of the facilities from a centralized control room at CMS and will be manned round the clock by operations engineers.

e) **System control:** Future provision to add control feature for manual and scheduled operations of respective zone

f) **Notifications:** System shall be capable of generating event based email and SMS notifications for predefined recipients.

g) **Smart Phone Connectivity:** It shall be also required to provide android application for viewing key parameters of any selected Remote Station as well as receive alerts and reports through secure access.

h) **Reports:** System shall be capable of generating various standard and customised reports for achieving safe, reliable and efficient operations throughout the Works area.

i) **The** Web Based Monitoring System shall be reliable, field proven and evolutionary state of the art.

3.6.7. **The** Web Based Monitoring System **shall meet the following requirements:**

The Web Based Monitoring System with the main Web Based Monitoring database shall be Web Based server resident and shall be built around SQL server with robust operating system.

a) The networking shall support OSI TCP/ IP/ Ethernet IP network connectivity.

b) The Web Based Monitoring System will be WEB enabled so as to view the reports and HMI displays through Internet/ Intranet.

c) The Web Based Monitoring System shall provide generic ODBC interface for interfacing third party software applications.

d) All the hardware to be supplied as part of the contract shall be manufactured utilizing good engineering practices.

e) The Web Based servers shall be designed so that it meets the system-loading requirement for future expansion.

f) The contractor shall ensure that the Web Based servers & HMI workstations hardware meet the Web Based Monitoring System performance and functional requirement specified in the tender and in case additional resources are required and the model number is required to be upgraded, the same shall be done by the contractor, at any stage of project implementation for fulfilling the system performance requirements, without any price and schedule implications.

g) The contractor shall ensure that system support for maintenance, up gradation and enhancement/ expansion of the Web Based Monitoring System shall be available for entire span of O&M period.

h) The contractor shall ensure the completeness of the Bill of materials (w.r.t. model nos. and quantities of various equipments, hardware and software modules, cards, peripherals, software licenses etc.) to meet the complete requirements of this tender as part of their responsibility and any change/ modifications required for the same during detailed engineering to meet the requirements of the tender shall be done by the Contractor without any delivery & cost implications to the department.

i) The contractor shall carry out the activities related to Web Based Monitoring System management, system design, engineering, integration, training & testing fully by themselves.

j) The tag license for Web Based Monitoring System to be installed at CMS shall be sufficient to handle following :

   i. Handle all the required functionality to interface with up to 100 RTU as well as future expansion.

   ii. Minimum tag license (if applicable) of 1,00,000 tags with expansion provision to accommodate future requirements.

   iii. Polling and update frequency from 5 minutes to 24 hrs.

   iv. All in one package including →

   - Web Based IO Server, Alarm Server and Trend Server
   - Web Based Historian (Data Base Server)
   - Web Based Reporter and Scheduler

- Web Based User Management and Audit

k) Up to 10 Remote clients and Unlimited web client's capability for reports and history viewing at a given point of time.

l) Easy installation and user friendly operations.

m) High security protection with necessary intrusion detection, Virus Protection, Server Authentication, encryption etc.

n) A comprehensive web-based information management tool

o) Support for MODBUS RTU, MODBUS TCP/ IP, OPC Client

p) Support for Multiple Master/ Network (Parallel Execution of all master: Multi Threading)

q) Ready to Use Redundancy Feature for Redundant Networks

r) Multi Protocol Network Support in Single Application

   i. Combination of MODBUS RTU/ MODBUS TCP/ IP and OPC Client in single Application

s) Reliable and High Speed Communication

t) User Friendly Web Based Configuration Utility

   i. Drag and Drop Configuration utility can be used remotely to update configuration

   ii. Configure Tag Groups as per requirement for better viewing and security options

u) Online Update of Engineering and Configuration

v) Disable Particular Network/Device/Tag without disturbing rest of the network

w) User Role based Configuration Rights and Access

x) Privilege based Security Mapping

   i. Tag Group wise privilege and Security Mapping

   ii. Page and Tag level privilege assignment to view/read and write a page/tag.

y) Alarm server to handle different Types of Alarms

   i. Analog Alarms : HH,H,L,LL Alarms with Dead Band and Delay Time Configuration

   ii. Digital Alarms : Indicate Digital Alarm based on user configured Alarm State

iii. Deviation Alarms : Compare Deviation Between Two Tags

iv. Rate Of change Alarms : Compare rate of change of a particular Tag

v. SOE (System Time Stamped): High Speed Scanning with system time stamp

vi. SOE (Device Time Stamp): Reads Device Memory using MODBUS with device time stamp

z) Web Based Alarm Configuration Utility

i. Map tags and Alarm

ii. Configure Status Limits, Dead Band ,Delay Time and Description of Individual Alarm

aa) Alarm Logger Control

i. Alarm Logger Control for Web based Project Development : User Selectable memory : 500/1000/2000

ii. Display of various Fields: Time Stamp, Tag Name, Status – Alarm/Clear, Set Point, Description etc.

