VOLUME – IIC

TECHNICAL SPECIFICATIONS
Electro-Mechanical Works

Sr. No.	Description
1	Technical Specification of Mechanical Works
2	Technical Specification of Electrical Works
3	Technical Specification of Instrumentation Works

C O N T E N T

1.0 GENERAL

These General Mechanical Electrical Technical Specifications are meant to amplify the specifications General Conditions of Contract. If any discrepancy is noticed between these conditions, General Conditions of contract, specifications, Bills of Quantities Drawings the most stringent of the above shall apply.

All electrical and mechanical installations shall be of high quality, safe, durable, complete fully operational including all necessary items, spares accessories whether or not specified in detail. All electrical and mechanical work shall be completed in accordance with the regulations stards to the satisfaction of the inspection agency authorized by owners. The general provisions, special provisions general requirements apply to all sections of this

specification.

The contractor shall be fully responsible for the maintenance of electrical, mechanical and other installations till the entire work covered by this contract is satisfactorily completed by him hed over to the owner.

ACCOMPANIMENT TOBID

The Contractor will attach to the bid, at the time of submission technical schedules provided by BID documents.

INTENT

It is the intention of the specification drawings to design, supply, installation, testing commissioning ready for use for continuous dependable satisfactory operation.

INTERPRETATION OF PROJECTDOCUMENTS

The specifications price schedule shall be considered as part of this contract any work or material shown on price schedule not called for in the specification or vice versa shall be executed as if specifically called in for both. The drawings indicate the extent general arrangement of the machineries, equipment's, apparatus, fixtures, controlling switches, wiring system etc. are essentially diagrammatic. The drawings indicate the points of termination of conduit runs broadly suggest the routes to be followed.

Machinery equipment shall be installed as indicated on the drawings. However any minor changes found essential to coordinate the installations of this work with other services shall be made without any additional cost to the owner. The drawings are for the guidance of the contractor. Exact locations distances levels will be governed by the building. The contractor shall examine all civil, structural, mechanical electrical drawings before starting the work report to the Department any discrepancies which in his opinion appear on them get them clarified.

SCOPE OF SPECIFICATION

These specifications covers Design, manufacture, factory testing, supply, delivery to site, unloading. Handling storage to site, complete installation including cement concrete foundation wherever necessary, final checkup, painting, performance testing commissioning of pumping machinery related electrical equipment's accessories to be supplied under these specifications on turnkey basis, to achieve a guaranteed co-ordinate commercial operation of the same to the entire satisfaction of the department.

Any item of work, either supply /or erection of material/machinery which have not been specifically mentioned in this specification drawing but are necessary to complete the work for trouble free, efficient operation guaranteed performance of the entire plant offered shall

be deemed as included within the scope of this specification shall be provided by contractor without any extra cost to the client.

The following mechanical electrical equipment's are to be covered under this contract.

a) Vertical Turbine (VT) Pumps and Motors
b) Pipes Fittings
c) Valves - (i) Sluice / Gate / Butterfly valves (b) Non Return Valves (c) Air Valves / velocity valve
d) E.O.T. Crane of required capacity
e) Expansion Bellows
f) De-watering Pumps
g) Trash Racks / Screens at in-let to the water sump
h) Low voltage switch gear control gear
i) Distribution board
j) Power control cables
k) Lighting system
l) Earthing

AMBIENT CONDITION

The equipment's are to be operated in tropical climate with high ambient temperature up to 50° C. So the equipment shall be so designed that it will be suitable to operate under tropical climate with high humidity, dust fungus condition.

RATING

Rating of all items shall be appropriate for the condition on the particular site on which the items will be used.

The rating of all electrical equipment/ components shall be for three phase 415 V, 50 Hz AC supply with the following variations:

a. Voltage variation +/-10%
b. Frequency variation +/-5%
c. Combined variation +/-10%

The rating shall be as per manufacture's printed literature drawings as per latest Indian Standards, IE rules Power supply authority conditions for power supply prevailing at the location.

REGULATIONS STARDS

The installation shall conform in all respects to Indian Standard Code of Practice for pumping machinery electrical equipment installations. It shall also be in conformity with the current Indian Electricity rules, Indian Electricity Act, National Electrical code Regulations of

the local Electrical Supply Authority in so far as these become applicable to the installation. Wherever these specifications call for a higher standard of material /or workmanship than those required by act of the above regulations, then these specifications shall take precedence over the said regulations standard. In general, the material, equipment workmanship not covered by the above shall conform to the relevant Indian standard.

