

- Name of Work -

**EPC Contract for Providing Irrigation Water  
Facility to Filling Kelamul Village Tank by Lifting  
Water from KLBMC at Ch.8.20 km of Taluka  
Kadana, Dist. Mahisagar.**

***Tender Document***

**VOLUME II – [B]**

**Technical Specifications for Mechanical Works**

**Government of Gujarat  
Narmada Water Resources, Water Supply  
& Kalpsar Department**

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## LIST OF ABBREVIATION

ACRONYM	DESCRIPTION
GWSSB	Gujarat Water Supply and Sewerage Board
HDPE	High Density Polythene Pipe
HP	Horse Power
KW	Kilo Watt
MS	Mild Steel
RCC	Reinforced Cement Concrete
ROU	Right of Use
SOR	Schedule of Rates



# 1. SCOPE OF WORK

## 1.1 GENERAL

- a. The scope of mechanical system includes Design, Manufacturing, Supply, Installation, Testing and Commissioning and Operation and Maintenance for 5 years including 3 years of Defect Liability Period.
- b. The minimum Design life of pump with motor shall be 15 years (Minimum) 140000 operating hours (minimum).
- c. The Contractor shall supply Mechanical Tools & Test Equipment for O&M Period & Mandatory Spare Parts as per specified in Annexure-M1 & M2 (Volume-IV Price Bid).
- d. The contractor shall submit to the department such as QAP / data sheets / drawings / catalogues etc. and any other supporting documents (each 3 sets) of equipment / items of mechanical system before start of manufacturing and approval of Engineer-in-charge to be obtained. Before shipping of such items, the contractor shall obtain inspection release note / dispatch clearance from the Engineer-in-charge.
- e. The Contractor shall submit operation and maintenance (O&M) manuals.
- f. Where provisions of the pertinent codes and standards conflict with these Specifications, Drawings and Datasheets or with each other, comply with the more stringent provision.
- g. Use the latest issue of Standards. Make available at least one copy of Standards for reference before construction at site office.

The following Pump-house Machineries, Valves, Pipes & Fittings, rising main valves & fittings are to be covered under Contractor's scope.

## 1.2 SUBMERGED CENTRIFUGAL PUMP

3 Nos. (2 working + 1 stand by) Submerged Centrifugal Pump with HT Induction Motor is to be provided. (At proposed pumping station location).

## 1.3 VALVES

Manually operated Butterfly Valve, Sluice Valve, Dual Plate Check Valve (DPCV- Reflux valve) etc. to be provided on each pump discharge (Delivery) pipeline.

## 1.4 PIPES AND FITTINGS

Mild steel suction and delivery pipes of given dia is to be provided for each pump. Metallic expansion bellow and related fittings is to be provided on each pump discharge (Delivery), Header line, Rising Main pipeline.

### 1.5 OTHER MECHANICAL COMPONENTS

- a. One (1) no. chain pulley block with triple gear arrangement with lifting hook, load chain & hand chain & locking device etc. (with all required parts or components for that) for pump house building for lifting or lowering of pumping machinery or any other components.

### 1.6 RAISING MAIN, VALVES & FITTINGS

- a. Mild steel raising main pipe with manually operated butterfly valves, reflux valve with dismantling joints (expansion bellow) of given dia is to be provided. Piping and related fittings is to be provided on rising main.
- b. Temper Proof Kinetic Air valves and Scour Valves are to be provided.
- c. Surge control devices are to be provided.

### 1.7 CODES & STANDARDS

The machinery, equipment, component and material shall confirm to the latest revision of the following standards:

Sr. No.	CODE	DESCRIPTION
01	IS -5	Colour for ready mixed paints and enamels.
02	IS -104	Ready mixed paint, brushing, zinc chrome, priming
03	IS -807	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists
04	IS -816	Code of practice for use of metal arc welding for general construction in mild steel
05	IS -900	Code of practice for installation and maintenance of induction motors.
06	IS – 1239	Mild steel tubes, tubular and other wrought steel fittings
07	IS – 1710	Vertical turbine pumps for clear, cold, freshwater.
08	IS – 2062	Steel for general structural purposes.
09	IS – 2629	Recommended practice for hot dip galvanizing on iron and steel
10	IS – 2633	Hot dip galvanizing
11	IS – 4691	Degree of protection provided by enclosures for rotating electrical machinery.
12	IS – 4137	Code of practice for heavy duty electric overhead travelling cranes including special service machines for use in steel work.

13	IS – 4722	Rotating electrical machines.
14	IS – 4889	Method of determination of efficiency of rotating Electrical machines.
15	IS – 12776	Galvanized strand for Earthling
16	IS – 13095	Wafer type butterfly valve size from 40 mm to 2000 mm
17	IS – 14846	Non rising stem type sluice valve size from 50 mm to 1200 mm
18	IS -3589	Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter - Specification
19	IS-4711	Methods for sampling of Steel Pipes, Tubes and Fittings
20	IS- 5312	Swing Check type reflux (non- return) valves for water work purposes-Specification Part-1
21	IS-14845	Resilient seated Cast Iron Air Relief Valves for water Works Purposes-Specification
22	IS -12615	Three Phase Induction Motors Specification
23	IS-10981	Class Of Acceptance Test for Centrifugal Mixed Flow and Axial Pumps - Class B
24	IS -1570(Part V)	Schedules For Wrought Steels - Part 5: Stainless and Heat-resisting Steels
25	IS -9866	Marking system for valves
26	IS- 638	Sheet Rubber Jointing and Rubber Insertion Jointing
27	IS-1363 (Part- 1)	Hexagon Head Bolts, Screws and Nuts of Product Grade C - Part 1: Hexagon Head Bolts (Size Range M 5 to M 64)
28	IS-1363(Part 2)	Hexagon Head Bolts, Screws and Nuts of Product Grade C - Part 2: Hexagon Head Screws (Size Range M 5 to M 64)
29	IS-1363(Part 3)	Hexagon Head Bolts, Screws and Nuts of Product Grade C - Part 3: Hexagon Nuts (Size Range M5 to M64)
30	IS- 6603	Stainless Steel Bars and Flats
31	IS-3444	Corrosion Resistant High Alloy Steel and Nickel Base Castings for General Applications
32	IS -1367	Technical Supply Conditions for Threaded Steel Fasteners
33	IS-5620	Recommendations for Structural Design Criteria for Low Head Slide Gates
34	IS-4622	Recommendations for Structural Design of Fixed-Wheel Gates
35	IS-4029	Guide for Testing Three Phase Induction Motors

36	IS-807	Design, erection and testing (structural portion) of cranes and hoists - Code of practice
37	IS-3177	Code of Practice for Electric Overhead Travelling Cranes and Gantry Cranes other than Steel Work Cranes
38	IS-3938	Electric Wire Rope Hoists
39	IS-13834	Crane Classification
40	IS-2048	Parallel Keys and Keyways
41	IS-2291	Tangential keys and keyways
42	IS-2292	Taper Keys and Keyways
43	IS-2293	Gib-head Keys and Keyways
44	IS-2327	Straight sided splines for cylindrical shafts with internal cantering - Dimensions, tolerances and verification
45	IS-2610	Power transmission - Straight sided splines for machine tools - Dimensions
46	IS 10981	Test setup and test procedure & Details of instrumentation along with their least counts and calibration certificates
47	HI 20.3-2010	Hydraulic Institute Guideline for Rotodynamic (Centrifugal and Vertical) Pump Efficiency Prediction
48	IS-5749	Specification for Forged Ramshorn hooks
49	HIS	Hydraulic Institute Standards
50	API 594	Check Valves: Wafer, Wafer lugs and Double Flanged type
51	API 598	Valve Inspection and Testing
52	IS -13159	Pipe Flanges and Pipe fittings – part-1: Dimension
53	IS – 2500	Sampling Inspection Procedure
54	BS -5155	Specification for Butterfly Valves

## 2. SUBMERGED CENTRIFUGAL PUMP

Supply, installation, testing & commissioning of submerged centrifugal pump sets (water immersed, dry air filled, class "F" insulated TEWC motor integrally mounted on volute casing pump sets for water duty, 3-phase,  $50 \pm 3\%$  Hz,  $415 \pm 10\%$  V along with suitable foundation / installation device with cable length from pumps to panels & of following Material of Construction:

Impeller: CF8M, Casing: C.I. FG 260, Wearing Ring: SS, TC mechanical seal, CS/SS bearing, SS shaft with sleeve, SS strainer & MS motor body.

**Note:** - The required size, power rating, capacity, head and quantity of above item is as per price bid.

### 2.1 GENERAL

This item covers the design, manufacture, supply, installation, testing, and commissioning of Submerged Centrifugal Pump Sets (water immersed, dry air-filled motor), complete with integrally mounted centrifugal pump, TEWC motor, cable, foundation / installation device, accessories, and required fittings, conforming to relevant Indian Standards and as approved by the Engineer-in-Charge (EIC). The pump set shall be suitable for handling clear / raw water, installed in wet conditions, and capable of continuous operation under specified duty parameters.

### 2.2 OPERATING CONDITIONS

- a. Type: Submerged centrifugal pump (water immersed, dry air-filled motor)
- b. Duty: Water pumping
- c. Power Supply: 3-Phase AC
- d. Frequency:  $50 \text{ Hz} \pm 3\%$
- e. Voltage:  $415 \text{ V} \pm 10\%$
- f. Motor Insulation: \*\*Class "F"
- g. Motor Type: TEWC (Totally Enclosed Water Cooled)
- h. Installation: Submerged / wet pit / sump as specified
- i. Required size & quantity: As per Price Bid

### 2.3 MATERIAL OF CONSTRUCTION (MOC)

Sr No.	Component	Material
1	Impeller	CF8M
2	Pump Casing / Volute	CI FG 260 (IS:210)
3	Wearing Ring	Stainless Steel
4	Mechanical Seal	Tungsten Carbide (TC)

5	Bearings	Carbon Steel / Stainless Steel
6	Shaft	Stainless Steel with sleeve
7	Suction Strainer	Stainless Steel
8	Motor Body	Mild Steel

## 2.4 SCOPE

The scope of work shall include, but not be limited to:

- a. Hydraulic design and selection of pump
- b. Manufacture and shop testing
- c. Supply, transportation, and handling
- d. Installation with suitable foundation / guide rail / lifting arrangement
- e. Supply and laying of power cable from pump to control panel
- f. Testing, commissioning, and performance verification
- g. Submission of complete documentation

## 2.5 CODES & STANDARDS

The pump and motor shall comply with the latest editions of the following standards:

IS 8034 – Submerged motor pump sets

IS 6595 – Centrifugal pumps

IS 325 – Induction motors

IS 9283 – Motors for pump applications

\* Applicable electrical safety and statutory regulations

## 2.6 DESIGN & FEATURES

The submerged centrifugal pump shall be capable of developing the specified required total flow & head at duty point at 50 Hz (rated frequency) for continuous operation.

- a. The pumps will be required to work satisfactorily in the entire operating range, while operating in solo as well as in any combination for parallel operation. The pumps of a particular category shall be identical & shall be suitable for parallel operation with equal load sharing. Components of identical pumps shall be interchangeable.
- b. The pump characteristics shall be of stable nature and such that efficiency is fairly constant for the operation under varying water levels as specified. The best efficiency point of pump should be near to specified duty point.
- c. The head capacity curve should be continuously rising towards shut off with highest at shut off. The pump curve should be of non-overloading type. The pump set should be designed to operate

up to a period of 5 minutes at shut off head without causing any damage to pump set. The shut-off head should not be less than 115 % of the total head of the pump.

- d. NPSH required by pumps offered should be lesser by at least 0.5 M than NPSH available at any point of operation in the entire range with solo and parallel operation.
- e. The pumps shall be suitable for nonstop continuous 24 hours operation without interruptions. However, the actual hours of operation per day shall be as per the approved design report of the system.
- f. The impeller adjustment shall be such that the impeller runs free in any installed condition despite extension of line shaft (caused by hydraulic down thrust, the weight of shafting and weight of impellers).
- g. The rating of the motor, driving the pump, shall have the power sufficient to drive the pump throughout the entire range of head capacity curve.
- h. Necessary lifting arrangement on equipment shall be provided for easy handling of the Pumps & Motors.
- i. The pump shall be designed considering the worst condition of raw water having turbidity, maximum up to 500 NTU and the suspended solid sizes which are entering during flood time and in monsoon season.
- j. The velocity of vibration shall be limited to 3.0 mm/sec at the thrust bearing. The noise level measured at pump; motor & discharge head shall be limited to 85 Db at a distance of 1.86 meters. The pump discharge head shall be of MS fabricated or CI construction & suitably reinforced to withstand all types of static dynamic loads, torsion loads etc. & design shall be rugged to limit vibrations within acceptable limits. The pump discharge head/ motor stool shall be suitable to accommodate thrust bearing with cooling arrangement & contain stuffing box with mechanical seal. A sufficient opening should be provided between adjacent pump-sets so as to have easy access & working on thrust bearing & stuffing box.
- k. The Thrust Bearing shall be of heavy-duty anti friction type. The bearing shall be designed to withstand all the loads under normal operation & shut off & shall be suitable for reverse rotation. The bearing should be oil lubricated type and shall be provided with an oil level indicator & a local as well as remote temperature measuring and indication arrangement. The Thrust Bearing shall have a water-cooling system preferably in the oil bath. The following shall be provided as minimum requirement. (a) Temperature probe suitable for dial type thermometer. (b) RTD for use with temperature scanner with an indication/ annunciation/ tripping protections in the PLC panel.
- l. The Cooling Water supply for the thrust bearing shall be of clean water and may be taken from a tapping from pump discharge line with a suitable replaceable water filtering arrangement. The life of thrust bearing shall not be less than 75,000 hours of operation.
- m. The Clearance between strainer & sump bottom, between adjacent pumps, as well as clearance from side walls should be such that the vortex free operation is ensured. Static balancing test shall be carried out.
- n. The line shaft bearing shall be having a Self-water lubrication system.

## 2.7 DESIGN & PERFORMANCE REQUIREMENTS

### 2.7.1 Hydraulic Performance

- a. Pump shall deliver the specified discharge and head continuously at rated voltage and frequency.
- b. Pump characteristic curve shall be stable and non-overloading.
- c. Shut-off head shall not be less than 120% of rated head.
- d. Best Efficiency Point (BEP) shall be close to duty point.
- e. Suitable for continuous 24-hour operation.