iii. Alarm Fonts Color Coding as per Alarm Status

iv. Alarm Font Style as per Alarm Acknowledgement Status

v. Single, Multi, Page wise or select All acknowledgement Facility to Acknowledge Alarms easily

vi. System as well as Operation Logs to be maintained at server level to be retrieved as and when necessary

bb) Web Based Alarm History

i. Filter based Alarm history to view alarms up to last 3 years

cc) Alarm Annunciation Control with First Up and Ring Back Features

dd) Alarm Privilege and security

i. Group wise privilege and alarm security

ee) Assign privilege to individual Alarm as well to restrict view as well as acknowledgement rights

ff) Real Time Trend

i. Multi Plot Trend : 16 Plots in a single trend

ii. Y Scale Selection : % or Engineering

iii. X Axis Span Settings : User Configurable Span Selection : HR/MIN/SECONDS

iv. Online History up to 7500 Samples, go back in frozen trend

v. Zooming and Panning Features

vi. Cursor : Multi Cursor Facility

vii. Dynamic Plot Settings

viii. Plot Color Settings

ix. Plot Type Settings : Line, Bar, Area

x. Plot Style Settings : Style/Thickness/Interpolation

xi. Single click Trend Image Export

xii. Single click Export Trend : Complete History of 7500 Samples will be exported in a file

gg) History Trend

i. Filter Based Hourly/Daily/Weekly/Monthly Single Tag and Comparison History Trends

ii. Cursor and Zoom analysis Features

hh) Rule Based History Module For Data Archiving

ii) Individual Tag wise rule definition

jj) Generate archived data by converting Hard Tag into Rule Base Soft Tag

kk) Three Categories for Rules

i. Delta Threshold/ Deviation: If deviation crosses defined value, tag will be punched

ii. Time Stamp Selection: Tag will be punched at defined time interval: Every 10 sec, 15 sec etc.

iii. Time Stamp with Deviation:

ll) Filter Based Crystal Type Reports for Web Based Monitoring System

i. Default Templates to Generate Reports

ii. Single Tag : Hourly/ Shift wise/ Daily/ Weekly/ Monthly

iii. Multi Tag : Hourly/ Shift wise/ Daily/ Weekly/ Monthly

iv. Instantaneous : Hourly/ Shift wise/ Daily/ Weekly/ Monthly

v. Consumption : Hourly/ Shift wise/ Daily/ Weekly/ Monthly

mm) Report Settings

i. Logo, Title, Header

ii. Company Settings

iii. Shift Settings

iv. Template Settings

nn) Export Report to Various File Formats

i. PDF, Excel, CSV, Web Archive, Rich Text Format

oo) Save and Manage report

i. Save your template settings in reports

ii. Manage reports in folders and paths

pp) Schedule Report for Automatic Mail Notification

qq) Easy Installation and Project Up gradation

rr) Integration with C and MATLAB for Complex Logic/ Model Development

i. Ability to use Graphical Programming, .Net Programming, C Programming and MATLAB Programming to gather in a single application

ii. Easy to develop any complex mathematical or model based application with math tools

ss) Easy to customize and modify existing control as well development of Animated Controls

tt) Online graphics editing features

uu) Ready to Use Library for Back Panel Programming

vv) Ready to Use Control Modules

ww) Web Based Configuration to Add/Edit/Delete Users

xx) Standard Roles

i. Network Admin : Can Add/Edit/Delete Engineering Related Configuration of Web Based Monitoring System

ii. Client Admin : Can Add/Edit/Delete Groups of Tags and alarms

iii. Viewer/User : Can use Web Based Monitoring System as per privilege assigned to a particular user

yy) Assign Privilege to Users

i. User will be assigned to privilege

ii. As per privilege user will be able to read/write/acknowledge Groups, Tags, MIMIC Pages as well as Alarms

zz) Complete Audit Trail

i. Configuration modification Audit

ii. Set Point/Tag Write Audit

iii. Alarm Acknowledgement Audit

aaa) User Name and Role Based Access rights in remote client

bbb) Complete MIMIC and Project is replicated in remote clients

i. Can be used as Operator Station

ccc) Support for Up to 10 Remote Clients*

i. * no .of remote clients depends on the server configuration

ddd) Create multiple networks using multiple com ports & modbus master

i. Accommodate multiple networks communicating on different protocols like modbus RTU serial, modbus TCP-IP or OPC, in a single Web Based Monitoring System installation.

eee) Hierarchy wise network configuration – 4 level hierarchy

i. Network → Plant → Machine → Device → Tags

fff) Information can be viewed in 5 different formats:

i. Panel View, Gauge View, Annunciation View

ii. Digital signal view, Mimic View

ggg) View color differentiation as per Tag status

i. Red : LL, HH Trip Signals

ii. Orange : LH, HL Alarm

iii. Green : Normal Signal

hhh) Flashing Event on Alarm/Trip Status

3.6.8. **Communication Infrastructure**

a) The communication infrastructure is the backbone, enabling the various system components to communicate with the Central Monitoring Station (CMS), Remote Terminal Unit (RTU) and each other, over various media types.

b) Communication from the RTU to CMS shall be through GPRS protocol provided through reliable ISP. SIM cards and its subscription shall be managed by Contractor.

c) Communication from CMS to Web Based System shall be through reliable Internet connection with sufficient bandwidth and link redundancy. Internet connection shall be provided by Contractor.

3.7. **Data Logger with Field Interface Unit/ Remote Terminal Unit (RTU)**

a) The Data Logger shall have the ability to perform "regular" Field Unit's functionalities, such as monitoring sensors or activating pumps, in addition to its RTU functionalities.

b) The RTU shall provide communication capabilities and interface between the Web Based Monitoring System and the on-site field interface units

c) Control Panel should include :

i. 2 No of SMPS

ii. Local LCD/ 7 Segment Display Unit as per described specifications (where applicable)

iii. Fuse failure detection circuit

iv. Door open sensing

v. Interposing relay for pump operations (if applicable)

vi. Required Terminal blocks for interfacing of field devices

d) The supply, installation, testing and commissioning of control panels are within the scope of this tender.

e) The proposed design shall take into consideration, that various types and size of field interface units may be required in order to optimize costs. All field interface units (types and size) shall be able to perform under the same Control Centre.

f) Once the configuration exists in the RTU (downloaded from the CMS or locally entered using laptop), the RTU shall be able to perform all applicable local functions even if the connection to the Control Centre is down.

g) RTU shall poll field devices on continuous basis for local basic alert, monitoring and control functions

h) RTU is connected through GSM/ GPRS to Web Based Monitoring System

i) The system shall have provision for demand polling individual RTU so that the data from specific station could be acquired in specific cases.