The electrical installation work shall follow codes of the Indian standard specifications Rules (within the best meaning of the same) under this contract.

The machinery, equipment, component material shall conform to the latest revision of the following standard:

LIST OF APPLICABLE INDIAN STANDARD CODE OFPRACTICE

Sr. No.	Stard No.	Title
1.	IS – 5	Colors for ready mixed paints enamels.
2.	IS – 104	Ready mixed paint, brushing, zinc chrome, priming.
3.	IS – 158	Ready mixed paint, brushing, bituminous, black, lead Free, acid, alkali head resisting.
4.	IS – 325	Three phase induction motors.
5.	IS – 335	New insulating oils.
6.	IS – 375	Marking arrangement for switch gear, Bus bars main Connection auxiliary wiring.
7.	IS – 613	Specification for copper rods bars for electrical purpose
8.	IS – 694	PVC insulated cables for working voltage up to including 1100 V.
9.	IS – 722	AC Electricity meters
10.	IS – 732 (part I)	Code of practice for electrical wiring installations
11.	IS – 807	Code of practice for design, manufacture, erection testing (structural portion) of cranes hoists
12.	IS – 816	Code of practice for use of metal arc welding for general construction in mild steel
13.	IS – 900	Code of practice for installation maintenance of Induction motors.
14.	IS – 1239	Mild steel tubes, tubular other wrought steel fittings
15.	IS – 1248 (Part and II)	Direct acting indicating analogue electrical measuring Instrument their accessories.
16.	IS – 1271	Electrical insulation classifies by thermal stability
17.	IS – 1520	Horizontal split casing centrifugal pump for clear, cold fresh water
18.	IS – 1554 (Part and II)	PVC insulated electrical cables (heavy duty)

19.	IS – 1651	Stationary cells batteries, lead acid type (with tubular positive plates)
20.	IS – 1710	Vertical turbine pumps for clear, cold, freshwater.
21.	IS – 1866	Insulating oil in service, code of practice for maintenance supervision of.
22.	IS – 2026 (Part Ito V)	Power Transformers
23.	IS – 2062	Steel for general structural purposes.
24.	IS – 2071 (Part to III)	High voltage testing method
25.	IS – 2099	Bushings for alternating voltage above 1000 V.
26.	IS – 2121 (Part to IV)	Conductors aid earth wire accessories for overhead Power lines.
27.	IS – 2147	Degrees of protection provided by enclosures for low voltage switchgear control gear
28.	IS – 2253	Designation for types of construction mounting Arrangements of rotating electrical machines.
29.	IS – 2309	Code of practice for the protection of buildings allied Structures against lightning.
30.	IS – 2486 (Part I)	Metal fittings for overhead power lines with a nominal Voltage greater than 1000 volts.
31.	IS – 2544	Porcelain post insulators for systems with nominal voltage greater than 1000 volts.
32.	IS – 2551	Danger notice plates.
33.	IS – 2629	Recommended practice for hot dip galvanizing on iron steel.
34.	IS – 2633	Hot dip galvanizing
35.	IS – 2667	Fittings for rigid steel conduits for electrical wiring.
36.	IS – 2675	Enclosed distributions fuse boards cutouts for voltage not exceeding 1000 volts.
37.	IS – 2705 (Part to IV)	Current transformers
38.	IS – 2834	Shunt capacitors for power systems.
39.	IS – 3043	Code of practice for Earthing
40.	IS – 3070 (Part and III)	Lightning Arrestors for AC system.
41.	IS – 3156 (Part and IV)	Voltage transformers
42.	IS – 3177	Code of practice for electric overhead traveling cranes gantry cranes other than steel work cranes
43.	IS – 3427	Metal enclosed switch gear control gear for voltage above 1000 v but not exceeding 11000 v.
44.	IS – 3452	Toggle switches