### 2.7.2 Mechanical Design

- a. Pump and motor shall be integrally coupled with rigid alignment.
- b. Design shall permit safe operation under fluctuating water levels.
- c. Pump shall be capable of operating without cavitation within operating range.
- d. Vibration level shall not exceed 2.8 mm/sec RMS.
- e. Noise level shall not exceed 85 dB at 1.0 m distance.

## 2.8 CONSTRUCTION FEATURES

### 2.8.1 General:

- a. Pumps shall be of centrifugal type complete with bowl, column assemblies, discharge elbow, suction strainer, bell mouth, base plate, motor stool, bearing housing, etc.
- b. Suction strainer shall be designed with a net opening area not less than 4 times the area at suction bell mouth diameter. Pump shall work satisfactorily even when strainer gets clogged up to 50%.
- c. The bowl assembly shall consist of rotating impellers which are housed in stationery bowls having guide vanes. The bowl shall also include the housing of the bottom pump shaft bearing.
- d. The column assembly shall consist of the column pipe to convey the liquid handled from bowl assembly to shaft assemblies and discharge elbow. The discharge shall be above floor discharge.
- e. Generally, the pump discharge shall be located in the discharge head and shall be taken out from the upper side of the supporting floor of the discharge head, unless otherwise specified.
- f. The Successful bidder /Contractor has to carry out CFD (Computational Fluid Dynamics) analysis of pump sump house through pump manufacturer to predict the flow characteristics and shall satisfy to owner for vortex free flow for Pump house.
- g. The pumps showing any abnormal behavior during performance test shall be stripped down for a thorough examination.
- h. Manufacturer shall demonstrate at site the trouble-free mechanical running, parallel operation and equal load sharing by the pumps and noise and vibration level.



### 2.8.2 Pump Casing

- a. Volute type, CI FG 260
- b. Smooth internal passage to reduce hydraulic losses
- c. Designed to withstand all hydraulic and mechanical loads

### 2.8.3 Impeller

- a. CF8M, enclosed type
- b. Dynamically balanced
- c. Secured firmly on shaft to prevent slippage
- d. Replaceable SS wearing rings provided

### 2.8.4 Shaft & Bearings

- a. SS shaft with corrosion-resistant sleeve
- b. Bearings of CS / SS suitable for submerged operation
- c. Designed for long service life and smooth operation

### 2.8.5 Mechanical Seal

- a. Double mechanical seal arrangement
- b. Tungsten Carbide (TC) faces
- c. Suitable for submerged continuous duty
- d. Seal chamber designed to prevent ingress of water into motor

### 2.8.6 Motor

- a. Dry air filled; water immersed motor
- b. TEWC construction
- c. Class “F” insulation
- d. Designed for frequent starts and continuous operation
- e. MS motor housing with corrosion-resistant coating

### 2.8.7 Suction Strainer

- a. Stainless Steel construction
- b. Adequate open area to prevent clogging
- c. Easily removable for cleaning

## 2.9 INSTALLATION & ACCESSORIES

- a. Pump shall be supplied with \*\*lifting chain / guide rail / installation device\*\* as required
- b. Foundation / mounting arrangement shall ensure:
- c. Proper vertical alignment

- d. Vibration-free operation
- e. Power cable of suitable rating and length from pump to control panel shall be provided
- f. Cable entry shall be water-tight and strain-relieved

## 2.10 TESTING & INSPECTION

### 2.10.1 Routine & Type Tests

- a. Insulation resistance test
- b. No-load and full-load motor test
- c. Leakage and pressure test of pump casing
- d. Mechanical seal integrity test

### 2.10.2 Performance Test

- a. Performance testing as per relevant IS standards
- b. Verification of head, discharge, power consumption, and efficiency
- c. No negative tolerance allowed at duty point

### 2.10.3 Inspection

- a. Visual inspection before dispatch
- b. Dimensional checks of critical components
- c. Verification of MOC through test certificates
- d. PMI test for SS components (random)

## 2.11 PAINTING & CORROSION PROTECTION

- a. All MS & CI surfaces shall be properly cleaned and prepared
- b. Primer coat followed by epoxy-based finish paint
- c. Coating suitable for submerged and humid environments
- d. Minimum total DFT as per manufacturer's standard

## 2.12 DOCUMENTATION

The contractor shall submit:

- a. GA & installation drawings
- b. Performance curves (Head vs Discharge, Efficiency, Power)
- c. Test certificates
- d. Material test certificates
- e. O&M manuals
- f. Warranty certificate
- g. Spare parts list

2.13 NAME PLATE

Each pump set shall have a stainless-steel nameplate indicating: Rated discharge, Total head, Motor power (kW), Speed (RPM), Voltage & frequency, Model & serial number, Manufacturer's name etc.

2.14 MODE OF MEASUREMENT & PAYMENT

Unit of Measurement - Per complete pump set

Payment Basis: Per number of complete sets (Pump + Motor + Cable + Accessories etc.)

Payment Includes: Supply, transport, and handling, Installation and commissioning, Testing and certification, Documentation submission.

Payment shall be made after successful commissioning and approval by the Engineer-in-Charge.

### 3. INDUCTION MOTORS

#### 3.1 SCOPE

The specification covers the design, manufacture, performance testing at manufactures works, supply, delivery, storage at site; erection, testing and commissioning of Squirrel cage induction motors complete with instrumentation controls and safety devices, equipment for the cooling water system, lubricating system oil, water piping with valves, fitting and other accessories at each pumping station as detailed in the Schedule of Requirements and as described in the various sub sections of the specifications. The scope of supply shall include spares for 5 years of operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance of all the motors even though these are nor individually or specifically stated or enumerated. Corresponding components of all the motors and associated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable.

The motor shall perfectly match in respect of speed, runaway speed, moment of inertia, overload capacities, couplings and any other requirement with that of pump.

#### 3.2 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of induction motors shall comply with all currently applicable status, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also confirm to the IEC 60034-1/2004 or latest applicable standards.

#### 3.3 PERFORMANCE AND CHARACTERISTICS:

- a. Motors shall be suitable for satisfactory and efficient operation of pumps for application and duty assigned. The rating of the motor shall be such that it should not get over loaded when the pump would be delivering high discharge due to water level in the sump at its highest level.
- b. Motors shall be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage for 5 minutes, commencing from hot conditions.
- c. Motors shall be capable of developing the rated full load torque even the supply voltage drops to 70% of the rated voltage. Such operation is envisaged for a period of one second. The pull-out torque of the motor to meet this requirement shall be at least 205% of full load torque.
- d. The locked rotor current of the motors shall not exceed 550% of full load current inclusive of 20% tolerance.
- e. The motor vibration shall be within the limit specified in IS 12075. The permissible noise level shall not exceed the stipulations laid down in IEC 60034-9. The motor shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage.
- f. Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under following supply conditions.
- g. Variation in supply voltage:  $\pm 10\%$

Variation in supply frequency:  $\pm 3\%$

Combined voltage and frequency variation:  $\pm 10\%$

- h. The locked rotor withstand time under hot condition at 110% rated voltage shall be more than the starting time at 80% voltage by at least two seconds or 15% of the accelerating time whichever is greater.
- i. The motor shall be so designed that it shall have maximum efficiency on load varying from 60% to 100% of full load. Dropping efficiencies from 100% full load to 60% of full load will not be acceptable.
- j. The rating of motor shall be 110% of the maximum power required by the pump over the entire operating range from shut off to run out flow or 125% of power required at duty point whichever is less. Motors shall be provided with eye bolts, lugs or other means to facilitate safe lifting.
- k. The rating of motor shall be 10% margin of the maximum power required by the pump over the entire operating range from shut off to run out flow (or 15% on duty point, whichever is higher). Motors shall be provided with eye bolts, lugs or other means to facilitate safe lifting.
- l. All motors shall be so designed that the maximum inrush currents, and locked rotor and pull out torques developed by them at highest voltage and frequency limits do not endanger the motor and the driven equipment.
- m. Induction motors shall be designed to be capable of withstanding the voltage and torque stresses developed due to the difference between the motor residual voltage and incoming supply voltage equal to 150% of the rated motor voltage during changeover of buses.
- n. Motor not meeting min guaranteed parameters shall not be accepted till required parameters are achieved in performance testing.

### 3.4 STATOR WINDING & INSULATION:

- a. Motor winding shall be of proven high quality and reliability. For HT motors the insulation system of stator winding shall be of the epoxy type.
- b. Stator coils and rotor bars shall be tight fit in their slots. Any stator slot packing used for winding of HT motors shall comprise of material impregnated with a conducting medium and shall be compatible with the system of stress control.
- c. All winding overhangs and leads shall be adequately supported, braced and blocked.
- d. Case winding and all joints shall be designed to give an adequate safety factor on the fatigue due to thermal and mechanical stresses, taking into account the specified starting and running conditions. All electrical joints and connections shall be of brazed or welded construction.
- e. Motors shall be given power house treatment. This comprises an additional treatment to the winding over and above the normal specified treatment. After the coils are placed in slots and all connections have been made, the entire motor assembly shall be impregnated by completely submerging in suitable insulating compound or varnish followed by proper baking. At least three such submersion and baking shall be applied to the assembly, class of insulation 'F'. Motor winding shall be given a further treatment with epoxy paint to withstand atmospheric conditions, polluted by hydrogen sulphide.

- f. The slot and overhang insulation of windings of HT shall also be based essentially on mica. Windings of HT shall be provided with stress control and corona protection. The anti-corona protection shall be adequately earthed and be resistant to damage due to abrasion or vibration.
- g. All windings insulation shall be non-hygrosopic, oil resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site.
- h. Temperature rises shall not exceed the values for insulation equivalent to class B. More than 60°C to 75°C. These temperature rises are acceptable for an ambient temperature of 50°C.
- i. The motor construction shall be suitable for easy disassembly and reassembly. The enclosure shall be study and shall permit easy removal of any part of the motor for inspection and repair.
- j. The rotor bars shall not be insulated in the slot portion between the iron core lamination and the bars.
- k. Motor shall be closed air circuit air cooled (without external cooling fan) machine mounted heat exchanger (CACA/CACW) and the degree of protection shall be IP 55, and duty cycle S1 as per IS-12615-2011, IS: 6362 & IS: 4691.
- l. The cooling fans shall be capable of being connected for rotation in either direction or due care for cooling etc.
- m. Motor shall be provided with PT 100 grade and terminals shall be brought in separate RTD box.

### 3.5 TEMPERATURE RISE:

The temperature rises shall not exceed the values given in following Table.

Temperature Measurement by	Insulation Class	Maximum temperature Rise for all types of enclosures
Thermometer Method	E	65° c.
	B	70° c.
Winding Resistance Method	E	75° c.
	B	80° c.
	F	100° c.
	H	125° c.

These temperature rises are acceptable for an ambient temperature of 50°c.

For motors specified for outdoor installation account shall be taken of heating due to direct exposure to solar radiation.

### 3.6 CONSTRUCTIONAL FEATURES:

- a. The motors construction shall be suitable for easy disassembly and reassembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repairs.
- b. Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- c. The rotor bars shall not be insulated in the slot portion between the iron core laminations and the bars. Unless otherwise approved, motors shall be designed to permit convenient access for drilling vertically through motor feet or mounting flange for installation of Purchaser's dowel pins after motors are mounted with the driven equipment.
- d. Motor and its components (such as stator, rotors, end shields, terminal boxes, bearings and heat exchangers) shall be designed to be readily interchangeable as integral units for the same design and rating.
- e. All nonmetallic components used shall be of resistant to flame propagation.
- f. The motor construction shall be suitable for easy disassembly and reassembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair.
- g. Motor shall be provided with eye bolts, lugs or other means to facilitate safe lifting.
- h. Vertical motor shall be flange mounted type provided with thrust bearing.
- i. All enclosures shall be designed to provide an effective sealing between the primary and secondary air circuits. All totally enclosed type of motors shall have suitable means of breathing.

### 3.7 BEARINGS:

- a. Motors shall have bearings of grease lubricated ball or roller type. Unless otherwise agreed the bearing shall be selected to give a minimum L-10 rating i.e., 75000 hours at rated operating conditions.
- b. Greased ball / roller / thrust bearings shall be of reputed make subject to the Owner's approval. The life expectancy of the bearings shall be stated.
- c. Bearings shall be adequate to absorb axial thrust in either direction produce by the motor itself or due to shaft expansion. Motor bearings exposed to high temperature (i.e. motors for hot oil pumps) shall have adequate provisions for cooling of bearings. Bearings shall have steel / brass cages. Bearings with polyamide cages shall not be acceptable.
- d. The bearings shall be so constructed that the loss of lubricating fluid is kept to a minimum and greasing shall be possible without any dismantling operation
- e. The bearings shall prevent dirt and water from getting into the motor. Bearing lubricant shall not find access to motor windings. Bearings shall be capable of grease injection from outside without removal of covers. The bearing boxes shall be provided with labyrinth seals, to prevent loss of grease or entry of dust or moisture. When grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices which ensure passage of grease through the bearings.
- f. The bearings shall permit running of the motor in either direction of rotation.

- g. If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level sight gauge shall be provided to show precise oil level required for stand-still and running conditions.
- h. Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain the required oil supply or keep bearing temperature within design limits.
- i. Lubricants shall be selected for prolonged storage and normal use of the motors in tropical climate and shall contain corrosion and oxidation inhibitors. Grease shall have suitable bleeding characteristics to minimize setting.
- j. Safety measures for bearing temperature for tripping to be added. (High temperature).

### 3.8 NUMBER OF STARTS

Continuous duty motors shall be suitable for two starts in succession and three equally spread starts in an hour under the specified conditions of load, torque and inertia, with the motor initially at its normal running temperature.

### 3.9 TORQUE REQUIREMENTS

The accelerating torque at any speed with the lowest starting voltage shall be at least 10% of rated full load torque of the motor.

The pull-out torque at rated voltage shall not be less than 205% of the full load torque.

### 3.10 STARTING TIMES

- a. For motors with starting time up to 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than starting time.
- b. For motors with starting time more than 20 seconds but not exceeding 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
- c. For motors with starting time more than 45 seconds at minimum permissible starting voltage, the locked rotor withstand time under hot conditions at highest voltage limit shall be more than the starting time by at least 10% of the starting time.