j) Communication protocol between Web Based Monitoring System and RTU shall conform to standard international open protocol. The protocol used shall not be proprietary protocol of the Contractor. The Contractor shall provide details of the implemented protocol also as part of documentation. Any proprietary software deployed by the agency will have to be shared with the department as & when required FOC.

k) Communication between field devices and RTU shall be digital or analog signals (0-10VDC, 4-20mA DC) or RS 485 MODBUS RTU interface.

l) The Contractor shall be fully responsible to implement the interfacing between Web Based Monitoring System and the RTU.

m) Flow meter, pressure transmitter and Energy meter with RS 485 modbus interface are available at most of the Pumping Station locations. If the same is not available, supplier to supply, install and commission the missing items.

n) UPS back-up: RTU needs to be powered up from single phase power supply, available locally. In the event of power failure battery backup is needed to send message for power fail. Vendor to provide suitable power back-up for intimation of power failure.

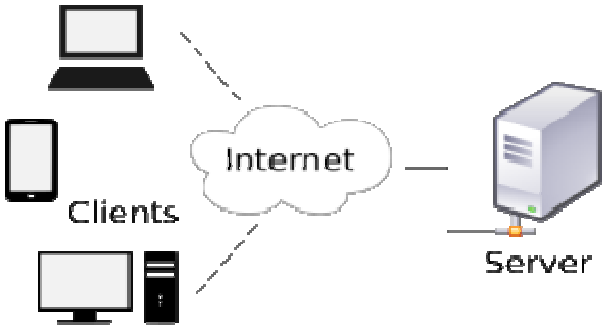
o) Technical Particulars: Remote Terminal Unit

Sr. No.	Description	Particulars
1	**General**	
1.1	Make	As per approved vendor list
1.2	Item	RTU Panel
1.3	Service	Automation
1.4	Area Classification	Non Hazardous
2	**RTU**	
2.1	POWER SUPPLY	24 VDC, Redundant Power Supply Inputs
2.2	PROCESSOR	32-bit Processor
2.3	MEMORY	64 GB Built In SD Card Storage (Expandable Up to 128 GB) for periodic data storage against time stamp
		1 MB Flash Memory Storage for storing configuration parameters
2.4	DATA STORAGE	FAT32 File System
		Daily one file for Periodic data storage up to 1500 records which includes operation events and SMS generated
		Each record will have up to 50 parameters with Time Stamp
		Configurable Time period: minimum 1 min.
		Daily one file for event snap shots with up to 500 event snap records
		On event data storage rather than periodic interval
		Each event snapshot will have event log and value of all other parameters (up to 50)
		Total storage up to 2000 daily files for periodic data storage and event snapshots
2.5	COMMUNICATION PORTS	1 Ethernet Port (10/100 Mbps)
		1 USB Port
		1 RS 485 MODBUS Slave Port
		2 RS 485 MODBUS Master Ports
2.6	CELLULAR CONNECTIVITY	QUAD BAND GSM/ GPRS Gateway for SMS/ Call/ Email Notifications
2.7	COMMUNICATION MODES	Web Server Interface through Ethernet
		Local File or Data transfer through USB Port
		RS 485 MODBUS/ TCP IP Master Communication to communicate with local MODBUS devices such as flow meter, energy meter, local display etc.

		RS 485 MODBUS Slave Communication for Local Interface
		SMS/ GSM based on demand data retrieval in case of unavailability GPRS
		MQTT(I o T) protocol based communication on GPRS connectivity
2.8	DIGITAL INPUTS (If applicable)	16 Digital Inputs – Provision to Integrate local digital sensors such as fuse status, door open, level switch, power supply sense etc.
2.9	PULSE INPUTS (If applicable)	8 Pulse Inputs (up to 1 kHz Frequency)– Provision to Integrate Flow Meters having Pulse Output
2.10	ANALOG INPUTS (If applicable)	8 Analog Inputs (0-10 VDC/4-20mA, 0.5% accuracy) – Provision to integrate Pressure transmitter, Level Transmitter etc.
2.11	RELAY OUTPUTS (If applicable)	8 Relay Output (10 A, 230VAC/24 VDC)
2.12	CLOCK	Built In RTC Provision for RTC Auto Sync GSM Network Time Provision to Sync RTC with Server Time Manually
2.13	Location Identity	GPS based location feedback for presentation on Google MAP and maintenance support
2.14	SECURITY	128 AES Encryption for User Log In Security for web server interface
2.15	PUMP OPERATION MODES (Not Applicable)	Device should have provision to operate pump in various modes such as
		Schedule Based Auto Operation – “Pump on” as per schedule and “Pump off” against flow set point or against schedule.
		A device should be able to store minimum of three schedules
		Sensor Based Auto Operation – “Pump on” against sensor activation (such as level) and “Pump off” against flow set point\
		Manual Operation – “Pump on” against giving manual command from SCADA and “Pump off” against flow set point
2.16	NOTIFICATIONS/ DIAGNOSTIC	Configurable SMS/Call Notifications on event Configurable activation/deactivation of Notifications Configurable Mobile Numbers to receive Notifications Configurable Polling Interval for local MODBUS Devices
		Digital Input Sense such as fuse failure, level, door open, mode etc. configurable Alarm Conditions : Positive Edge / Negative Edge
		Relay Operations such as pump operation

		commands configurable Alarm Conditions : Positive Edge / Negative Edge
		Analog Parameters such as flow, pressure, level, Load (A), Power (kW), voltage configurable Alarm Condition : High , Low
		Mains Power Supply Failure
		SCADA Server Communication Failure MODBUS Communication Failure
2.17	COUNTERS/INTEGRATORS	Pump Running Hours Totalizer for Pulse Inputs Totalizer for 4-20mA Inputs
2.18	EFFICIENCY	Provision to perform pump station efficiency calculations Notifications against pump station efficiency thresholds : Low

3.8. **Client Server Model:**



- The client–server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients.
- Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system.
- A server host runs one or more server programs which share their resources with clients.
- A client does not share any of its resources, but requests a server's content or service function.
- Clients therefore initiate communication sessions with servers which await incoming requests.