45.	IS – 3589	Seamless or Electrically welded steel pipe
46.	IS – 3624	Vacuum pressure gauges
47.	IS – 3637	Buchholz relay
48.	IS – 3639	Fittings accessories
49.	IS – 3835	Aluminized steel core wire for Aluminum conductors (ACSR)
50.	IS – 3938	Electric wire rope hoists
51.	IS – 3961 (Part II)	Recommended current ratings for cables
52.	IS – 4029	Guide for testing three phase induction motors
53.	IS – 4064	Switch fuse unit
54.	IS – 4137	Code of practice for heavy duty electric overhead traveling cranes including special service machines for use in steel work
55.	IS – 4237	General requirements for switch gear control for voltage not exceeding 1000 volts.
56.	IS – 4691	Degree of protection provided by enclosures for rotating electrical machinery.
57.	IS – 4722	Rotating electrical machines.
58.	IS – 4728	Terminal marking direction of rotation for rotating electrical machinery.
59.	IS – 4759	Hot dip galvanizing
60.	IS – 4889	Method of determination of efficiency of rotating electrical machines.
61.	IS – 5504	Spiral welded pipe
62.	IS – 5039	Distributions pillars for voltage not exceeding 1000 v.
63.	IS – 5082	Wrought aluminum alloy bars, rods, tubes sections for electrica purposes.
64.	IS – 5216	Guide for safety procedures practices in electrical work.
65.	IS – 5312	Swing type Non return valve
66.	IS – 5578	Guide for marking of insulated conductor.
67.	IS – 5831	PVC insulation sheath of electric cables.
68.	IS – 6005	Code of practice for phosphate of iron steel.
69.	IS – 6346	Specification for PVC insulated cables for electricity supply
70.	IS – 6362	Designation of methods of cooling of rotating electrical machine.
71.	IS – 6474	Polyethylene insulation sheath for electric cables
72.	IS – 6511	Range of preferred safe working loads for cranes, lifting appliances related excavators equipment.
73.	IS – 6595	Horizontal centrifugal pump for clear, cold fresh water
74.	IS – 6600	Loading of oil immersed transformer

75.	IS – 6792	Method for determination of Electric strength of insulating oils
76.	IS – 6875	Control switches for voltage up to (part I to III)including 1000 V AC 1200 VDC
77.	IS – 7098 (Part I and II)	Cross linked polyethylene insulated PVC Sheathed cables for working voltages from 3.KV up to including 33 KV
78.	IS – 7421	Bushings for </= 1000 V
79.	IS – 7538	Three Phase squirrel cage indications motor for Centrifugal pumps for agricultural application.
80.	IS – 8061	Code of practice for design, installation maintenance of service lines up to including 650 v.
81.	IS – 8084	Inter connecting Bus bars for A.C. voltage above 1KV Up to including 36 KV.
82.	IS – 8130	Conductors for insulated electric cables fixable cords.
83.	IS – 8197	Terminal marking for electrical measuring instruments their accessories
84.	IS – 8309	Compression type tubular terminal ends for aluminum conductors of insulated cables.
85.	IS – 8923	Warning symbol for dangerous voltage
86.	IS – 9046	AC contractors of voltage above 1000 V up to including 11 KV.
87.	IS – 9137	Code of acceptance test for CF pumps
88.	IS – 9224	Low voltage fuses.
89.	IS – 10001	Performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 KW)
90.	IS – 10028	Code of practice for selection installation (Part I to III) maintenance of transformers.
91.	IS – 10234	Pipeline Welding
92.	IS – 10418	Specification for drums of electric cables
93.	IS – 10748	Hot-Rolled steel strip
94.	IS – 10810	Methods for test for cables
95.	IS – 11346	Testing of agricultural pump
96.	IS – 12661	High voltage motor starter (D.O.L)
97.	IS – 12672	Internal fuses internal overpressure disconnections for shunt capacitors
98.	IS – 12776	Galvanized str for Earthling
99.	IS – 13095	Wafer type butterfly valve size from 40 mm to 2000 mm
100.	IS – 13118	High Voltage AC circuit Breakers.
101.	IS – 13349	Cast iron single faced thimble mounted sluice gates
102.	IS – 13947 (Part I to V)	Low voltage switchgear control gear
103.	IS – 14845	Air Relief Valves

104.	IS – 14846	Non rising stem type sluice valve size from 50 mm to1200 mm
105.	IS – SP: 30-1984	National Electrical code.
106.	ASME (Section –ix)	Non Destructive Test
107.	API 1104	Pipeline Works
108.	AWWA C 512	Air Relief Valves

MATERIAL EQUIPMENT

All material equipment shall conform to the relevant Indian standard shall be of the approved make design. The contractor shall be responsible for the safe custody of all the materials shall insure them against theft, damage by fire, earthquake etc. A list of items of materials equipment together with sample of each shall be submitted to the Engineer-In-Charge within 15 days of the award of the contract. Any item which is proposed as a substitute shall be accompanied by all technical detail giving sizes, particulars of materials the manufacturer's name shall be submitted along with the bid offer. At the time of the submission of proposed substitute the contractor shall state the credit, if any due to the client's. In the event, the substitution is approved all changes substitutions shall be requested in with detail justifications approvals obtained in writing from the Engineer-In-Charge. Decision of Engineer-In-Charge in the matter shall be final.