### 3.11 TERMINAL BOX:

- a. Terminal box shall be of weather proof construction designed for indoor service, to eliminate entry of dust and water, gaskets of approved make shall be provided at cover joints and between box and motor frame & Terminal box shall be Phase segregated only.
- b. Terminal box shall be suitable for single compression cable jointing kit. The terminal box shall be suitable for top and bottom entry of cables.
- c. Unless otherwise approved, the terminal box shall be capable of being turned through 360



degrees in steps of 90 degree.

- d. The terminals shall be of the stud type with necessary plain washers, spring washers and check-nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearances.
- e. Suitable cable jointing kit shall be supplied by the motor vendor to match Purchaser's cable.

### 3.12 ROTOR

- a. The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and a long service life to the bearings. The accepted values of peak-to-peak vibration amplitudes for a motor at a rated voltage and speed on a machine surface bed plate with the motor levelled and with a half key or coupling fitted shall not exceed those given in IS 4729. The shaft ends shall be provided with a suitably threaded hole or holes to facilitate the assembly or removal of couplings and bearing races.
- b. The rotor bars shall not be insulated in the slot portion between the iron core laminations for squirrel cage motors.
- c. Rotor will be made up of electrical steel followed by environmental protection coating for anti-corrosion.
- d. All motor rotors shall be dynamically balanced. Rotors shall be so designed as to keep the combined critical speeds with the driven equipment away from the running speed by at least 20%.

### 3.13 PAINT AND FINISH:

Motor external parts shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of zinc epoxy primer and two coats of Epoxy paints.

The motor fan shall also be painted to withstand corrosion.

### 3.14 ANTI-CONDENSATION HEATERS AND TEMPERATURE DETECTORS:

- a. All motors shall be provided with 240-volt anti condensation heaters, sized and located so as to prevent condensation of moisture during shut down period. The heater shall remain "ON" when the motor is not in service, and shall not cause damage to the windings.
- b. At least 3 wire simplex and 6 wire duplex resistance type embedded temperature defectors for the stator winding each having D.C. resistance of 100 at 0°C embedded in the stator winding at locations where highest temperature may be expected and at bearings. The material of the RTD shall be platinum. Temperature Detectors detector leads, external to the slot shall be provided with a protective covering. These RTDS shall be wired to PLC controls for monitoring temperature rise.
- c. The heater leads shall be brought out to a separate terminal box of the same specification and grade of protection as the main power terminal box excepting that the nickel-plated brass glands provided shall be suitable for 2 core 4 Sq. mm aluminium conductor, armored cable.

- d. A warning label with indelible red inscription shall be provided on the motor to indicate that isolation of the power line alone is not sufficient and that the heater supply should also be isolated before carrying out any work on the motor. Motor supplied shall be complete with all double compression cable glands, crimp type cable lugs.
- e. Motor supplied shall be complete with all double compression cable glands, crimp type cable lugs.

### 3.15 NOISE LEVEL

The permissible noise level shall not exceed the stipulations laid down in IEC 34-9 & IS – 12065.

### 3.16 MOTOR VIBRATION

Motor vibrations shall be within the limits of IS 12075 unless otherwise specified for the driven equipment.

### 3.17 NAME PLATE

Each motor shall have a nameplate displaying all the particulars specified in relevant standards. In addition, the nameplate shall indicate identification, number of bearings used for motor and recommended lubricant indicating required quantity of lubricant and interval at which the bearings are to be lubricated.

Nameplate shall be made of 2-mm thick stainless steel with the relevant details embossed on it in English.

### 3.18 ACCESSORIES:

Two independent earthing points shall be provided on opposite sides of the motor, for bolted connection of the Purchaser's earthing conductors. These earthing points shall be in addition to earthing stud provided in the terminal box.

12 Nos Simplex type Winding temperature detector & 2 Nos duplex type Bearing temperature detector to be provided for each HT motor.

Anti-vibration pad & vibration probe to be provided for each HT motors.

### 3.19 INSPECTION AND TESTING AT MANUFACTURER'S PREMISES:

All Motor shall be subjected to all the routine tests & 1 no from total motor lot shall be performed type test as per applicable IEC 60034 standard with latest amendment in the presence of the Purchaser's representative at manufacturer works. Copies of test certificates of type and routine tests, as specified in the distribution schedule, shall be furnished for the Purchaser's approval.

### 3.19.1 QAP, Testing and Inspection of Motor

The general QA requirement is attached; the vendor is advised to go through the same before submitting the bid.

All tests shall be conducted as per relevant IS/IEC/IEEE standards

Quality Assurance plan shall be submitted by the bidder along with the vendor documents for the approval.

### 3.19.2 General Conditions

- a. OEM (Original equipment manufacturer) shall have ISO certification
- b. All the tests are to be carried out in the presence of any authorized representative of the client and third party as per direction of Engineer of Contract.
- c. The contractor shall have to offer stage inspection during manufacturing process where required by the client / final inspection on completion of manufacturing for Routine test & type test inspection.
- d. Routine test shall be performed by manufacturer on all equipment (100%) in presence of EPC agency/ contractor, client and TPA and minimum one motor to be type tested.
- e. The proposed date of stage/ final inspection shall be informed to Owner FIFTEEN days in advance.
- f. The contractor shall submit the following during commencement period.
  - A. Name of raw material as well as bought out accessories and the names of sub suppliers selected from those furnished after award of work.
  - B. The contractor shall submit the routine/ type test certificate of bought out items& raw materials at the time of routine testing of the fully assembled equipment.
  - C. List of standards; according to which the raw materials are tested, list of tests normally carried out on raw materials in presence of contractor's representative, copies of test certificates.
  - D. Type test certificates of the raw material and bought out accessories.
- g. Instruments
  - A. The manufacturer should keep the precise and accurate measuring instruments.
  - B. The periodical calibration should be carried out of all the instruments /equipment used for the measurement during tests and for assessing the various properties of the material and accessories.
  - C. The proper record of the same should be maintained during manufacturing stage and shall be shown to the inspecting officer on demand.
  - D. All measuring instruments used in inspection and testing shall be properly calibrated and sealed once in a year with tag of competent authority.
- h. Equipment offered shall have all Type Test Certificates from accredited laboratory (accredited based on ISO/IEC Guide 25 / 17025 or EN 45001 by the National Accrediting

Body of the country where laboratory is located), as per IEC /IS /technical specification.

- i. The type test conducted shall be on similar equipment and on similar capacity.
- j. Equipment not type tested in the last five years; type tests need to be performed without any extra cost. The purchaser may select the transformer for type tests randomly.
- k. The acceptance of any quantity of equipment shall in no way relieve the vendor of his responsibility for meeting all the requirements at this specification & shall not prevent subsequent rejection, if such equipment is later, found to be defective.
- l. EPC agency shall arrange for commissioning test at site by the OEM/ OEM approved agency confirm equipment are healthy at site & test result at site are same & committed figures are achieved.
- m. Four sets of certified type tests reports shall be submitted for approval prior to dispatch of the equipment. The equipment shall be dispatched only when all the required acceptance & routine tests have been carried out & the test reports have been approved by the client & TPA.
- n. Certificates shall be clearly identified by serial or reference number where possible to the material being certified and shall include information required by the relevant reference standard or specification clause.
- o. Job pump of each type shall be tested with job motor and shall be witnessed by client's representative.
- p. Soft starter shall be tested with job motor & Job pump to check that Starting current of motor shall be as per the value given during bid evaluation. In case this type of testing not done during factory test, agency shall be responsible to prove the starting current value during commissioning stage. Any dispute between pump/motor/ soft starter shall be resolve by the agency.

### 3.20 ROUTINE TEST

- a. Insulation resistance test before and after HV test
- b. High voltage test
- c. No load running of the motor and measurements of currents and voltages on all three phases.
- d. Locked rotor test at suitable voltage.
- e. Testing of accessories/auxiliaries for correct functioning.
- f. Vibration test.
- g. Noise Level test.
- h. Reduced voltage running up test at no load to check the ability of motor to run up to full.

### 3.21 TYPE TEST

Measurement of stator resistance and rotor resistance of motor.

- a. No load running of motor and reading of voltage, current, power and speed.

- b. Open circuit voltage ration on motors.
- c. Reduced voltage running up test at no load to check the ability of motor to run up to full
- d. Speed on no load in each direction of rotation with  $1/\sqrt{3}$  of the line voltage applied to the motor.
- e. Locked rotor reading of voltage, current, power input and torque of motors.
- f. Full load reading of voltage, current, power input at 125%, 110%, 100%, duty point, 75%, 60%, 50 % load
- g. Temperature rise test.
- h. Momentary over load test
- i. Insulation resistance test with before and after the high voltage test.
- j. High voltage test
- k. IP 55 test as per applicable standard.

### 3.22 MOTOR ACCEPTANCE AFTER TEST

Motor not meeting min guaranteed parameters shall not be accepted till required parameters are achieved in performance testing.

Though the motors shall be accepted on the basis of the satisfactory results of the tests at the works, it shall not absolve the vendor from liability regarding the proper functioning of the motor coupled to the driven equipment at site.

## 4. PIPES AND SPECIALS

Manufacture, supply & delivery of submerged arc spiral welded MS Pipe of following dia, with inside lining food grade solvent free epoxy of 406 micron thickness & outside 3 LPE Coating having beveled ends plate or coil confirming to IS-3589-2001 or its latest revision/ amendment for following thickness & outside diameter at Departmental store/ site including Providing and Laying/ Fixing the specials anywhere in the Project area including all taxes, insurance, transportation, freight charges, Octroi, inspection charges, loading, unloading, conveyance to Department store/ sites, stacking etc. complete as instructed by EIC, including Excavation for pipe trench incl. all safety provisions using site rails and stacking excavated stuff up to a lead directed by EIC, Cleaning the site etc. complete for all lifts and all strata, Lowering & laying in position to correct line & level M.S. Pipe as above on pedestal or chairs upon prepared formation or completely dry or completely saturated sand bedding of 100 mm thickness in trenches, the rates include conveyance from store to site of work loading, unloading, jointing, hydrotesting etc. complete & Refilling the Pipeline trenches incl. ramming, watering, consolidating disposal of surplus stuff as directed within Project area as per approved design and drawing by EIC or his Authorized Representative. (Rate for MS Pipe based on the ex. works price of HR Coil as Rs.58500 per MT - without GST (Above 3.15 mm to 10 mm) & Rs. 59000.00 per MT without GST (Above 10 mm) as on Jan-23. (WPI Index of H. R Coil of Dec-22 is 144).

**Note:** - The required size and quantity of above item is as per price bid.

### 4.1 GENERAL

The scope of work is to manufacture & supply pipes, which shall be in conformity with IS: 3589 – 2001 (latest) & IS 5504 (latest) from M. S. Plates conforming to IS: 2062 -1999 or hot rolled steel coils conforming to IS: 10748-2004 of required sizes with internal lining of solvent free Food-grade Epoxy (confirming to BS-6920) and external coating of 3 Layer Poly Ethylene (3 LPE) - confirming to DIN 30672 or any other appropriate standard. The Dry Film Thickness (DFT) of internal epoxy lining shall be minimum 406 micron and total thickness of external 3 LPE coating shall be 3.7 mm on body of pipe and 3.3 mm on weld joint.

The M. S. Pipes, manufactured at the factory shall be provided with bevel ends. After the final inspection of the pipe, the pipe bevel ends on both the sides shall be covered with suitable protectors such that the pipe ends do not get damaged during transportation, loading and unloading work. Also, varnishing will be carried out at the inside and outside of the pipe cut back portion to avoid the corrosion of the un-coated metal during storage period. The varnishing can be removed after wards at the time of the welding and field joint coating. The spiders on both ends of the pipe shall be of adequate size and stiffness to keep the pipe in circularity during handling and storage. It will not be less than 80 mm OD pipe. The spider pipe shall be a heavy-duty pipe with at least 6 mm wall thickness. If possible, the pipe vendor shall avoid the welding of the spider pipe with the main pipe and adopt some other means for this purpose as it damages the internal surface of the pipe metal.

All the Piping Work in side of the Pump House shall be externally coated with Zinc Rich Primer & suitable Epoxy Paint (Total DFT 200 microns). All the piping works out side of the Pump House

including the pump discharge piping and discharge header shall be externally coated with 3 LPE coating of 3.7 mm DFT on body of pipe and 3.3 mm on weld joint.

The pipes shall be of uniform bore and straight in axis.

The flanges of the straight pipes shall be square to the axis of the pipe. The faces of the flange shall be parallel. The bolt holes circle shall be concentric with the bore and bolt holes equally spaced. In straight pipes, the bolt holes in one flange shall be located in line with those in other.

The faces of the flanges of the fittings shall be square to the directional axes. The holes shall be located symmetrically off the center line. The intersecting axes of the tees shall be perpendicular to each other.

The bolt holes on flanged pipes and fittings shall be drilled with the help of drilling jig. The blank flanges are to be machined and drilled.

All nuts and bolts used for jointing the pipes and fittings shall be of hot dipped galvanized. The approximate quantity for the pipe and fittings shall be furnished in schedule of quantity.

The quantity of pipes is for tender purpose only. So, during ordering of pipes & fittings, Contractor has to measure the actual quantities required as per execution of the site & prior approval should be taken from Engineer-In-Charges / client.

The Pump discharge pipe lines in the pump house, shall be provided with necessary air venting arrangement like, air valves or ball valves (manually operated) of adequate size & rating for venting of air during start-up of the pumps.

The reducers shall be prepared by conical bending of M S Plates in either single piece (with one long seam weld joint) or half round pieces (with 2 nos. of long seam weld joints). The minimum length of reducers shall be at least equal to or more than the major diameter of the pipes to be connected. At Shop, the testing of the welding joints shall be carried out by UT and Die Penetrating Testing to ensure the soundness of the weld joints. Required pre-heating shall be done while welding of field joints on the pipe to ensure that there is no moisture present. Coil joint weld seam should not be failed at any time during testing. The LCM of ultra-sonic thickness gauge must be 0.01 mm at pipe manufacturing unit.

Sr. No.	Description	Particulars
1	Plates / HR coil	IS:2062, Gr, E 250 BR / IS: 10748 Gr. III Fe 410
2	Welding & Electrodes	ASME-SECT-IX, IS-7310, IS:7307, IS:814, IS:3613, IS:6419, IS:7280
3	Inside Food Grade Epoxy / Outside Epoxy Coating	Relevant detail Specification
4	Fabrication & Manufacturing of Pipe	IS: 3589 and / or IS: 5504

#### 4.2 MODE OF MEASUREMENT AND PAYMENT

Unit of Measurement: Per Running Meter (RM) of laid, jointed, tested pipe including fittings.