3.9. **Database Server:**

- A database server is a server which houses a database application that provides database services to other computer programs or to computers, as defined by the client–server model.
- Users access a database server either through a "front end" running on the user's computer – which displays requested data – or through the "back end", which runs on the server and handles tasks such as data analysis and storage.

- In a master-slave model, database master servers are central and primary locations of data while database slave servers are synchronized backups of the master acting as proxies.
- Most database applications respond to a query language. Each database understands its query language and converts each submitted query to server-readable form and executes it to retrieve results.
- The SQL (Structured Query Language) query language is more or less the same on all relational database applications.
- For clarification, a database server is simply a server that maintains services related to clients via database applications.

3.10. **Database Application:**

- A database application is a computer program whose primary purpose is entering and retrieving information from a computerized database.
- A characteristic of modern database applications is that they facilitate simultaneous updates and queries from multiple users.
- Information would be pulled from the database, transmitted over a network, and then arranged, graphed, or otherwise formatted by the program running on the PC.
- Contractor has to build database applications with a Web interface. Rather than develop custom software to run on a user's PC, the user would use the same Web browser program for every application.
- A database application with a Web interface shall have the advantage that it could be used on devices of different sizes, with different hardware, and with different operating systems.

3.11. **Database:**

- A database is an organized collection of data, stored and accessed electronically.
- Database designers typically organize the data to model aspects of reality in a way that supports processes requiring information, such as (for example) modelling the non availability of flow meter readings in networks in a way that supports finding a flow meter with No reading.

3.12. **Database-management System (DBMS)**

- A database-management system (DBMS) is a computer-software application that interacts with end-users, other applications, and the database itself to capture and analyze data. (Sometimes a DBMS is loosely referred to as a "database".)
- A general-purpose DBMS allows the definition, creation, querying, update, and administration of databases.
- A database is generally stored in a DBMS-specific format which is not portable, but different DBMSs can share data by using standards such as SQL and Open Database Connectivity (ODBC) or Java Database Connectivity (JDBC).
- In computing, Open Database Connectivity (ODBC) is a standard application programming interface (API) for accessing database management systems (DBMS). The designers of ODBC aimed to make it independent of database systems and operating systems. An application written using ODBC can be ported to other platforms, both on the client and server side, with few changes to the data access code.
- Java Database Connectivity (JDBC) is an application programming interface (API) for the programming language Java, which defines how a client may access a database. It is a Java-based data access technology used for Java database connectivity. It is part of the Java Standard Edition platform, from Oracle Corporation. It provides

methods to query and update data in a database, and is oriented towards relational databases. A JDBC-to-ODBC bridge enables connections to any ODBC-accessible data source in the Java virtual machine (JVM) host environment.

- Computer scientists may classify database-management systems according to the database models that they support.
- Relational databases: These model data as rows and columns in a series of tables, and the vast majority use SQL for writing and querying data.

3.13. **Web/ Mobile Based Application:**

- Client can view entire flow meter network Data with secured Username and password.
- Consumer can view their own flow meter reading with secured user name and password.
- All possible reports, trends, alarms, graphical representation shall have to prepared by developer and to be tested and verified in presence of TPI prior to starting of trial RUN.

3.14. **Billing Software:**

- Developer has to prepare billing software for all consumers and clients.
- Billing software shall have to prepare by developer and to be tested and verified in presence of TPI prior to starting of trial RUN.
- Minimum 2 years of bills can be viewed by Client and Consumer.
- 10 Years of Bill Record can be stored in Data based Server.

For Example:

Consumer: 10000 Nos

Billing per Month: 1 No

Bill Generated Per Year: 1 X 12 X 10,000= 12,000/- Nos

Bill Can be Viewed By User and Consumer: 24,000/- Nos

Bill Can be stored in Data Based Server: 1, 20,000/- Nos

3.15. Control Room Specification (Not Applicable)

3.15.1. False Ceiling Specification:

a) Supply, fitting & fixing of False Ceiling with Gypsum Board (30mm thick) in 600mm x600mm panel, MS framing work with adjustable jack supports).

b) Sufficient Clear space to be made available over false ceiling. 10 mm thick x 37 mm high teak-wood lining shall be provided around the room where the floor panels meet the wall surfaces 2 mm thick and 100 mm high homogenous anti-static PVC skirting shall be provided around the room.

c) This item includes supply of all materials, fixtures, tools & tackles, fittings etc complete.

3.15.2. False Floor Specification:

a) Supply, fitting & fixing of False Floor (Cavity Floor). False flooring with M.S. channels support system.

b) False flooring with cement bonded particle boards 600 x 600 x 30 thk. supported on same grid made by M.S. channel sections on both directions supported on ISMB of required sections fixed to true floor.

c) The false floor shall provide a rigid and a highly durable load carrying surface constructed generally in square modules and resting freely on rigid framework of steel jacks/PCC pedestals and channel stringers.

d) The flooring system shall be such as to allow any framing members or floor boards to be removed quickly and easily to facilitate complete freedom for laying cables or other services in any direction without removing large section of the floor.

e) The floor shall be capable of supporting a minimum distributed load of 750 kg/sq m. The base of the floor jacks shall be fixed to the sub-floor by special adhesive or plugged and screwed.

3.15.3. 10 mm thick x 37 mm high teak-wood lining shall be provided around the room where the floor panels meet the wall surfaces with the top of the lining matching with the finished top of floor panels.

3.15.4. 2 mm thick and 100 mm high homogenous anti-static PVC skirting shall be provided around the room.