All materials of the same kind of service shall be identical made by the same manufactures. Any deviation to this rule shall be got approved from the Engineer-In- Charge. Top priority shall be given to the products that have a permanent agent providing spare parts maintenance facilities in the same city where the project is situated.

MANUFACTURERS

Where manufacturers are furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.

Where manufacturer's names /or catalogue numbers are given this is an indication of the quality standards performance required.

Where interfacing occurs, equipment shall be mutually compatible in all respects.

The list of vendors is furnished in Volume – II of Condition of Contract of Tender Document.

INSPECTION TESTING

The Engineer-In-Charge reserves the right to inspect test at manufacturer's works at all reasonable times during manufacture of items included in this contract. Tests on site of completed works shall demonstrate among other things.

m) That all items operate efficiently quietly to meet the specified requirements.

n) That all circuits are correctly fused protected that all protective devices are properly coordinated.

o) That all non-current carrying metal work is properly safely grounded in accordance with the

specifications.

p) While testing any machineries/equipment's at manufacturers/contractor's place the Engineer-In-Charge shall reserve the right to check/calibrate all the measuring devices.

The contractor shall provide all necessary instruments labor for testing shall make adequate records of test procedures readings shall repeat any tests requested by the Engineer-In-Charge shall provide test certificates signed by a properly authorized person. Such test certificates shall cover all works.

If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements or retesting will be considered. The Engineer-In-Charge decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.

q) All materials, components equipment's covered in this specification shall be procured, manufactured, erected, commissioned tested at all the stage as per comprehensive quality assurance programmed drawn in with IS -9000A.

This is however, not intended to form a comprehensive programmed as it is the contractor's responsibility to draw up implement such programmed duly approved by the Engineer-In-Charge. The detailed quality plans for manufacture field activities should be drawn up by the Contractors separately in the prescribed format signed by TPI will be submitted to Engineer-In-Charge for his approval.

r) Manufacturing quality plan will detail out for all components equipment's, various test/inspection be carried out as per the requirements of specification standard mentioned there in quality practices procedures followed. Contractor's quality control organization, the relevant reference documents standard, acceptance norms, inspection documents raised etc. during all stages of material procurement, manufacture, assembly final testing / performance testing.

s) Field quality plans will detail out for all the equipment's the quality practices procedure etc. to be followed by contractor's site quality control organization, during various stages of site activities from receipt of materials / equipment's at site.

t) The Contractors shall also furnish along with the quality plan copies of the reference documents/ plant standard / acceptance norms/test inspection procedure etc. as referred in them. These quality plans reference documents / standard etc. shall be subject to Engineer-In-Charge approval, without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, owner shall identify customer hold points(CHP), test/checks which shall be carried out in presence of TPI the Engineer-In-Charge or his representative beyond which work shall not proceed without approval of Engineer-In- Charge in writing.

All deviations to these specifications, approved quality plan applicable standard must be documented referred to Engineer-In-Charge or his representative along with technical

justification for approval.

u) No materials/ equipment's shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection (including verification records of all previous test/inspection) by Engineer-In-Charge or his representative or such pre-dispatch final inspection is waived by the Engineer-In- Charge.

All material used or supplied shall be backed up by valid material certificate test reports. These certificates reports shall indicate the hit numbers or other such acceptable identification numbers of the material they purport to certify. The material certified shall also have the identification details stamped on it.

v) All material used for equipment construction including casting forging etc. shall be of tested quality as per relevant codes/ standard. Details of results of the test conducted to determine the main properties, chemical analysis details of treatment procedure recommended actually it shall be recorded on certificates. Tests shall be carried out as per applicable materials standard agreed details.

w) No welding shall be carried out on iron component for repair or whatsoever purposes. All the sub vendors proposed by the contractor for procurement of major bought out items including castings, forging, semi-finished finished components/equipment- (list of which shall be drawn by the contractor, submitted to finalize by the Engineer-In-Charge shall be subject to Engineer-In-Charge's approval.

x) The contractor shall undertake an inspection, testing programming during manufacture in his work that of his sub contractor's to ensure the mechanical accuracy of components, compliance with drawing conformance to functional performance requirements acceptability of all materials, parts equipment's correlation of its identity with test certificate shall carry out all test/inspection required establish that the items/equipment's conform requirements of this specification the relay codes/ standard specified in this specification in addition to carrying out tests as per the approval.