The Payment shall be made on running meter basis.

- Payment Includes:
  - a. Manufacturing, internal/external coating, delivery to site.
  - b. Excavation, bedding, laying, jointing, testing, and backfilling.
  - c. Field joint coating, weld testing, and special fittings.
  
- No extra payment shall be made for:
  - a. Site handling, shifting from store to laying site
  - b. Damaged pipes due to mishandling

#### 4.3 DOCUMENTATION & QUALITY ASSURANCE

Contractor must submit:

- Material test certificates (coils, welding rods, epoxy, coating)
- Coating DFT test reports (internal and external)
- Hydrotest records and weld test reports
- Daily progress reports and trench logs
- As-built drawings and GIS pipe route map (if applicable)

**Note: -**

All design, manufacturing, quality and construction parameters not explicitly stated herein shall comply with the applicable provisions outlined in the chapters titled 'Technical Specification for M.S. Pipes' in the volume of 'Technical Specification for Civil Works'. The Engineer-in-Charge is required to consult these chapters for comprehensive guidance, all technical parameters and detailed requirements.



## 5. MANUALLY OPERATED BUTTERFLY VALVE

Providing & erecting Ductile Iron D/F Butterfly valves IS 13095 with ISI Mark (PN-1.6) as Isolation Valves with jointing to pipe work (including all hardware and packing) water quality, having non-rising spindle with hand wheel and without bypass arrangement, spindle, etc. as per requirement, including providing and fixing expansion Bellow. Hydraulic tests certificate & certificate of material of construction of parts shall be submitted before dispatch of valve of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc. complete rate for Butterfly valve including followings but Without Actuator. Also, including SITC of flange ends Expansion Bellow as per EJMA standards of overall length of minimum 300 mm, designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of following MOC & pressure ratings. MOC: Bellows: SA 240 Gr. 304; Internal Sleeve: SA 240 Gr. 304; Weld ends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538 / IS 6392) & Limit Rods & Nuts: CS - IS 1367. complete of same dia including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc. complete rate for Butterfly valve including fixing in position.

**Note:** - The required size and quantity of above item is as per price bid.

### 5.1 GENERAL

- a. This specification covers the design, engineering, manufacturer, transportation to site, installing, testing double flanged and wafer type of metal seated, dual eccentricity ductile iron electrically/manually operated butterfly valves.
- b. Valves covered under this specification are electrically and manually operated. Fabricated valve will not be considered.

### 5.2 DESIGN CRITERIA

- a. Butterfly valve shall be as per IS 13095 (ISI Marked (up to 2000 mm dia.)) /BS 5155. Valve shall be suitable for mounting in any position.
- b. Butterfly valve shall be provided with bypass arrangement (Minimum 4" or as per manufacturer whichever is high). This may be integral with valve or connected between pipes.
- c. Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline.
- d. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel and free from sharp projections.
- e. The valve seat shall be of integrally cast or renewable 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.
- f. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.

- g. Valve shall be suitable for throttling purpose.
- h. All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.
- i. All 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.

### 5.3 SERVICE APPLICATIONS

- a. Valves shall be suitable for one or more of the following applications
- b. Tight Shut off- A valve having no visible leakage on the disc in closed position under test conditions
- c. Regulating - A valve intended for regulating purpose and which may have a Clearance between the disc and the body in close position.
- d. Low leakage - A valve which has specified maximum leakage rate on the disc in the closed position.
- e. Vacuum Condition - Where valves are to be used under vacuum conditions, the detailed design provision shall be mutually agreed between the purchaser and the manufacturer

### 5.4 NOMINAL PRESSURES

Valve shall be designated by nominal pressure (PN) defined as the maximum permissible working pressure (MPa) at 20° C temperatures as follows:

PN 0.25, PN 0.6, PN 1.0, PN 1.6, PN 2.0 & PN 2.5

### 5.5 PRESSURE/TEMPERATURE RATINGS

Maximum permissible gauge working pressure and operating temperatures shall be in accordance with IS 6418: 1971 and IS 13159 (Part-1):1991 except that restriction on temperature may be placed by the manufacturer on valves in accordance with this standard by reason of valve type, trim materials or other factors. However, all valves shall be suitable for continuous use at their PN designation within the temperature range of –10 0°C.to 65 0°C.

### 5.6 BODY ENDS

#### 5.6.1 Double Flanged Body Ends

- a. The dimensions of flanged body ends and drillings shall be in accordance with the IS 9523 (latest). Flanges as per any other specific requirements of the Owner may also be given “As Agreed” between the manufacturer and the Owner.
- b. Flanges shall be at right angles to the axis of the bore and concentric with the bore. Flanges

shall be drilled unless otherwise specified and bolt holes shall be off centers.

#### 5.6.2 Water Body Ends (Where ever applicable)

- Body ends shall be capable of being fitted between the pipe flanges complying with the requirements of flange drilling.
- The joint faces shall be at right angles to the axis of the bore and concentric with the bore.
- Holes may be provided, where required by the design, for the passage of the bolts securing the flanges and the valve. Where through bolting is not practicable due to the presence of valve shaft, bearing housing, tapped holes may be provided for individual bolting of each flange.

#### 5.6.3 Face to Face Dimension

Face to face dimensions of double flanged and wafer types of valves shall be as per standard. Face to face dimensions is exclusive of the sealing gaskets at both ends. The manufacturer shall ensure that adequate space will be available between valve flanges for bolting when flanged valve with short body face to face or wafer type face to face are manufactured. Tolerance on face-to-face dimension shall be as follow.

Face to face Dimension of the Valve (mm)		Tolerance (mm)
Over	Up to and including	
0	250	$\pm 2$
250	500	$\pm 3$
500	800	$\pm 4$
800	1,000	$\pm 5$
1,000	2,400	$\pm 6$

#### 5.6.4 Bodies

Bodies end ports shall be circular and the numerical valves of the diameter shall be as close as possible to the valve of DN.

#### 5.6.5 Disc and shafts

The disc and shaft shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The shaft may be of one-piece design attached to the disc. Any means of attachment between the shaft and the disc shall be such as to preclude components becoming loose in service.

#### 5.6.6 Seating and linings

Non-integral seating, and lining where used, and their means of attachment shall be such as to preclude their becoming loose in service.

#### 5.6.7 Bearings

The bearings shall be suitable for the maximum loads imposed by the shaft during testing and in service.

For valves DN 350 and above, a bearing shall be provided to take the axial thrust; spring retaining clips (circlips) shall not be used as thrust bearing. Suitable sealing shall be provided for the shaft where it passes outside the pressure containing enclosure.

### 5.7 OPERATION

#### 5.7.1 Electrically and Manually Operated

All valves shall be electrically (pump house valve) and manually operated (rising main valves) and capable of operate at a differential pressure across the disc as marked on the valve.

#### 5.7.2 Direction of Operation

Unless otherwise, specified manually operated valves shall be closed by turning hand wheel or lever in a clockwise direction when facing the hand wheel or lever. The design of lever when fitted shall be such that the lever may only be assembled to the valve so that it is parallel to the direction of flow when the valve is open.

All gear traveling nut operators shall be provided with suitable stops to prevent movement of the shaft beyond the limit corresponding to the fully closed position of the disc.

All gear traveling nut operators shall be packed with grease for life time operation. Gear / traveling nut operators shall be totally enclosed and weather proof for general application. For special applications such as marine, submerged service, etc. the purchaser may specify special enclosure.

All gear/traveling nut operators shall be self-locking type. All leaver operated valve shall be capable of being locked at least three intermediate positions.

The operating hand-wheels shall be marked 'CLOSE' or 'SHUT' to indicate the direction of closer.

The operator shall be provided with arrangement to indicate the disc position.

### 5.8 TESTING

All valves shall hydrostatically test by the manufacturer before dispatch. The pressure shall

be obtained without any significant hydraulic shock. Testing shall be carried on before application of paint. There shall be no air entrapped within the part of the valves subjected to test pressure.

#### 5.8.1 Performance Testing

Each valve shall be shop operated from fully closed to fully open position and reverse, under no pressure and no flow condition to demonstrate that the complete assembly is workable.

#### 5.8.2 Body Test

Completely assembled valve shall be tested as follows:

The body ends shall be blanked so that the valve is subjected to the full pressure in all directions include by the test pressure water. Valves may be tested in any suitable manner as directed by Engineer-In-Charge. The valve disc shall be in slightly open position and pressure equivalent to 1.5 times the maximum permissible working pressure shall be applied with water. The duration of this test shall be as per standard.

#### 5.8.3 Seat Test

- a. The seating surface of the valve shall be cleaned unless a surface treatment forms an integral part of the design or the use of a temporary surface treatment has been agreed between the manufacture and the owner to avoid the possibility of damage under the condition of the test.

Nominal diameter (mm)	Minimum test duration(minutes)	
	Body Test	Seat Test
Up to and including 50	0.25	0.25
65 to 150	1.00	1.00
200 to 300	2.00	2.00
350 to 1000	5.00	2.00
1200 to 2.000	5.00	3.00

- b. Each valve shall be shop tested for leaks in close position. The test shall be conducted with the body flanges in a horizontal position. Pressure shall be applied to the upstream end of the valve, the downstream being open to atmosphere. The duration of test shall be as per Table above. There shall be no indication of leakage the valve disc during test and valves shall be drop tight. Seat test shall be carried out in both the direction of valve.
- c. The seat pressure applied on upstream side shall be equivalent to 1.6 (16 Kg/Cm<sup>2</sup>) times the maximum permissible working pressure at 20°C and shall be applied with water.

#### 5.8.4 Disc Strength Test

- a. The test shall be conducted with the body flanges in horizontal position. The test pressure shall be 1.5 times the maximum permissible pressure at 20°C With disc in closed position, hydro test pressure shall be applied to the lower face of the disc for duration as per above table.
- b. There shall be no damage to the valve disc nor shall any part of valve or disc be permanently deformed by the test. The purpose of this test is to provide evidence of the adequacy and structural integrity of disc and body (Sampling test sample as per IS 2500).
- c. Pouring witness and sampling of the integral test bar shall be carried out at the foundry by TPI for the valves above 500 mm diameter. Necessary provision shall be made in the quality assurance plan (QAP) submitted by the agency for review and approval.

#### 5.8.5 Positive material Identification (PMI Test)

PMI test shall be checked witness at random for Stainless steel parts.

#### 5.8.6 Painting

Each valve shall be drained, cleaned, prepared & shot blast cleaning of valve should be done before application of paint. Cast Steel parts shall be sand blasted to near white cleaning before painting. Edges, sharp covers etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin-based coating with at least 75 microns dry film thickness is to be provided. In addition, the parts are to be provided with adequate number of coats of RAL 5005 Grade epoxy coating to a dry film thickness of 175 microns including primer coating.

### 5.9 TEST CERTIFICATES

When specified by Owner, the manufacturer shall issue a test certificate confirming that the valves have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

VALVE TEST	LEAKAGE RATE
Tight shut of	No Visible leakage for duration of test
Low leakage	0.1 mm <sup>2</sup> / s X DN (sec 5)
Regulating	Not specified (outside the scope of this standard)

### 5.10 INSPECTION

- a. The Owner& TPI representative shall have access to the manufacturer's works at all reasonable times to inspect assembled valve at factory. The Contractor has to make

necessary arrangements for testing facilities of the valves as per the relevant Standard at factory.

- b. Pouring witness and sampling of the integral test bar shall be carried out at the foundry by TPI for the valves above 500 mm diameter. Necessary provision shall be made in the quality assurance plan (QAP) submitted by the agency for review and approval

#### 5.11 WITNESSING OF TESTS

When the Owner desires to witness the tests, this shall be specifically agreed in advance by Owner representative.

#### 5.12 MARKING

Marking shall be cast integral on the body or on a plate securely attached to the body for 'DN' size and 'PN' rating. The markings shall be in accordance with I.S. 9866:1981 or Latest Edition.

#### 5.13 PREPARATION FOR DISPATCH

- a. Valve shall be complete in all respect when dispatched. Each valve shall be drained, cleaned, prepared and suitably protected with 2 coats of red oxide on machined surfaces and rust preventive coats on machined and flanged surfaces for 'seaworthy dispatch' in such a way as to minimize the possibility of damage and deterioration during transit and storage.
- b. Disc shall be unseated when dispatched, but care shall be taken to ensure that there is no risk of damage to the disc.
- c. When specified, the body ends shall be suitably sealed to exclude foreign matter during transit and storage.
- d. Components shipped unattached shall be adequately protected and identified to permit correct field assembly.

#### 5.14 FIXING OF VALVES

- a. Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. Valves used in pipeline shall be straight through type. 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.
- b. The Contractor has to provide dismantling joint in rising main for easy assembly /disassembly and maintenance or replacement of the manually operated butterfly valve.

#### 5.15 ELECTRIC ACTUATOR

- a. Each actuator shall be adequately sized to suit the application and be continuously rated to suit the

modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.

- b. The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.
- c. The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.
- d. The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.
- e. Only for pump house BFV shall be attached with electric actuator.
- f. However, for rising main “CI BFV” (Refer Technical Particulars 5.16 3b) shall be with suitable size manually gear attachment because of its isolated cross-country different locations.
- g. Electric actuator for “DI BFV” (Refer technical Particulars 5.16 3a) of pump house shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position. If required in future, these positions (open or closed position) shall be computable for extending its signals with RS 485 Ethernet port to central control room through PCB-SCADA system.
- h. Each starter shall be equipped as follows:
  - i. A.C. electric motor.
  - ii. Reduction gear unit.
  - iii. Torque switch mechanism complete with set of torque switches.
  - iv. Limit switch mechanism complete with set of limit switches.
  - v. Hand wheel for manual operation.
  - vi. Hand-auto changeover lever with suitable locking arrangement.
  - vii. Local control switch / push buttons
  - viii. 415 V / 240 V AC control transformer
- i. The actuator shall be suitable for operation in the climate conditions and power supply conditions given in the specification. The actuator shall be capable of producing not less than 1½ time the maximum required torque and shall be suitable for at least 15 minutes continuous operation.
- j. All local controls shall be protected by a lockable cover.