3.15.5. Entire sub-floor may be rendered smooth with cement slurry trowel and neat cement finish and wall surfaces under the false floor may be painted with two coats of synthetic enamel paint over a coat of primer.

3.15.6. Aluminum Partition Wall:

a) Fitting & fixing of Aluminium framed casement fixed half glass partition wall. Aluminium sections used shall be of approved type and make.

3.16. **Cabinets for Field Instruments**

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

3.16.2. The cabinets for electronic indicating instruments like transmitters, flow computing units etc. mounted outdoors shall be provided with proper sunshade.

3.16.3. The cabinets shall be fabricated from cold rolled sheet steel of 2 mm thickness with powder coating and shall be suitable for wall mounting or pedestal mounting as required.

3.16.4. The cabinet shall be properly painted from inside and from outside by paint shade RAL 7035.

3.16.5. The cabinet shall conform to IP 65 weather protection and shall have built in locking facility.

3.16.6. 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.

3.17. **Cables and Cabling System:**

3.17.1. This specification covers the requirements for instrument signal cables, thermocouple extension cables, RTD cables and power / control cables.

3.17.2. Single pair shielded signal / alarm cables shall be used between field instruments / switches and junction boxes / local control panels.

3.17.3. Single pair shielded thermocouple extension cables shall be used between thermocouple head and junction boxes / transmitters / local control panel mounted instruments.

3.17.4. Single triad shielded signal cables shall be used between RTD head and junction boxes / transmitters / local control panel mounted instruments.

3.17.5. For field bus compatible instrument single pair shielded cable shall be used between instrument to junction box/ local panel and to control room.

3.17.6. Foundation Field bus shall be Type-A cable. Construction of same shall be as per IEC 61158-2. Trunk cable shall be used of 1 Pair, 5 Pair, and 12 Pair.

3.17.7. Separate Multipair/ multitriad cables shall be used between junction boxes/ local control panel and control room as per following applications.

a) 4-20 mA signals (for conventional HART Transmitters)

b) Foundation Field signals

c) Thermocouple signals/ Resistance Temperature Detectors (RTD) signals

d) Switch contacts / Proximity switch contacts, Gas detectors

3.17.8. Power cables shall be used between power supply distribution boards and power consumers such as control panels, DCS / PLC cabinets, any instruments requiring power supply, etc.

3.17.9. Control cables shall be used for solenoid valves.

3.17.10. For solenoid valve signals and power supply to instruments, junction boxes shall be used.

3.17.11. The cable design shall generally follow BS 5308 Part-1 for various cables listed in clause-e as above.

3.17.12. Thermocouple cables design shall comply with ANSI MC 96.1.

3.17.13. The power and control cables shall be generally as per BS 6346. For these cables, equivalent IEC/IS specifications are also acceptable.

3.17.14. The insulation grade shall be 1100 V for all cables.

3.17.15. The primary insulation shall be cross-linked Polyethylene with temperature rating 70˚C conforming to BS- 5308 / IS 7098.

3.17.16. Inner and outer sheath / jacket shall be made of extruded fire retardant, low smoke, low halogen, low toxic, polymeric compound having physical properties as per IS-5831 –Type ST2.

3.17.17. All cables shall be armoured and suitable for operation when installed as follows:

a) Directly buried in the ground

b) Fastened to cable ladder rack or tray in the open air

c) In underground ducts

d) In overhead closed cable ducts

3.17.18. Running length of the cable shall be printed at least at every 5 metre interval.

3.17.19. For Multipair/ multitriad cables, pair identification shall be provided with numbers at interval of not more than 250 mm as per vendor's standard.

3.17.20. Contractor shall ensure a minimum of 20% of quantity of each type of cables supplied as spare including any special cable and in each Multipair cable 20% pairs shall be kept as spare.

3.17.21. A pair of communication wire shall be provided for Multipair / multitriad cables.

3.17.22. Each wire shall be 0.5 mm 2 of plain annealed single or multi-strand copper conductor with 0.4 mm thick 70 ˚C XLPE insulation.

3.17.23. All cables shall be fire retardant and low smoke.

3.17.24. **Laying of Cables:**

a) A distance of minimum 300mm shall be maintained between the cables to be laid on trays/conduits carrying low voltage AC and DC signals and a distance of minimum 600mm shall be maintained between cables carrying HT and LT signals.

b) Each instrumentation and power supply cable shall be terminated to individual panel/ terminal box.

c) Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.

d) Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for approval.

e) All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end.

f) Various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables.

g) A loop of 1 metre shall be left near each field instrument before terminating the cable.

h) Cables shall be complete uncut lengths from one termination to the other.

i) Separate cables shall be used for digital and analog signals.

j) All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedules.

k) Identification tags shall be securely fastened to the cables at both the ends.

l) Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.

m) The Contractor shall take the actual measurement of the cables and the associated accessories such as cable trays, conduits etc required at site, prior to the placement of order on the cables.

3.17.25. **Cable Gland**

a) Cable glands required for glanding all cables at both ends shall be supplied by contractor.

b) A minimum of 20% of cable glands shall be supplied as spare.

c) Cable glands shall be of SS 316 and double compression type suitable for armoured cables.

d) All cable glands shall be weatherproof to IP-66. Flameproof glands wherever required shall be supplied with Ex (d) certification suitable for Gas Groups IIA / IIB / IIC.

e) All cable glands shall be with LSF shrouds.

f) For all field items and junction box end, NPT threaded cable glands shall be used and for control room / control panel end, cable glands shall be ET threaded types.