RECTIFICATION TAKINGOVER

The contractor shall carry out all rectifications, repairs or adjustment work found necessary during performance testing, commissioning trail run.

On successful commissioning trial run on carrying out the rectification work, the Engineer-In-Charge will take over the installation either wholly or in part as the case may be. Unless otherwise specified, the work, material accessories shall confirm to the latest applicable Indian standard.

COMPLETION CERTIFICATE

On completion of the electrical mechanical installation (or an extension to an installation) a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under

whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority. The contractor shall be responsible for getting the installation inspected approved by the local concerned authorities.

PRICE DETAILS

At any time at the request of the Engineer-In-Charge, the contractor shall provide details or break up of costs prices of any part or parts of the work.

TEST CERTIFICATES

The contractor shall submit valid test certificates for all the electrical mechanical plant, equipment material/system. These shall be issued by a Government recognized inspection office certifying that all equipment's, materials, construction functions are in agreement with the requirements of these specifications accepted standard.

INSTRUCTION MANUAL

The contractor shall prepare instruction manuals in English, on operation, preventive maintenance repairs of pumping machinery, mechanical electrical equipment's supplied submit 5 copies of the same to the Engineer-In-Charge at the time of hing over.

AS BUILTDRAWINGS

At the completion of work before issue of certificate of virtual completion the contractor shall submit to the Engineer-In-Charge layout drawing drawn at appropriate scale indicating the complete electrical mechanical system "As Installed" These drawings must provide:

y) Run, location size of conduits. Inspection, junction pull boxes.
z) Number size of conductors in each conduit.
aa) Location rating of sockets switches containing the light power outlets.
bb) Location details of distribution boards switch gear other particulars.
cc) A complete wiring diagram as installed scheduled drawings showing all connections in the complete electrical system.
dd) Location of outlets, junction boxes, sizes of various conduits for telephone, clock system, fire alarm, sound system all other extra low voltage system.
ee) Location of all Earthing stations, route size of all Earthing conductors, man holes etc.
ff) Route particulars of all cables.
gg) Pumping machinery dimensional layout drawings in pump house.
hh) EOT EOH with electrical hoist drawings.
ii) Pumps dimensional drawings, cross sectional drawings, foundation drawings, supply location, Valves dimensional cross sectional drawings complete with details.

SPAREPARTS

The Contractor shall indicate include, in the supply all the necessary commissioning spares, matory spares recommended spares in the schedule of spare parts. The Engineer-In-Charge reserves the right to finalize the exact quantities of the spare parts effect price adjustment on the basis of the rates quoted by the Contractor. The spare ordered by Engineer-In-Charge shall be delivered at the site at agreed delivery schedule.

COMMISSIONING SPARES

jj) It will be the responsibility of the Contractor to draw furnish a list of all commissioning spares required for successful commissioning of the equipment covered under the contract. Such list shall be furnished by the contractor within four months of the date of LOA, separately for all equipment's shall be reviewed by Engineer-In-Charge discussed for mutual agreement. The commissioning spares will be so identified as to allow the trial operation not to suffer for want of commissioning spares. The identification of commissioning spare will not in any way relieve the vendor any of its responsibilities of satisfactory performance under the provisions of other condition of contract. All the commissioning spares shall be deemed to be included in scope of the contractor as a part of the respective equipment package at no extra cost to owner.

kk) All such identified spares shall be supplied by contractor at least two months before the schedule date of commencement of trial operation of the respective package. Such spare shall be received stored.

PACKING PRESERVATION

ll) Each spares shall be clearly marked or labeled on the outside of the packing with its description. When, more than one spare-part is packed in a single case, a general Description of the contents shall be shown on the outside of such case a detailed list enclosed. All cases, containers other packages must be suitably marked numbered for the purposes of identification.

mm) All cases, containers or packages are liable to be opened for such examination as may be reasonable by the engineer.

nn) In case of equipment supplied with grease/lubricants from imported origin, the supplier shall clearly indicate the indigenous equivalent of the grease/lubricant source of supply so as to enable to owner to procure these items from indigenous sources. Necessary initial filling of lubricating oil, grease etc. shall be arranged by the contractor with no extra cost to client.

PAINTING

All metallic surfaces equipment components shall first be thoroughly cleaned, degreased phosphate then be given two coats of zinc primer in then the surface shall be coated, painted

with approved shade of paint. The resulting coating shall be uniform smooth shall adhere perfectly to the surface.