#### 5.16 TECHNICAL PARTICULARS OF MANUALLY OPERATED BF VALVE (PN – 1.6)

Sr No	Description	Requirements
1	<b>General</b>	



1.1	Type	Both end flanged hand wheel / Gear operated / Actuator Operated as mentioned in BOQ
1.2	Rating of valves	PN 1.6
1.3	Manufacturing Standard	IS 13095 / BS 5155 or latest
1.4	Sizes and quantity	As per price bid
<b>2</b>	<b>Materials of construction</b>	
2.1	Internal Hardware	Stainless Steel AISI - 304
2.2	Body/ Disc	DI IS1865 Gr500/7
2.3	Body ring (Retainer/seat)	Stainless steel AISI -304
2.4	Shaft	Stainless steel AISI-410
2.5	Disc Seat	EPDM rubber
2.6	Disc Pin	SS 304
2.7	Bush	Stainless steel Backed PTFE
2.8	Nut Bolts	Stainless steel AISI -304
2.9	Flange End	IS 9523

#### 5.17 MODE OF MEASUREMENT AND PAYMENT

Measurement: Per number of Butterfly Valve with expansion bellows and Electrical Actuator, installed and commissioned.

The Payment shall be made on Number basis.

Payment Includes:

- Supply and delivery of valve and bellows assembly with electrical actuator.
- Loading/unloading, transportation, insurance.
- Installation and jointing including all hardware.
- Hydrotesting and certification.
- Documentation and submission of test certificates.

## 6. REFLUX VALVE (DPCV)

SITC of Providing and supplying ISI mark CI D/F Reflux Valves as per IS:5312 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. Also, including SITC of flange ends Expansion Bellow as per EJMA standards of overall length of minimum 300 mm, designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of following MOC & pressure ratings. MOC: Bellows: SA 240 Gr. 304; Internal Sleeve: SA 240 Gr. 304; Weld ends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538 / IS 6392) & Limit Rods & Nuts: CS - IS 1367. complete of same dia including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc. complete.

**Note:** - The required size and quantity of above item is as per price bid.

### 6.1 DESIGN REQUIREMENTS

- a. The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the Contractor of his responsibility.
- b. The non-return valves shall be of dual plate check valve type design. It shall be free from sharp projections.
- c. The valves shall be designed for minimum head loss. The valves shall have flanged ends.
- d. The valve shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.
- e. Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.
- f. Dual plate check valves shall conform to API 594. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate especially when the friction coefficients are uneven due to one plate resting upon one another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition.
- g. In case of the nozzle check valve, the disc shall be correctly positioned at all times to achieve fully non-slam closure. The spring shall be fully shielded from the flow stream by the central flow diffuser.
- h. Sealing shall be metal to metal. The disc shall be stable and shall not vibrate under full or partial load conditions. The pressure designation of the valve shall be as per the Data Sheet.

### 6.2 CLEANING

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

### 6.3 PAINTING

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 shall adhere perfectly to the surface.

### 6.4 TESTING AND INSPECTION

- Valves shall be tested as per the relevant Indian standards. Specification IS 5312, Part – II, with latest revisions.
- Valves shall be offered for visual inspection and dimensional checks.
- The hydrostatic and water tightness testing shall be witnessed by the Owner.

### 6.5 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. Valves used in pipeline shall be straight through type. 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 Contractor has to provide dismantling joint in rising main for easy assembly /disassembly and maintenance or replacement of the manually operated butterfly valve.

### 6.6 TECHNICAL PARTICULARS OF DUAL PLATE CHECK VALVE (PN 1.6)

Sr. No.	Description	Requirement
1	<b>General</b>	
1.1	Type	Both ends flanged
1.2	Rating of Valves	PN 1.6
1.3	Manufacturing Standard	API 594 / 598
1.4	Sizes and quantity	As per price bid
1.5	Maximum pressure drops at design flow rate (mwc)	0.5
1.6	Maximum permissible leakage rate (cc/hr./mm diameter)	7.0
2	<b>Materials of construction</b>	
1	Body	DI IS1865 Gr500/7
2	Door & Door Face	DI IS1865 Gr500/7
3	Stop, hinge pin & washer	Stainless Steel – SS 304

4	Seat ring (Body)	Stainless Steel – SS 316
5	Bearings (Body & Plate lug)	PTFE
6	Seat ring (Plate)	Cast steel ASTM A216 Grade WCB With 13% Cr. Steel overlay
7	Spring	Stainless Steel – SS 410
8	Hardware	Carbon Steel IS 1367 CL 4.6/4.0
9	End Cover	Mild Steel
10	Flange End	IS 9523

## 6.7 MODE OF MEASUREMENT AND PAYMENT

Measurement Unit: Per number of reflux valve including expansion bellows, installed and commissioned.

The Payment shall be made on Number basis.

Payment Includes:

- Supply and delivery of reflux valve and expansion bellows.
- Transportation, insurance, loading/unloading, and stacking.
- Installation, jointing, and testing.
- Submission of certificates and documentation.

## 7. MANUALLY OPERATED SLUICE VALVE

SITC of double flanged Gear Operated Sluice Valve generally conforming to IS:780/IS:2906, having body, door, cover in graded cast iron to IS:210, FG:200, in side screw non-rising spindle of stainless steel-AISI410, Body and door seat (four) ring of stainless-steel CF-8. Spindle nut of leaded TIN bronze grade LTB:2 to IS:318. Valve seat tested to 10kg/cm<sup>2</sup> and body to 15kg/cm<sup>2</sup> flanges machined faced and drilled to IS:1538/1976 Part-IV/VI. Hydraulic tests certificate & certificate of material of construction of parts shall be submitted before dispatch of valve of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc.

**Note:** - The required size and quantity of above item is as per price bid.

### 7.1 GENERAL

- a. This specification covers the design, engineering, manufacturer, transportation to site, installing, testing double flanged manually operated Sluice valves.
- b. Valves covered under this specification are manually operated. Fabricated valve will not be considered.

### 7.2 DESIGN FEATURES

- a. Sluice valve shall conform to IS 14846. Except pump house, these valves are to be installed in valve chamber
- b. All valves of pump house and rising mains shall be non-rising stem type. However, for rising main, it shall be complete with its “as required length” “valve key” for valve operation from outside of chamber.
- c. The valves shall be free from sharp projections, which are likely to catch and hold stringy materials.
- d. Valves shall close with clockwise rotation of the hand wheel. The direction of closing and opening shall be marked on the hand wheel.
- e. The stuffing box gland shall be of one-piece design.
- f. other technical data required please refer technical datasheet of volume –III (E)

### 7.3 FEATURES OF CONSTRUCTION

- a. The valves shall have non-rising spindle. The valves shall be provided with a valve position locking arrangement (Mechanical).
- b. Valves shall be provided with back seating arrangement. Renewable body and wedge ring shall be provided. Valve shall be double flanged and holes drilling on flange shall conform to the standard IS1538-1976.
- c. The valves shall be completely overhauled before placing in position.
- d. Necessary joining materials viz. bolts, nuts, washers, packing etc. shall be provided by the contractor this cost. The valves shall be fixed so as to have axis perfectly horizontal.

- e. If required the contractor shall also carry out drilling of holes of appropriate diameter in flanges in required numbers.
- f. A hand wheel shall be provided for emergency operation. The hand wheel drive shall be mechanically independent.
- g. The valve design shall take care of the pressure drop across the valve disc in case of partial opening of the valve and shall take care of the erosion and cavitation effect on the body and disc during such operation.
- h. Valve(s) subjected to back pressure shall have the valve seat, disc and the operator suitably designed to ensure trouble-free operation.
- i. Valve body shall be of Ductile iron with flanged ends.
- j. The shaft diameter shall take into consideration, the maximum torque required for the valve operation, the maximum differential pressure across the valve disc when the valve is closed and the shock load due to accidental closure of the valve disc.
- k. The disc shall be designed for maximum differential pressure across the valve as well as the shock load due to accidental closure of the valve. Disc design shall offer minimum head loss. Disc shall also offer minimum resistance to flow Disc shape shall be contoured.
- l. Valve seats shall be of a design that permits removal and replacement at site and shall be securely clamped on the body or disc of the valve.
- m. Seat material shall be suitable for the operating conditions and handling fluid and may be suitably reinforced, if required.
- n. The seat design shall permit easy removal for replacement purposes without the need for removing the valve from the line. No deposited or welded seat rings permitted.
- o. The valve bearings shall be of 'self-lubricated' type and shall not have any harmful effect due to handling fluid.
- p. Adjustable thrust bearing(s) shall be provided to hold the valve disc securely in the centre of the valve seat.
- q. Each Sluice Valve shall be provided with a hand wheel for manual operation. The hand wheel and associated gearing arrangement shall be designed to limit the maximum manual effort to around twenty (20) kg for valve operation. For the Valves located at in accessible position, it shall be provided with extension spindle and floor stand or hand lever / round chain to facilitate manual operation.

#### 7.4 OPERATION

##### Electrically and Manually Operated

All valves shall be electrically (pump house valve) and manually operated (rising main valves) and capable of operate at a differential pressure across the disc as marked on the valve.

#### 7.5 INSPECTION AND PERFORMANCE TESTS

- a. Manufacturer shall conduct all tests and stage inspections required to ensure that the equipment offered by him conform to the specification requirement.

- b. Test certificates for all shop tests shall be furnished to Consultant / Owner for approval. The Client may witness the tests, if he so desires.
- c. The Contractor shall arrange for inspection of valves at manufacturer's premises and shall arrange for testing of valves for body test pressure and seat test pressure of all the valves to be supplied in presence of Consultant / Owner in line with the approved Quality Assurance Plan.
- d. Defects noted during inspection, test and operation of valves shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Consultant / Owner.

## 7.6 VARIOUS TESTS

### a. Material Test

Material to be used for the valve components shall be of tested quality. Chemical analysis and mechanical tests on materials to be used shall be done as per relevant standard.

### b. Non-destructive Test

Valve body and disc shall be subjected to Non – Destructive Testing (NDT). Components subjected to NDT and shall be stamped for identification.

### c. Hydrostatic Test

Each valve body shall be subjected to hydro static test as specified. For valves subjected to back pressure condition, leakage test shall be carried out on both sides of the disc.

### d. Performance Test

Each valve complete with operator shall be shop operated at least three (3) times from fully closed to fully open conditions and reverse, hold at intermediate positions under no flow condition, to prove the workability of the assembly.

## 7.7 TESTS AT SITE

Performance of the valves shall be tested at site at actual working condition.

## 7.8 CLEANING

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

## 7.9 PAINTING

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

## 7.10 HANDWHEEL

A hand wheel shall be provided for emergency operation. The hand wheel drive shall be mechanically independent of the motor drive and any gearing should be such a stop permit emergency manual operation in a reasonable time.

## 7.11 TESTS AND INSPECTION

Valve shall be offered by vendor for visual inspection before shipment. Valves shall be tested as per the relevant standards. The hydrostatic testing shall be witnessed by the purchaser

## 7.12 MATERIAL OF CONSTRUCTION

All sluice valves shall be of body Cast Steel, Spindle SS. All valves shall be supplied with matching companion flanges with necessary bolts, nuts and gaskets.

## 7.13 DUCTILE IRON SLUICE VALVES

End flanges shall be Ductile iron with the body.

The body to bonnet joint shall be flanged, male & female, tongue & groove or ring joint type. The bonnet joint shall have at least four through bolts.

## 7.14 FIXING OF VALVES

- a. Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. Valves used in pipeline shall be straight through type. 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.
- b. The Contractor has to provide dismantling joint in rising main for easy assembly /disassembly and maintenance or replacement of the manually operated Sluice valve.

## 7.15 ELECTRIC ACTUATOR

- a. Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.
- b. The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.
- c. The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.
- d. The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.
- e. Only for pump house Sluice Valve shall be attached with electric actuator.
- f. However, for rising main “CI SV” (Refer Technical Particulars 7.16 3b & 3c) shall be with



suitable size manually gear attachment because of its isolated cross-country different locations.

- g. Electric actuator for “DI SV” (Refer technical Particulars 7.16 3a) of pump house shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position. If required in future, these positions (open or closed position) shall be computable for extending its signals with RS 485 Ethernet port to central control room through PCB-SCADA system.
- h. Each starter shall be equipped as follows:
  - i. A.C. electric motor.
  - ii. Reduction gear unit.
  - iii. Torque switch mechanism complete with set of torque switches.
  - iv. Limit switch mechanism complete with set of limit switches.
  - v. Hand wheel for manual operation.
  - vi. Hand-auto changeover lever with suitable locking arrangement.
  - vii. Local control switch / push buttons
  - viii. 415 V / 240 V AC control transformer
- i. The actuator shall be suitable for operation in the climate conditions and power supply conditions given in the specification. The actuator shall be capable of producing not less than 1½ time the maximum required torque and shall be suitable for at least 15 minutes continuous operation.
- j. All local controls shall be protected by a lockable cover.

#### 7.16 TECHNICAL PARTICULARS OF SLUICE VALVE (PN – 1.6)

The all-technical particulars should be considered as per datasheet.

#### 7.17 MODE OF MEASUREMENT AND PAYMENT

Measurement Unit: Per number of sluice valve installed and commissioned.

The Payment shall be made on Number basis.

Payment Includes:

- a. Supply and delivery of sluice valve and expansion bellows.
- b. All taxes, transportation, insurance, octroi, loading/unloading, stacking.
- c. Installation, jointing, and hydrostatic testing.
- d. Documentation and submission of test certificates.

## 8. METALLIC EXPANSION BELLOW (PN 1.6)

### 8.1 GENERAL

- a. Design, fabrication, testing and installation of metallic expansion bellows with necessary hardware have to be provided at delivery side of each pump. 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.
  - Compensate, Lateral, Axial, Torsion and Angular movements.
  - Low movement forces
  - Reduced fatigue factor
  - Reduced heat loss
  - flexibility and concurrent movements.
- b. 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. The bellows shall be metallic corrugated design and shall have double flange. The material for bellows shall be SS 304.
- c. 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.
- d. 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.

### 8.2 OPERATING PRINCIPAL

- a. Expansion Joints are flexible, reinforced bellows which are used in piping systems to meet the following major needs.
- b. To protect piping by absorbing any difference in dimension due to temperature variation or line movement.
- c. It shall be protected equipment such as supports & anchors, pumps & valves etc., other equipment.
- d. It shall be useful for simple connection of misaligned pipes.
- e. Movement Accommodation.