3.18. **Junction Boxes**

a) In order to make the most economic use of cable tray and trench capacity, multicore / multipair cabling shall be utilised in order to connect instrumentation groups by using suitably located junction boxes.

b) The junction boxes shall have weather protection suitable for the area in which they are to be installed and for the type of circuit.

c) They shall be readily accessible for maintenance and clearly labeled.

d) Wires and terminals for the digital and analog signals shall be segregated within junction boxes.

e) Junction Box Enclosure shall comply with minimum IP65 protection.

f) Enclosure shall meet global certifications- DIN standard EN 62 208 or EN 60529/09.2000 compliance with NEMA 4 and UL approved.

g) Enclosure material of construction shall be Cold Rolled close annealed (CRCA) steel sheets.

h) Enclosure Surface shall be anti-corrosive type.

i) Enclosure and door shall be electro-phoric dipcoat primed, powder coated in textured RAL 7032/ 7035 and Mounting Plate shall be Zink Plated.

j) Enclosure of all-round solid construction, single sheet construction, single door, 1 gland plate in the enclosure base, right hand door hinge, may be swapped to opposite side with lockable arrangement.

k) In case of single sheet construction thickness will be 1.2 -1.38mm however if it is welded, thickness will not be less than 2.5mm.

l) The JB shall have Z- bend design for superior mechanical strength.

m) The gasketing will be PU foam and complete paint process will be Restriction of Hazardous Substances (ROHS) compliant (including solvent) with EC dipcoat. Alternatively, galvanised sheet with direct powder coating is also acceptable.

n) Technical Particulars (Junction Box)

Sr. No	Content	Technical Specification
1	Make	As per approved vendor list
2	Item	Junction Box

3	Type	Single Sheet, Solid Construction
4	Protection Class	IP 65
5	MOC of Junction Box and Mounting Plate	CRCA
6	Color	RAL 7035
7	Gasket	PU Foam
8	Locking facility	Required
9	Certification	EN 62 208 – Fabrication Standard EN 60529/09.2000 – Fabrication Standard, NEMA 4, UL

3.19. **Spares & Consumables:**

3.19.1. **Commissioning Spares:**

a) Bidder shall submit a list of spares & consumables required for start-up and commissioning of the plant, equipment, systems etc. which will be supplied as part of scope.

b) The list shall broadly include spares & consumables for the field instrumentation items, as per manufacturer's recommendation and one no. of each type of I/O module of the PLC based automation system, with respective description & quantities.

c) In addition, any other spare & consumable, required during these activities, shall also be supplied by bidder under his scope.

3.19.2. **O&M Spares:**

a) As specified in the Scope of Work, bidder shall keep with himself necessary spares during entire period of Operation & Maintenance for repair, replacement, maintenance etc. of ICA equipment.

b) The list of recommended spare parts shall be provided by the bidder but shall not consider in price bid. Mandatory spare parts shall be inclusive of quoted price.

3.19.3. **Tools and Tackles:**

a) Bidder shall include in his offer and provide all the special tools and tackles for erection, testing & maintenance of the instrumentation & automation system, as required for proper functioning and maintenance system

3.20. **Applicable standards**

3.20.1. All equipment shall comply with all applicable national and local laws regulations and Standards, in addition to those listed below:

1	ISO 9000 and 9004	Quality Systems
2	ISO 6817	Measurement of conductive liquid flow in closed conduit- Methods using Electromagnetic Flow meter
3	ISO 4185	Measurement of liquid flow in closed conduits -- Weighing method
4	ISO 9104	Method of evaluating the performance of electro-magnetic flow meters for liquids
5	BS EN 50081	Electromagnetic Compatibility
6	ISO 12242:2012	Measurement of fluid flow in closed conduits- Ultrasonic transit time flow meters.
7	ISO 7066-2	Assessment of uncertainty in the calibration & use of flow measurement device.
8	IEEE 587	Power Supply Surge Protection
9	IEC 61158-2	Communication Protocols
10	ISO 9075 (BS 6964)	Structured Query Language (SQL)
11	BS 5515	Documentation of Computer Based
12	BS 7165	Recommendation for Achievement of quality in Software
13	ISO 3511	Process measurement & control functions- Instrumentation symbolic
14	ISO-OSI	7 Layer Communication Model
15	IEEE 472-1974	Surge protection.
16	EEMUA	Alarm rationalization and management
17	DNP	Distributed Network Protocol
18	UHF Radio / GPRS standards	
19	Network standards	SNMP/SMTP Statement of Compliance

3.20.2. The Contractor shall provide a list of the reference standards used and shall provide a compliance/non-compliance statement during drawing / documents evaluation and the bid submission.

3.21. **Drawings & Documents Required:**

3.21.1. To be submitted along with the Bid (as minimum, but not limited to following):

a) P&IDs for the complete process indicating all the local & remote /panel mounted measurements & controls, alarm & interlocking functions, using ISA symbols.

b) Consolidated instrument list (Instrument Index) indicating description, application, location, type, quantity, accuracy, process parameters, measuring ranges, etc.

c) Tentative instrumentation power (UPS & Non UPS) & air requirements, as applicable.

d) Automation system configuration diagram along with a write up explaining the system functions, redundancy features, interfacing with other systems, etc.

e) Broad bill of materials for the Instrumentation & Automation equipment & peripherals.

f) List of spares and consumables with details and quantities.

3.21.2. To be submitted after the award of Contract (as minimum, but not limited to following):

Drawings:

a) Power supply distribution single line and schematics diagrams for each control panel

b) Internal and external general arrangement for each control panel (dimensional)

c) Control panel wiring diagram, relay logic diagram along with terminal block details

d) UPS and battery sizing calculations;

e) Control and instrumentation loop drawings (control and instrumentation loop drawings shall show on a single drawing the complete circuit associated with an instrument or device including details and location of power supplies, cabling and terminations)

f) Instrument installation detail drawing (Hook up drawings shall detail how an instrument or device is installed)

g) Cable block diagrams

h) Cable routing/installation drawings

i) Foundation and fixing details and trenches drawings

Schedules:

a) Cable schedule

b) Cable interconnection schedule

c) Control and instrumentation load schedule for each control panel

d) Junction box schedule

e) Instrument schedule with tag nos

f) Instrumentation, process control set point schedule

g) Instrument data sheets

Documents:

a) Factory Acceptance Test procedure (FAT)

b) Site Acceptance Test procedure (SAT)

4. Quality Assurance, Inspection and Testing:

4.1. The instrumentation and automation system shall be design, select & supplied ensuring proper quality & performance. Vendor's procedures for Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) shall be submitted at least 60 days prior to the scheduled conduction of these tests for review/acceptance.