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

### 8.3 TESTS AND INSPECTION

- a. Bellows shall be tested as per the relevant Standards with latest revisions.
- b. Bellows shall be offered for visual inspection and dimensional checks.
- c. The hydrostatic and water tightness testing of one of each size shall be witnessed.
- d. Compression and expansion test shall be offered for one no. for each size and to be witnessed.
  - i. UTS
  - ii. Liquid Penetration test
  - iii. Deflection
  - iv. Life Cycle Test with load
  - v. Vacuum test
  - vi. Hydraulic test
  - vii. Stiffness test
  - viii. Vibration test

### 8.4 MECHANICAL DATA

- a. M.O.C. of Tie Rods & Nuts shall be as per IS 1367.
- b. M.O.C. of Weld ends & Lugs shall be as per IS 2062.
- c. All Bellows shall have IS: 2062 plate flanges. The hole-drilling dimension shall be as per IS: 1538 to match with the pump outlet flange or valve flange as the case may be, however, selection of the flange thickness as per IS: 6392, Table 17 for PN 1.6 & IS: 6392 Table 23 for PN 2.5 may be done for these M. S. flanges of the expansion bellows.
- d. All Bellows shall be hydro tested, by our internal inspection department at 24 kg/sq. cm pressure For PN 1.6 & 37.5 kg/sq. cm for PN 2.5.
- e. M.O.C. of Bellows element and liner shall be SA 240 TP 304.

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.

### 8.5 POSITIVE MATERIAL IDENTIFICATION (PMI TEST)

PMI test shall be checked at random for Stainless steel parts.

### 8.6 TEST CERTIFICATES

When specified by Owner, the manufacturer shall issue a test certificate confirming that the bellows have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

## 8.7 MARKING

Marking shall be cast integral on the body or on a plate securely attached to the body for 'DN' size, 'PN' rating, Heat Number and Serial number.

## 8.8 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.

## 8.9 PAINTING

Each bellow shall be drained, cleaned, prepared & shot blast cleaning of bellow should be done before application of paint. Cast Steel parts shall be sand blasted to near white cleaning before painting. Edges, sharp covers etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin-based coating with at least 75 microns dry film thickness is to be provided. In addition, the parts are to be provided with adequate number of coats of RAL 5005 Grade epoxy coating to a dry film thickness of 175 microns including primer coating.

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 impart any taste or odor to the water.

## 8.10 ACCESSORIES AND INSTALLATION

### 8.10.1 Accessories

- a. The Control Unit assembly, consisting of two or more control rods & stretcher plates are placed according to SS Expansion Joints from flange to flange. This minimizes possible damage of the SS Expansion Joint caused by excessive motion of the bolt line, due to failure of anchor or equipment, it also absorbs static pressure thrust developed at the joint and limits the extension and compression movements, if required to prevent damage to the main equipment without hampering its basic need. Inadequate support of pipelines, incorrect anchoring, and considerable temperature variations may cause many abnormal movements. As such undesirable and destructive movements can effectively be encountered by using control units.
- b. The Protective Shields/Cover should be used on the SS Expansion Joint that carries high temperature. It protects the environment in the event of leakage/ splash & protects the SS Expansion Joint from fire during a flash fire.
- c. A device which minimizes contact between the inner surface of the bellow & the liquid flowing it, so as to protect the inner surface from corrosion and to ensure that no foreign

materials remain on the corrugation.

- d. Companion/ Counter Flanges for the pipeline for which the SS Expansion Joint is to be fitted can also be supplied with the SS Expansion Joint, if required.

#### 8.10.2 Installation of Accessories

- a. Piping sections where SS Expansion Joints are accommodated should be anchored properly to take care of stresses/ Reaction forces due to internal pressure.

Taking into consideration the above, solid & belting anchor points should be selected particularly where change in direction of piping elbows are near to the pump etc.

- b. An SS Expansion Joint must always be installed between two anchoring points (fixed supports). If it is not possible to install anchoring points (support points), stabilizing devices must be used.
- c. 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.

#### 8.11 TENDER DRAWINGS

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

## 9. CHAIN PULLY BLOCK CRANE

Providing chain pulley block with triple gear arrangement, lifting hook, load chain & hand chain & locking device etc.

**Note:** - The required size and quantity of above item is as per price bid.

### 9.1 GENERAL

Providing, supplying, testing, and commissioning of Chain Pulley Block (CPB) of required Ton Safe Working Load (SWL) with required lift, complete with triple gear arrangement, upper suspension hook, lower load hook, load chain, hand chain, automatic load braking and locking device and all accessories, conforming to relevant IS and as approved by the Engineer-in-Charge (EIC).

### 9.2 APPLICABLE STANDARDS

The Chain Pulley Block shall confirm to the latest revisions of the following standards (or equivalent):

IS 3832 – Specification for Chain Pulley Blocks

IS 2762 – Specification for Hand Operated Chain Hoists

IS 3177 – Code of practice for electric and hand operated hoists (relevant provisions)

All statutory safety requirements shall be complied with.

### 9.3 SCOPE OF WORK

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

- a. Providing and supplying Chain Pulley Block of required Ton Safe Working Load (SWL) as per price bid.
- b. CPB shall be provided with triple gear arrangement for smooth, efficient, and safe lifting operation.
- c. Supply of forged steel upper suspension hook and lower load hook, complete with safety latch.
- d. Provision of load chain and hand chain of adequate strength and length to achieve required lifting height.
- e. Provision of automatic load braking and locking device to prevent accidental load slippage.
- f. Provision of all necessary components such as chain guides, gear housing, bearings, and fasteners.
- g. Testing of CPB for smooth operation and safe load handling before acceptance.
- h. Enclosed gear housing with corrosion-resistant finish
- i. All fasteners, chain guides, bearings, and internal components necessary for safe operation
- j. Submission of manufacturer's test certificates and relevant documentation.

#### 9.4 MATERIALS AND CONSTRUCTION

- a. Hooks, gears, shafts, and load chains shall be manufactured from high-grade alloy steel.
- b. Hooks shall be heat-treated, forged steel, capable of safely handling the rated load.
- c. Load chain shall be heat treated, wear resistant, and proof tested.
- d. Load chain shall be calibrated, hardened, and wear-resistant, suitable for heavy-duty lifting.
- e. Gears shall be accurately machined to ensure smooth, jerk-free operation.
- f. Gearbox and housing shall be robust and suitable for heavy-duty industrial use. It should be corrosion-resistant, and designed for long service life.
- g. Hand chain shall be smooth-running and ergonomically suitable for manual operation.
- h. Bearings and moving parts shall ensure smooth and low-effort operation.

#### 9.5 INSTALLATION (WHERE APPLICABLE)

- a. CPB shall be installed on approved supporting structure / beam / trolley / hook.
- b. Alignment shall ensure free vertical movement of load without twisting or obstruction.
- c. Installation shall be carried out strictly as per manufacturer's recommendations and EIC's instructions.

#### 9.6 TESTING AND INSPECTION

Each Chain Pulley Block shall be factory tested and supplied with manufacturer's test certificate.

At site, CPB shall be load tested at 125% of rated SWL (or as directed by EIC) to check:

- a. Braking efficiency
- b. Structural integrity
- c. Smooth operation
- d. No permanent deformation, slippage, or abnormal noise shall be permitted

CPB shall be accepted only after successful testing and inspection

#### 9.7 MARKING AND IDENTIFICATION

Each CPB shall be permanently and clearly marked with:

- a. Manufacturer's name
- b. Safe Working Load
- c. Lift height
- d. Year of manufacture
- e. Serial number

#### 9.8 WORKMANSHIP AND QUALITY CONTROL

- a. The CPB shall be of approved make and quality, free from manufacturing defects.
- b. Chains shall run freely without jamming or abnormal noise.

- c. Brake and locking mechanisms shall operate smoothly and reliably.
- d. All components shall be properly aligned and securely assembled.

#### 9.9 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be made on per number (Each) basis for one complete Chain Pulley Block of specified capacity and lift.

The rate shall include the cost of supply, testing, documentation, transportation, and all incidental charges. Payment shall be released after inspection, testing, and approval by the Engineer-in-Charge.

#### 9.10 DOCUMENTATION

- a. The contractor shall submit:
- b. Manufacturer's test certificate
- c. Warranty certificate
- d. Operation & Maintenance manual
- e. Compliance statement with relevant IS standards



## 10. INSPECTION & TESTING AT MANUFACTURER'S PREMISES

### 10.1 GENERAL

- a. All inspection and testing shall be carried out in accordance with the Specification and in absence of Specification relevant Indian Standard or internationally approved equivalent standard code.
- b. The Contractor shall carry out at the place of manufacture tests of the Plant /Equipment at any part of the Works.
- c. The Owner shall be entitled to attend the aforesaid inspection and/or tests by his own duly authorized and designated representatives.
- d. The Owner and his duly authorized representative shall have access to the manufacturer's premises at all suitable times to inspect and examine the material and workmanship of the mechanical and electrical plant and equipment during its manufacture there. If part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain permission for the Owner or his duly authorized representative, Testing (including testing for chemical analysis and physical properties) shall be carried out by the Contractor.
- e. The Contractor shall forward to the Owner 3 duly certified copies of the test certificates and characteristics performance curves for all equipment.
- f. The test equipment, meters, instruments etc., used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the Owner representatives at the time of testing. The calibrating instrument used as standards shall be traceable to National/International standards.
- g. The following Testing shall be carried out for all the equipment as applicable
  - i. Visual Inspection.
  - ii. Material Certificates for all the specified material shall be furnished.
  - iii. Welding Qualifications
  - iv. Dimension Checking
  - v. Stage Inspections (in process inspection)
  - vi. Dynamic balancing for all rotating parts
  - vii. Hydrostatic / Leak testing for all pressure parts, Pneumatic Leak Test wherever applicable
  - viii. Operation check
  - ix. Liquid penetrant tests or magnetic particle tests for all machined surfaces of pressure parts.
  - x. Ultrasonic test for forging materials viz.
  - xi. Radiographic testing for all butt-welded parts, as per applicable codes.
  - xii. Hardness tests for all Hardened surfaces.

- h. The Contractor shall maintain proper identification of all materials used, along with reports for all internal / stage inspection work carried out, based on the specific job requirement and or based on the datasheets / drawings / specifications.

## 10.2 INDUCTION MOTOR

### 10.2.1 Routine Tests

All routine tests shall be carried out as per the latest edition of IS 325.

### 10.2.2 Acceptance Tests

Full load test to determine efficiency, power factor and slip shall be conducted on all the motors.

### 10.2.3 Type Tests

The following type tests shall be carried out on one motor of each rating

- i. Temperature rise test
- ii. Vibration measurement test
- iii. MOMENTARY OVERLOAD TEST shall be conducted based on interpolation Method.
- iv. Noise level test
- v. Full load test to determine efficiency, power factor and slip
- vi. Starting current and starting torque at reduced voltage

## 10.3 VALVE

- a. During testing there shall be no visible evidence of structural damage to any of the valve component.
- b. Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.
- c. Sluice valves for isolation purpose shall be offered for open end test.
- d. The following test shall be carried out for butterfly valves:
  - i. Seat leakage test at rated pressure.
  - ii. Body hydrostatic test at 1.5 times the rated pressure.
  - iii. Disc strength test at body test pressure.
  - iv. Valve operation.
  - v. 15 ° opening and closing test.
- e. The following test shall be carried out for sluice valves:
  - i. Seat leakage test at rated pressure

- ii. Hydrostatic test at 1.5 times the rated pressure
- iii. Valve operation with and without actuator
- f. The following test shall be carried out for non-Return valves:
  - i. Seat leakage test at rated pressure
  - ii. Body hydrostatic test at 1.5 times rated pressure
  - iii. Operation

#### 10.4 MS PIPE WORK (PUMP HOUSE)

Testing of pipes and fitting shall be carried out in accordance with relevant Indian Standard. Pipes shall be hydrostatically tested as per as per specification available as per this tender document (AS per Vol-III (B)).

# **11. INSTALLATION, TESTING AND COMMISSIONING**

## **11.1 ERECTION - GENERAL**

- a. The Contractor's staff shall include adequate and competent erection engineers with proven, suitable, previous experience on similar contracts to supervise the erection of the Works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of Works in time. The Contractor shall not remove any representative, erector or skilled labour from the Site without prior approval of the Engineer's Representative.
- b. The Contractor shall ensure that no installation or erection work shall commence until full and unconditionally approved working drawings, signed and stamped by the Employer are available at Site.
- c. The Contractor's erection staff shall arrive on the Site on dates to be agreed by the Engineer. Before they proceed to the Site, however, the Contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub-contractor's) supply has arrived on Site so that there will be no delay on this account.
- d. One erection engineer who shall be required to be the Contractor's representative shall be conversant with the erection and commissioning of the complete Works. Should there be more than one erector, one shall be in charge and the Contractor shall inform the Engineer's Representative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manager.
- e. The Contractor shall be responsible for setting up and erecting the plant to the line and levels of reference and of the positions, levels dimensions and alignment, appliances and labour in connection therewith. The checking of setting out of any line or level by the Engineer or Engineer's Representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.
- f. Erection of Plant shall be phased in such a manner so as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the Contractor shall check the dimension of structures where the various items of Plants are to be installed and shall bring any deviations from the required position, lines or dimensions to the notice of the Engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the Engineer, the Contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the Contractor during the course of erection to new or existing Plant or buildings or any part thereof, the Contractor shall, at no additional cost to the Employer, make good, repair or replace the damage, promptly and effectively as directed by the Engineer and to the Engineer's satisfaction.
- g. The Contractor shall align all equipment and holding down bolts and shall inform the Employer before proceeding with grouting-in the items concerned. The Contractor shall ensure that all equipment is securely held and remains in correct alignment before, during and after grouting-in.

- h. The approval by the Employer of the Contractor's proposals for rigging and hoisting any items of the Plant into final positions shall not relieve the Contractor from his responsibility for damage to completed structures, parts or members thereof or other installed equipment. He shall at his own cost make good, repair or replace any damaged or injured items, whether structural, electrical, architectural, or of any other description, promptly and effectively to the satisfaction of the Employer.
- i. No Plants or other loads shall be moved across the floors of structures without first covering the floors with timber of sufficient size so that applied loads will be transferred to floor beams and girders of steel or concrete. If it is required to reduce bending stresses and deflection, the beams and girders shall be provided with temporary supports.
- j. During erection of the Plant the Engineer will inspect the installation from time to time in the presence of the Contractor's Site representative to establish conformity with the requirements of the Specification. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the Engineer.

#### 11.1.1 Levelling and Grouting of Machinery

- a. He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cutouts etc., to achieve uniform level of reference for erection. All concrete surfaces receiving grout shall be hacked as required to ensure better bonding with grouting.
- b. Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the Engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc. shall be made good to the satisfaction of the Engineer.
- c. All grout for equipment shall be carried out using non-shrinkable continuous grout materials with suitable frame work of at least 12mm thickness. Surfaces to receive the grout shall be hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be blown off by compressed air before commencing grouting. Grouting shall be done in one continuous operation from one side such that grout flows in a single wave until grout reaches all confined spaces with no air pockets and air from all confined spaces is expelled. A hydro static head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out in the presence of the Engineer's Representative. All lines and levels shall be checked up after grout is set. Block outs shall be closed using cement concrete of the same grade as that of the parent structure.

#### 11.2 RECORDS, PROCEDURES AND REPORTS

- a. The Contractor shall maintain records pertaining to the quality of installation/erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The Contractor shall submit such records to the Engineer after the

completion of any particular work before submitting the bill of supply/progress of work. Such report shall comprise shop inspection reports, shop testing reports, material test reports, based on which dispatch clearances are provided, all the quality control reports of welding, erection and alignment records.

- b. All the above-mentioned records shall be submitted in the final form duly countersigned by the Engineer's Representative attesting conformity to specifications and his approval of installation, and duly incorporating all the additions, alternations, and information as required by the Engineer, on the basis of preliminary reports giving the progress of the work. Such records notwithstanding, any records submitted earlier with bill of supply/progress etc., shall be duly bound and submitted to the Engineer in six copies by the Contractor on his notification of the mechanical completion of erection.

### 11.3 GENERAL PREPARATIONS BEFORE COMPLETION OF THE PLANT

#### 11.3.1 Necessary Documents

##### a. Technical Documents

- i. Operation and Maintenance manual
- ii. Design documents including the Contractor's design data, drawings and Specifications.
- iii. Tools and test equipment list
- iv. Spare parts list
- v. Lubricant list

##### b. Procedures

- i. Mechanical testing procedure
- ii. Electrical testing procedure
- iii. Instrumentation testing procedure
- iv. Detailed Pre-commissioning and Commissioning procedure
- v. Detailed Performance Test procedure

##### c. General and Coordination Documents.

- i. Detailed organization charts for Pre-commissioning and Commissioning showing lines of authorities and responsibility, and functions of all key personnel.
- ii. The job description of the members of the team.
- iii. The scheduled dates of assignment of each member to Pre-commissioning and Commissioning Organization.
- iv. A detailed schedule showing the time sequence which the Contractor anticipates to follow for the various steps in Completion of Erection, Pre-commissioning and Commissioning of each unit and equipment.
- v. The regulations for safety, hygiene and discipline.

- vi. The practical organization of the relationship (meetings, reports, etc.) between the Contractor and the Employer at the phases of Pre-commissioning and Commissioning.
- vii. Emergency communication route.

#### 11.4 MANPOWER

Required manpower shall be provided as agreed between the Contractor and the Employer in a Manpower Mobilization Plan which shall include the number and qualifications of the operator and maintenance personnel to be furnished by the Employer for the Plant.

#### 11.5 COMPLETION OF ERECTION

- a. The completion of Plant under erection by the Contractor shall be deemed to occur, if all the units of the Plant are structurally and mechanically complete and will include among other such responsibilities the following:
  - i. Plant in the Scope of the Contract has been erected, installed and grouted as per specifications.
  - ii. Installation checks are completed and approved by the Engineer.
  - iii. The erected Plants are totally ready for commissioning checks.
- b. At the stage of completion of erection, the Contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the Plant is fit and sound to undergo tests on completion and subsequent pre-commissioning checks.
- c. Upon achieving the completion as described above, the Contractor shall notify the Engineer by a written notice intimating completion of erection and notify the Engineer for inspection. The Engineer / Engineer's Representative shall proceed with the inspection of such units within 14 days of such a notice.
- d. The Engineer shall certify completion when there are no defaults in the Works.
- e. The Engineer shall inform the Contractor list of deficiencies for rectification hereinafter referred as Punch list and the Contractor shall complete the rectification work within a jointly agreed period before pre-commissioning activities and obtain the Engineer's acceptance or approval of the same before proceeding with the same.
- f. The Engineer may inform the Contractor that the works are accepted with the 'Punch' list (items which do not hamper operability, safety or maintainability) and allow the Contractors to proceed with the pre-commissioning checks when the Contractor undertakes to complete such outstanding works within an agreed time during defects liability period. Taking over shall be based on rectification of all deficiencies as advised by Punch lists.
- g. The erection period indicated by the Contractor would be deemed to cover all the activities up to Completion as stipulated in previous paragraphs, notice of completion by the Contractor, inspection by the Engineer for Completion, and Contractor rectification of all

deficiencies as noticed by the deficiency/Punch list, and acceptance by the Engineer of such rectification's, prior to Tests on Completion.

- h. Minor defects, which in the opinion of Engineer which do not hamper operability and maintainability will not be taken into account for deciding Mechanical Completion. Such defects shall be rectified concurrent to commissioning checks before Tests on Completion. However, the Engineer's decision in this regard is final.
- i. The commissioning period as notified by the Contractor shall be deemed to occur beyond the date of Completion and shall include all periods of pre-commissioning, trials and Tests on completion.
- j. It is in the Contractor's interest to offer the section/units/systems, progressively under identified milestones within overall erection period, duly completed for rectification of any deficiencies pointed out by the Engineer and to achieve Mechanical Completion before undertaking the tests on Completion within the specified erection period. The Engineer also reserves the right to withhold the cost is estimated to be equivalent to the rectification of deficiencies pointed out to the Contractor until such a time such deficiencies are rectified to the satisfaction of the Engineer.

#### 11.6 PRE-COMMISSIONING

- a. After the Completion of erection, Pre-commissioning activities listed below shall be carried out to make the Plant ready for Commissioning. All instruments, materials and provisions necessary for conducting site tests shall be provided by the Contractor at his own cost.
- b. Upon completion of erection of each piece of equipment, facility or discrete part of the plant, mechanical checks and tests shall be carried out according to the Contractor's check list. The mechanical checks and tests shall be to establish that:
  - i. The Plant is erected in accordance with the Contractor's construction drawings, pipe work drawings, instrument diagrams, etc. issued for the Plant.
  - ii. The materials are installed and mechanically function in accordance with the Contract and
  - iii. Applicable codes as listed in the Contract are followed for Materials and Workmanship.
- c. Items such as painting, thermal insulation and final clean-up which do not materially affect the operation or safety of the Plant will be excluded. All these items shall be listed and completed after Pre-commissioning or Commissioning at the discretion of the Contractor, but before acceptance.
- d. The Contractor shall prepare and maintain at Site test forms and records which shall include:
  - i. Description of type of test or check,
  - ii. Date and times of test or check,
  - iii. Identification of equipment and facilities,
  - iv. Test pressure, test data and results, including remarks, if any,



- v. Signature of the Contractor's personnel attesting to data recorded, if any. Checks, tests and records thereof shall be carried out by the Contractors construction forces.
- e. Wherever the Employer's witness or attesting of the check or test is required, the Employer's personnel shall attend such check and test. For this purpose, the Contractor shall keep the Employer informed of a day-to-day test plan schedule. The test plan schedule may be revised from time to time to reflect the actual progress of the work and test.
- f. Any items found incomplete or requiring repair or adjustment shall be marked as such on the test records and then reported by the Contractor to the Employer and the Contractor's personnel in charge of the relevant construction area.
- g. Checking procedures shall be repeated until all the items on the check list are cleared.
- h. A complete set of test records shall be handed over to the Employer on completion.
- i. The tests on the different Mechanical and Electrical equipment shall include but not limited to.

#### 11.7 PUMPS, PIPING AND VALVES

- a. Complete piping installation shall be subjected to hydrostatic test at a pressure of 1.5 times the shut off pressure of pump or twice the working pressure of pump whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tapings etc. for carrying out these tests shall be included in the Contract.
- b. Leakage tests shall be carried out on all erected pipe work, pumps and valves immediately after erection and where possible before being built in.
- c. Operating tests shall be conducted on valves.
- d. The pump set shall be tested for performance. The vibration and noise levels shall be checked to be within the specified.
- e. The pump shall be tested throughout the operating range with all working (excluding stand-by) for all the pumps. No negative tolerance shall be permitted on any parameters visibly head, discharge and efficiency. All the pumps will be tested for efficiency at duty point after installation.

#### 11.8 PUMP MOTORS

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

#### 11.9 CRANES

The crane and lifting tackle shall be tested for the safe working load at factory. The Contractor shall arrange the test load. Deflection and speed tests shall also be conducted at site with load in presence of Engineer in- charge.

## 11.10 INSTRUMENTATION

- a. The tests on the instrumentation equipment shall include but shall not be limited to:
  - i. All cables shall be tested for polarity, continuity and insulation resistance. The common mode D.C. voltage at each signal input terminal shall be measured and recorded.
  - ii. The pre-commissioning tests on the various main categories of plant shall be as listed below:
    - The resistance of each electronic loop shall be measured
    - Electronic equipment shall have been energized for at least 24 hours before testing begins
    - The zero setting of each display instrument including any local indicator on or associated with a transmitter shall be checked
    - The correct calibration of each item in each control or monitoring loop shall be checked by the introduction of appropriate signal at each source, at five cardinals' points of the range for increasing and decreasing signals.
- b. The following tests methods shall be used:
  - i. Pressure operated devices – dead weight testers or portable calibrators
  - ii. Level operated devices – actual level variation or simulation thereof. Instrument zero reading shall be checked against a bench mark:
  - iii. For controlling devices, the Contractor shall demonstrate the correct operation of the loop including the regulating devices. Each automatic controller shall be set to the appropriate estimated values of the terms. Which shall be optimized during the plant start-up? Each control valve shall be optimized during the plant start-up. Each control valve shall be checked by operation of the manual control on the associated controller and the correct stroking verified. Valve petitioners, electropneumatic converters and gauges shall be checked during these tests.
  - iv. All systems shall be checked for “fail-safe” operation.
  - v. Initiating devices not covered by the foregoing e.g., plant stop/start controls shall be checked in conjunction with the testing of the associated switchgear and machine.
- c. The Contractor shall also demonstrate the data transfer as per data transfer schedule between Pumping Stations.

## 11.11 COMMISSIONING

- a. After the completion of Pre- commissioning activities, the final checks preparations necessary for start-up of the plant shall be carried out. The Contractor shall submit to the Employer a written Notice of Mechanical Completion which shall include:
  - i. Identity of a part of the Plant considered mechanically complete,
  - ii. A copy of all relevant completed test reports,

- iii. The date on which the completion of the tests was achieved.
  - iv. Check list, and
  - v. A request for issuance of a Mechanical Completion Certificate in respect of that part.
- b. Within fourteen (14) days from the date of receipt of the Contractor's written Notice, the Employer shall:
- i. In the case of acceptance, issue a Mechanical Completion Certificate.
  - ii. In the case of Objection, submit a rejection Statement setting forth remaining items to be completed or defects or deficiencies to be corrected before Mechanical Completion status can be accepted. When the Employer rejects the Contractor's Notice the Contractor shall take any necessary action to complete or correct the items marked and give the Employer a second Notice of Mechanical Completion.
- c. After the issuance by the Employer of a Mechanical Completion Certificate, Commissioning activities listed below shall be carried out to enable the start-up and operation of the Plant. Procedures are described as below:
- i. Commissioning Procedure shall be carried out in a methodical sequence as follows
    - Warming up,
    - Start-up,
    - Initial running,
    - Operability adjustment,
    - Stable operation
    - Final adjustment
  - ii. At all stages of commissioning sequence, the Plant shall be operated at optimum Plant conditions. To ensure this, the Contractor may make minor adjustment to the conditions indicated in the Operation and Maintenance Manual as necessary.
  - iii. The Contractor shall check the operating conditions of the Plant by constantly monitoring operating data.
  - iv. The Contractor shall specify for each discrete part of the Plant the operational data to be recorded and the manner in which the data is to be taken.
  - v. All the operating data shall be recorded by the Employer on the forms to be mutually agreed. A copy of the operating log and analytical data from initial operation through to the completion of Performance Test shall be made available by the Employer to the Contractor for evaluation.