4.2. The proposed FAT & SAT procedures of Vendor shall be reviewed and modified as required to generate mutually agreed & finalized procedures, based on which these acceptance tests will be performed and supervised by authorized agency of Purchaser.

4.3. All system hardware & software used for testing shall be complete as specified and shall use actual equipment to be shipped to the site as per scope.

4.4. The test equipment, meters, instruments etc. used for testing shall be calibrated at recognized test laboratory at regular intervals and valid certificates shall be made available to the Purchaser at the time of testing. The calibrating instruments used as standards shall be traceable to international standards. Calibration certificates for test instruments shall be produced from a recognized laboratory for the purchasers consent in advance of testing and if necessary the instruments shall be recalibrated or substituted before the commencement of the test.

4.5. **Factory Acceptance Tests (FAT):**

4.5.1. The factory acceptance test shall be held at manufacturer's works. Prior to the FAT, all the equipment shall be fully assembled, wired and properly connected & tested to establish all the specified features & functional requirements of the systems.

4.5.2. During FAT, functional integrity of the system hardware and software shall be tested & demonstrated. All the necessary simulation kits as may be required for testing of software shall be arranged by the manufacturer.

4.5.3. Bidder shall perform functionality tests of complete system and satisfy himself of the results before giving notice regarding readiness of the system and its availability for FAT. Such notice shall be given minimum 15 days before the scheduled start of the FAT.

4.5.4. The factory acceptance tests shall include visual and mechanical testing to establish correctness, completeness, good workmanship and functional testing. The tests shall establish performance of all the hardware & software in presence of Purchaser. All the sub-systems shall be interconnected to simulate, as close as possible, the total integrated system. Each test carried out shall be documented. Simulators shall be used for simulating field inputs. Any deficiency or problem faced shall be clearly brought-out and corrected.

4.5.5. Before start of the FAT, the complete integrated system shall be kept powered on for 72 Hrs.

4.5.6. All assemblies shall be aligned & adjusted and all test results shall be documented.

4.5.7. The automation system shall be shipped to site only after successful completion of FAT and receipt of dispatch clearance from Purchaser.

4.6. **Site Acceptance Test (SAT)**

4.6.1. At site, the system shall be properly installed taking care of manufacturer's recommendation, after which Site Acceptance Tests (SAT) shall be carried out taking into the actual field instruments/ equipment in the loops.

4.6.2. The Site Acceptance Test shall be held at site after the system has been installed as per the

finalized SAT procedures. The tests shall be witnessed by Purchaser.

4.6.3. A log of all failed/ mal-operating components /modules in a sub-system shall be maintained by Vendor, with description of the affected components /modules, cause of failure, effect of failure on the sub-system and number of hours of operation before it failed. This will start from the date of power on of the system for cold commissioning. The minimum tests to be carried out shall be as indicated in table below.

4.7. **Periodic Site calibration-**

4.7.1. Contractor shall periodically calibrate the flow/ pressure/ level/ Energy meters installed in the pipelines. Each meter shall be calibrated on site, once in twelve months, with a standard reference meter. Calibration certificate of the reference meter with validity period, duly certified by govt. approved research institutes/labs (i.e. FCRI / NABL) shall be provided to the Engineer-in Charge. Reference meter shall have an accuracy of +/-1% or better of the flow rate. Reference meter should be a precise instrument and the precision record (certificates of past readings) of the instrument shall also be submitted. Site calibration shall be arranged and shown to prove the accuracy of actual flow. In case of large deviation in the flow rate measured or if the Engineer-In -Charge feels that the readings of particular meters are not accurate, then these meters shall be taken out & calibrated at FCRI/NABL laboratories or manufacturers lab duly accredited by FCRI/NABL.

4.8. **Test & Acceptance Criteria:**

4.8.1. Test Criteria: Following tests shall be performed as a minimum for automation system, during both FAT & SAT, in presence of authorized representatives and documented test results shall be compiled:

Sr. No.	Test Description	FAT	SAT
1	Check of supply completeness	√	√
2	Visual & dimensional check	√	√
3	Power-off and power-on of any single unit	√	√
4	Test of alarm system	√	√
5	Check of loop configuration for correct entry of ranges, limits etc.	√	S
6	Check of various log formats, shutdown reports etc.	√	S

FAT=Factory Acceptance Test; to be performed at Vendor's workshop.

SAT= Site Acceptance Test; to be performed at site.

√= Complete test; 100% of devices/ functionality will be tested.

S = Sample test All the necessary simulation kits as may be required for testing of software shall be arranged.

Acceptance of any equipment or the exemption of inspection shall in no way absolve the Vendor of the responsibility for delivering the equipment meeting the entire requirement specified in this specification and also as may be required for satisfactory operation of the process.

4.9. **Acceptance Criteria:**

4.9.1. Automation system shall be suitable to meet the below minimum acceptance criteria, which are to be demonstrated by the successful bidder during testing of the system.