## 12. DATA SHEETS FOR MECHANICAL WORKS

### 12.1 SUBMERGED CENTRIFUGAL PUMP

Sr. No.	Parameter	Details
<b>A</b>	<b>PUMPS</b>	
<b>1</b>	<b>General &amp; Performance</b>	
1.1	Make	Bidder has to furnish (Only “A” category as published in vendor list on GWSSB website at the time of approval of document shall be followed)
1.2	Pump type	Submerged Centrifugal Pump
1.3	Number of units	As per Price Bid
1.4	Design Capacity each pump (m <sup>3</sup> /hr)	As per Price Bid
1.5	Minimum total Head (m)	As per Price Bid
1.6	Shut off Head	Minimum 20% above duty point head
1.7	Pump Efficiency	As per Price Bid
1.8	Direction of rotation (viewed from Top)	To be furnished by Bidder
1.9	Total duration of operation	Continuous
1.10	Pump Speed	As per Price Bid
1.11	Submergence available (m)	As per IS
1.12	Pump Location	Indoor & On water sump
1.13	WHP, at 50 Hz	Bidder has to specify
1.14	Pump Input (BKW)	As per Calculation- Bidder has to specify
1.15	Drive Rating	Minimum as per Price Bid or Suitable to Duty Parameter
<b>2</b>	<b>Construction Features</b>	
2.1	Type	Vertical Turbine
2.2	Applicable Standard	Tender Spec.
2.3	Mounting	Common Base frame
2.4	Internal element	Mixed Flow impeller
2.5	Type of Lubrication	Self-water lubricated
2.6	Type of Sealing	Mechanical

Sr. No.	Parameter	Details
2.7	Type of Coupling	Shaft Drive
2.8	Number of Stage	To be furnished by Bidders
2.9	Column Size	To be furnished by Bidders
2.10	Discharge level with respect to floor	Above Floor
<b>3</b>	<b>Liquid Data</b>	
3.1	Liquid handled	Raw water
3.2	Temperature	Ambient temp.
3.3	Turbidity	Minimum turbidity: 500 NTU. However, the bidder is advised to carry out physical and chemical analysis of Raw water, as for the most of the days, it is expected to pump flood water having high turbidity.
<b>4</b>	<b>Guaranteed Parameters</b>	
4.1	Duty point H & Q	As Per Price Bid -no negative tolerance
4.2	Duty point Efficiency / Pump Input Power	As Per Price Bid / As per Calculation
4.3	Vibration	50 microns/ 4.5 mm/s
4.4	Noise Level	85 dBA maximum at distance of 1.86 meter from the source
<b>5</b>	<b>Material of Construction</b>	
5.1	Base Frame/plate	M.S. Fabricated, M.S. IS 226
5.2	Discharge Elbow	M.S. IS 226
5.3	Column Pipe	ERW, M.S. minimum 14 mm. wall thickness with inside and outside epoxy painted, in, minimum 1.5 m Sections. As per IS 1239
5.4	Suction bell	C.I. having 1.5 to 2.0% Nickle Cast Iron I.S 210 Gr FG260
5.5	Pump casing / Impeller bowl	C.I. having 1.5 to 2.0% Nickle (M) with inside anti-corrosive coating As per cast Iron IS 210
5.6	Impeller	Stainless steel CF8M As per IS 1570
5.7	Line shaft with coupling	Stainless Steel 410 (IS 1570 (part V) Gr. X12Cr12)
5.8	Impeller shaft	Stainless Steel 410 (IS 1570 (part V) Gr. X12Cr12)
5.9	Head shaft	Stainless Steel 410 (IS 1570 (part V) Gr. X12Cr12)
5.10	Shaft coupling	Stainless steel 316 As per IS 1570

Sr. No.	Parameter	Details
5.11	Line bearing	Thrust type
5.12	Suction strainer	Stainless Steel AISI – 304 (M) As per IS 1570
5.13	Shaft sleeves	S.S ASTMA 351 CF8M As per IS 1570
5.14	Wearing Ring	AISI SS CF8M
5.15	Painting	Epoxy
5.16	Hardware in contact with water	AISI SS 304, Hot dip Galvanized
5.17	Companion flanges	M.S. as per IS 1538 table IV & VI, off centre drilling.
<b>6</b>	<b>Required Accessories &amp; Services</b>	
6.1	Base plate	Required
6.2	Foundation bolts	Required
6.3	Suction strainer	Required
6.4	Companion Flanges	Required
6.5	Spares parts recommended	Required
6.6	Maintenance Tools	Required
6.7	Start-up / essential spares	Required
6.8	Flexible coupling	Required
6.9	Painting	Required (Epoxy)
<b>7</b>	<b>Inspection &amp; Testing</b>	
7.1	Hydrostatic test	Yes, to be witnessed
7.2	Performance Testing Standard	IS 5120/IS 9137 (Latest Amendment)
7.3	Pump casing	Ultrasonic test not to be witnessed but certificate for testing during manufacturing is to be produced.
7.4	Performance test	Yes, to be witnessed
7.5	Standard running test	Yes, to be witnessed
7.6	Static balancing test	Required
7.7	Dynamic Balancing test	Yes, to be witnessed
7.8	Visual inspection check	Required
7.9	Parallel Operation test at site	Required
7.10	Hydro test pressure	1.5 x operating pressure or 2 x Shut off pressure whichever is higher
7.11	Material Test certificates	review & acceptance

Sr. No.	Parameter	Details
7.12	Guaranteed parameters	Witnessed
<b>B</b>	<b>PRIME MOVER (MOTOR)</b>	
<b>1</b>	<b>General</b>	
1.1	Make	Only “A” category as published in vendor list on GWSSB website at the time of approval of document shall be followed
1.2	Number of units	As per Price Bid
1.3	Type	TEFC Squirrel Cage Solid Shaft Induction Motor
<b>2</b>	<b>Rating</b>	
2.1	kW Rating	Minimum as per Price Bid or Suitable to Duty Parameter
2.2	Operating Voltage	3 phase, 50 Hz +/- 3%, Voltage Level as Per Price Bid
2.3	Speed & Direction of rotation	To suit Pump
2.4	Design Ambient Temp	50 °C
<b>3</b>	<b>Performance</b>	
3.1	Minimum Efficiency @ Rated Speed Duty point	94 % (minimum at full load without negative tolerance)
	a) At Full Load	Bidder has to furnish
	b) ¾ Load	Bidder has to furnish
	c) ½ Load	Bidder has to furnish
3.2	Power Factor Duty point	(To be achieve minimum 0.996 at full load & 0.9 at part load with the help of HV Capacitor bank across motor & APFC Panel)
	a) At Full Load	Bidder has to furnish
	b) ¾ Load	Bidder has to furnish
	c) ½ Load	Bidder has to furnish
<b>4</b>	<b>Construction Features</b>	
4.1	Applicable Standards	IEC 60034-1/2004 or latest revision
4.2	Operation	S1 (continuous)
4.3	Enclosure	IP 54
4.4	Cooling	TEFC
4.5	Insulation	Class F with temp rise restricted to class B

NOTE:

- a. Material certificates of components shall be furnished before inspection of components.
- b. Bidder to furnish GA drawing indicating overall dimensions, weight, and height details along with offer.
- c. The capacity range shall be zero flow to maximum flow.
- d. Bidders have to submit performance test report sand, family curves (Head (H)Vs. Discharge (Q), Efficiency Vs. Discharge, and Power (P) Vs. Discharge (Q) and Torque speed curve for similar model of pump.
- e. The difference of 50 BHN hardness shall be between casing ring and impeller ring.
- f. If the guaranteed efficiency of pump quoted by the bidder is less than minimum specified in the tender, then the offer of bidder is liable to be rejected.
- g. Bidder to furnish guaranteed technical particulars duly filled.

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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## 12.2 INDUCTION MOTORS

Sr No	Description	Requirements
1	Make/Application	Bidder has to furnish (As per approved vendor list)
2	Type of motor	Squirrel cage Induction motor
3	No. of units. (Nos.)	As per Price Bid
4	Supply system fault level	Min 25 kA
5	Supply neutral	Resistance earthed
6	Rated voltage / Indicative Rated KW	As per Price Bid
7	No. of Phases & frequency	3 Phase & 50 Hz
8	Supply condition	± 10% voltage variation ± 3% frequency variation ± 10% combined voltage and frequency variation
9	Duty condition as per IS 325 or equivalent	S1 suitable for constant operation
10	Method of starting	FCMA / HFSR
11	Starting torque % Of full load torque	Sufficient starting torque to start the pump with delivery valve open and when other pumps are running.
12	Pull out torque % Of full load torque	Sufficient to bring the motor to normal speed in minimum time
13	Class of insulation & temp. rise by thermometer	Class "F" but Temperature rise restricted to that of class "B" i.e., 65° c. / 75°C (temp. Range indicative)
14	Ambient temperature	50°C.
15	Location	Indoor
16	Hazardous area division	N.A.
17	Atmosphere	Humid, Dusty at a time
18	a) Type of Cooling b) Degree of protection	CACA / CACW/TETV IP – 55
19	Terminal box	Phase segregated terminal box for line and neutral side. And shall be suitable for termination of heat shrinkable termination kit or push on type termination kit.

20	External cable details. a) No. of cores. b) Size	Bidder has to furnish
21	Shaft	Solid shaft
22	Type of Couplings	Flexible
23	Type of bearings	Ball / Roller / Thrust
24	Colour shade of paint if special	Grey shade 65% as per IS 5
25	Space heater for motors required	240 V, 1 Ph., 50Hz., A.C. for winding heating
26	Thermistors / RTD's / required	For trip, alarming and indicating
27	Bearing temp. Detectors	Required for alarm only
28	Winding connections	6 Terminals
29	Standard to be followed	IS 12615 and another relevant Indian Standard or equivalent BSS.
30	Efficiency @ Rated Speed Duty point	94 % (minimum at full load without negative tolerance)
a	Full Load	Bidder has to furnish
b	0.75 Load	Bidder has to furnish
c	0.50 Load	Bidder has to furnish
31	Power Factor Duty point	(To be achieve minimum 0.996 at full load & 0.9 at part load with the help of HV capacitor bank across motor & APFC Panel.)
a	Full Load	Bidder has to furnish
b	0.75 Load	Bidder has to furnish
c	0.50 Load	Bidder has to furnish

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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## 12.3 BUTTERFLY VALVE

Sr No	Description	Requirements
1	Make	Bidder has to furnish (As per approved vendor list)
2	Type	Both end flanged hand wheel / Gear operated / Actuator Operated as mentioned in BOQ
3	Rating of valves	PN 1.6
4	Manufacturing Standard	IS 13095 / BS 5155 or latest
5	Sizes and quantity	As per price bid
6	Fluid	Raw water
7	Ends	Flanged Ended, Flat Faced flanged as per IS: 1538 Table IV & VI
8	Body/ Disc	Dual Eccentrically Solid Wedge DI IS1865 Gr500/7
9	Operation	Electrically Actuator Operated (As described)
10	Seat	Body – Renewable. Disc – Renewable.
11	Stem	Stainless Steel AISI 316
12	Shaft (Drive & Stub)	Stainless Steel AISI 316
13	Body ring (Retainer/seat)	Stainless steel AISI -304
14	Disc Seat	EPDM rubber / Nitrile rubber
15	Bolts, Studs & Nuts	Stainless steel AISI -304
16	Disc Pin	SS 304
17	Bush	Stainless steel Backed PTFE
18	Flange End	IS 9523
19	Internal Hardware	Stainless Steel AISI - 304
20	Body Test Pressure	As per Design Code
21	Disc Test Pressure	As per Design Code
22	Seal Leakage Test	As per Design Code
23	Total Weight (kg) of the complete Assembly	To be furnished by Bidders

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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## 12.4 REFLUX VALVE (DPCV)

Sr. No.	Description	Requirement
1	Make	Bidder has to furnish (As per approved vendor list)
2	Type	Both ends flanged
3	Rating of Valves	PN 1.6
4	Manufacturing Standard	API 594 / 598
5	Sizes and quantity	As per price bid
6	Fluid	Raw water
7	Maximum pressure drops at design flow rate (mwc)	0.5
8	Maximum permissible leakage rate (cc/hr./mm diameter)	7.0
9	Ends	Flanged Ended, Flat Faced flanged as per IS: 1538 Table IV & VI or IS 9523
10	Disc	Dual Eccentrically Solid Wedge
11	Operation	Electrically Actuator Operated (As described)
12	Seat	Body – Renewable, Disk – Renewable
13	Seat ring (Body)	Stainless Steel – SS 316
14	Seat ring (Plate)	Cast steel ASTM A216 Grade WCB With 13% Cr. Steel overlay
15	Body	Ductile Iron
16	Disc	SG Iron IS 1865 GR. 500/7
17	Stem	Stainless Steel AISI 316
18	Drive Shaft	Stainless Steel AISI 316
19	Stub Shaft	Stainless Steel AISI 316
20	Disc Seal	EPDM rubber / Nitrile rubber
21	Hardware	Carbon Steel IS 1367 CL 4.6/4.0
22	Door & Door Face	DI IS1865 Gr500/7
23	Stop, hinge pin & washer	Stainless Steel – SS 304
24	Bearings (Body & Plate lug)	PTFE
25	Spring	Stainless Steel – SS 410

26	End Cover	Mild Steel
27	Body Test Pressure	As per Design Code
28	Disc Test Pressure	As per Design Code
29	Seal Leakage Test	As per Design Code
30	Total Weight (kg) of the complete assembly	To be furnished by Bidders

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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## 12.5 SLUICE VALVE

Sr No	Description	Requirements
1	Make	Bidder has to furnish (As per approved vendor list)
2	Type	Both end flanged hand wheel / Gear operated / Actuator Operated as mentioned in BOQ
3	Rating of valves	PN 1.6
4	Manufacturing Standard	IS: 14846-2000 PD or latest
5	Sizes and quantity	As per price bid
6	Fluid	Raw water
7	Ends	Flanged Ended, Flat Faced flanged as per IS: 1538 Table IV & VI
8	Body/ Disc	Dual Eccentrically Solid Wedge DI IS1865 Gr500/7
9	Operation	Electrically Actuator Operated (As described)
10	Seat	Body – Renewable. Disc – Renewable.
11	Stem	Stainless Steel AISI 316
12	Shaft (Drive & Stub)	Stainless Steel AISI 316
13	Body ring (Retainer/seat)	Stainless steel AISI -304
14	Gland Packing	Jute & Hemp IS 5414 (Latest Amendment)
15	Bolts, Studs & Nuts	Stainless steel AISI -304
16	Internal Hardware	Stainless Steel AISI - 304
17	Body Test Pressure	As per Design Code
18	Disc Test Pressure	As per Design Code
19	Seal Leakage Test	As per Design Code
20	Total Weight (kg) of the complete Assembly	To be furnished by Bidders

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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## 12.6 EXPANSION BELLOWS

Sr. No.	Description	Requirement
1	Make	Bidder has to furnish (As per approved vendor list)
2	Type	Both ends flanged
3	Rating of Valves	PN 1.6
4	Manufacturing Standard	As per EJMA
5	Sizes and quantity	As per price bid
6	Fluid	Raw water
7	End Connection	Suitable end connection or Flanged. Flanges shall be Flat faced, (As per IS 1538)
8	Material of Flange	MS
9	Material of Bellows	SS 304 - PN 1.6
10	Internal Sleeve	SS 304
11	Weld ends	IS 2062 Gr. B
12	Lugs	IS 2062 Gr. B
13	Limit Rods and Nuts	CS - IS 1367
14	Flange End	IS 9523
15	Axial expansion (mm)	15(Min.) to be acquainted with pump installation requirement.
16	Axial compression(mm)	15(Min.) to be acquainted with pump installation requirement
17	Lateral Movement (mm)	±1 (Min.) to be acquainted with pump installation requirement
18	Hydrostatic Test Pressure (kg/cm <sup>2</sup> )	15 min
19	Mode of Installation	Horizontal
20	No. of Tie rods	As Per manufacturer Standard

I/We are bound to supply the above item of stated manufacture having rated capacity, material of construction and other requirements mentioned in the data sheet or as per requirement.

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