Sr. No.	Description	Criteria
1	Availability of Automation System	99.8% [calculated over a period of seven (7) working days]

5. Abbreviations Used

AMF	Automatic Mains Failure	LAN	Local Area Network
API	Application Program Interface	MIS	Management Information System
CCTV	Closed Circuit Television	MLD	Million Litres per Day-
COM/DCOM	Computer Object Model/ Distributed Computer Object Model	MUX	Multiplexer
CPU	Central Processor Unit	OPC	OLE for Process Control
SCADA	Supervisory Control and Data Acquisition System	ORP	Oxidation Reduction Potential
DDE	Dynamic Data Exchange	OSI	Open Systems Interconnect
DLP	Data Loss Prevention	PLC	Programmable Logic Controller
DO	Dissolved Oxygen	PS	Pumping Station
EMCS	Electromagnetic Compatibility Society	RAS	Returned Activated Sludge
FBD	Functional Block Diagram	RTU	Remote Terminal Unit
FOC	Fibre Optic Cable	SCADA	Supervisory Control and Data Acquisition
GPRS	General Packet Radio Service	STP	Sewage Treatment Plant
GRP	Glass Reinforced Plastic	TCP/IP	Transmission Control Protocol/Internet Protocol
GSM	Global System for Mobile	TE	Treated Effluent
HMI	Human Machine Interface	VBA	Visual Basic for Applications
I&C	Instrumentation & Control	VFD/VSD	Variable Frequency Drive/

			Variable Speed Drive
IEC	International Electro technical Commission	SAS	Surplus Activated Sludge
I/O	Input / Output	Windows TM	Microsoft Windows
ISO	International Standards Organization	WTP	Water Treatment plant
IT	Information Technology	XML	Extensible Mark-up Language

6. Makes for Major Instruments/ Equipment

INSTRUMENT/ EQUIPMENT NAME	MAKE
Instruments	• ABB • Emerson • Endress+Hauser • Krohne Marshall • Siemens • Yokogawa • Fuji • Honeywell
Web Based Monitoring System Integrator/ Data logger/ RTU	• ABB • Rockwell • Schnieder • Siemens • Honeywell • Fuji • GE Fanuc
Server	• IBM • Dell • Lenovo • HP
UPS	• Hitachi • Eaton • Vertiv • APC • Numeric
Printer	• HP • Canon • Brother • Epson • Xerox

Note: GWSSB Approved Makes are also valid for Execution of this Project.

Actuator Specifications:

- Actuator shall be 3 phase, 415 V operated.
- Actuator shall have integral starter with IP 68 protection in case submerged application and IP67 in case outside chamber/ building application.
- Material of Actuator shall be Non corrosive and shall withstand minimum 10 years of life.

1.0 Actuator Rating

Sr. No.	Description	Detail
1	Motor Make	As per Approved Vendor List
2	Average Current	As per Manufacturer Standard
3	Rated Torque Current	As per Manufacturer Standard
4	Lock Rotor Current	As per Manufacturer Standard
5	RPM	As per Manufacturer Standard
6	Torque	As per Manufacturer Standard
7	Open Time	< 120 Sec
8	Close Time	< 120 Sec

2.0 Actuator Power & Control Cable Termination Details

Sr. No.	Description	Terminal Designation
1	Power Terminal	R, Y, B
2	Remote Available Terminal	Required
3	Open Position Switch Feedback	Required
4	Close Position Switch Feedback	Required
5	Open Torque Switch Feedback	Required
6	Close Torque Switch Feedback	Required
7	Motor Running Indication	Required
8	Open Command	Required
9	Close Command	Required

ARRANGEMENT OF TRAFFIC DIVERSION DURING CONSTRUCTION

a) General: The contractor shall at all times carry out work on the road in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same .For all work involving improvements to the existing road the contractor shall, in accordance with the directives of the Engineer-in-charge, provided and maintain, during the execution of the work, a passage for traffic along a part of the existing way under improvement, or along a temporary diversion constructed close to the road.

b) Passage of traffic along a Temporary Diversion: If in the opinion of the Engineer-in- charge it is not possible to pass the traffic on part width of the carriage way for any reason, a temporary diversion close to the road shall be constructed as directed. It shall be paved with locally available materials such as hard murrum, gravel, brick or stone metal to the specified thickness and provided with bituminous surfacing, where directed. In all case, the alignment, gradients and surface type of the diversion, including its junctions, shall be approved by the Engineer-in-charge before the highway is detoured and closed to traffic. At cross drainage points, the contractor shall provide temporary crossings for the diversion according to the designs approved by the Engineer- in-charge.

c) Traffic Safety and control: The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, fights and flagmen as may be required by the Engineer- in-charge for the information and protection of traffic approaching or passing through the section of the road under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

The barricades erected on either side of the carriage/portion of the carriage way closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept throughout from sunset to sunrise.

At the point where traffic is to deviate from its normal path whether on temporary diversion or part width of the carriage way the channel for traffic shall be clearly marked with the aid of pavement markings painted drums or a similar device to the directions of the Engineer-in-charge. At night the passage shall be delineated with lanterns or other suitable light source.

One way traffic operation shall be established wherever the traffic is to be passed over part of the carriage way inadequate for two-lane traffic. This shall be done with the help of flagmen kept positioned on opposite sides during all hours for

regulation of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides suitable regulatory/warning signs shall be installed for the guidance of road users, On each approach at least two signs shall be up put one close to the point where transition of carriage way begins and the other 120 meters away. The signs shall be of approved design and of refractory type if so directed.

d) Maintenance of Diversion and traffic control Devices: Signs, lights, barrier and other traffic control devices as well as the riding surface of diversions shaft be maintained, in satisfactory conditions till such time they are required as directed by the Engineer-in- charge. The temporary travel way shall be kept free of dust by frequent application of water if necessary.

e) Measurements for payment traffic Arrangement: All arrangements for traffic during construction including maintenance these off but excluding initial dressing and/or extra treatment of the shoulders and construction of temporary diversions shall be considered as incidental to the works and Contractor responsibility.

Construction of temporary diversions, initial dressing of the shoulders and extra paving at passing places shall, however be paid for as provision sum, if written order is issued to do so by the Engineers-charge.

The work in general shall be carried out as per instructions & approval of engineer in charge.