2.0 VERTICAL TURBINE PUMPS:

SCOPE

This specification covers the design, performance, manufacturing, construction features, testing, delivery, installation commissioning of vertical turbine pumps at Pumping Station with suction strainer, bell mouth, column assembly, discharge elbow, motor stool, thrust bearing, non-reversing device etc.

CODES and STANDRDS

The design, manufacturing, performance of vertical turbine pumps shall comply to all currently applicable statutes, regulations safety codes in the locality where the equipment will be installed. The equipment shall conform to IS 1710 (latest edition). The performance test shall be carried out as per IS 11346:2002

DESIGN FEATURES

The vertical turbine pump shall be capable of developing the specified required total flow and 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 and 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 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 120 % 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 parallel operation.

e) The pumps shall be suitable for nonstop continuous 24 hour's 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 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 Holding of the Pumps and Motors.

i) The pump shall be designed considering the worst condition of raw water having turbidity, maximum up to 500 NTU the suspended solid sizes which are entering during flood time in monsoon season.

j) The noise level measured at pump, motor and 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 and suitably reinforced to with list all types of static dynamic loads, torsion loads etc. and 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 and contain stuffing box with PTFE impregnated gl packing. A sufficient opening should be provided between adjacent pump-sets so as to have easy access and working on thrust bearing and stuffing box. An anti-reverse rotation arrangement should be provided in pump/ motor to prevent pump/ motor from rotating in reverse direction.

k) The Thrust Bearing shall be of heavy duty anti-friction type. The bearing shall be designed to withst all the loads under normal operation and shut off and shall be suitable for reverse rotation. The bearing should be oil lubricated type shall be provided with an oil level indicator and a local as well as remote temperature measuring indication arrangement. The Thrust Bearing shall have water cooling system preferably in the oil bath or alternatively through a suitable cooling water jacketing arrangement. 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 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 and 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 forced water lubrication system. A suitable overhead tank, forced water lubrication water pumps necessary filtering arrangements shall be provided for this purpose.

o) Selection of pump shall be towards downward side.

FEATURES OFCONSTRUCTION

p) GENERAL

i. Pumps shall be of vertical turbine type complete with bowl column assemblies, suction strainer, bell mouth, discharge elbow, motor stool, thrust bearing, non-reversing device etc.

ii. 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 to50%.

iii. The bowl assembly shall consist of a rotating impeller/ impellers housed in a stationery bowl/ bowls having fixed guide vanes. The bowl/ bows shall also include the housing of the pump shaft bearing.

iv. The column assembly shall consist of a column pipe/ pipes to convey the liquid from bowl assembly to column assemblies shaft bearings, discharge elbow.

v. Generally, the VT pump discharge shall be located in the discharge head shall be taken out from the upper side of the supporting floor of the discharge head, unless otherwise specified.

vi. The Successful bidder /Contractor has to carry out CFD (Computational Fluid Dynamics) of pump sump house to predict the flow characteristics shall satisfy to owner that no vortex cone / Breaker is require for Pump house.

q) SUCTION STRAINER

i. Each pump shall be provided with a suitable suction strainer to prevent entry of foreign materials debris which can damage the pump. The strainer shall be fabricated from SS 304. The net opening area of the strainer shall be at least 4 times the area at suction diameter of the bell mouth. It shall be designed such that, it will cause minimum choking or clogging.

r) BOWLS

i. The bowls shall be of Cast steel WCB shall be free from blow holes other detrimental defects. The surface shall be smooth.

ii. The bowl assembly shall be equipped with replaceable wearing rings. Liquid passage shall be smooth finished the bowl shall contain bushes to serve as bearings for the impeller shaft.

iii. The pump shall be painted from inside outside with anti-corrosive primer epoxy based paint.

s) IMPELLER

i. The impeller shall be of S.S. CF8M, enclosed type shall be balanced dynamically. The impeller shall be properly machined, with finished liquid passages. They shall be adjustable vertically by means of an adjusting nut in the head assembly.

ii. Impeller shall be securely fastened to the impeller shaft with keys, lock-nuts.

iii. To avoid any internal resonance, the number of vanes on diffuser shall not be equal to or be a multiple or number of vanes on the impeller.

t) IMPELLER SHAFT

i. The impeller shaft shall be made of hardened stainless steel SS-410. It shall have a surface finish between 0.75 microns or less. It shall be guided by bearings above below each impeller. The butting faces of the shaft shall be machined square to the axis the shaft ends and shall be chamfered on the edges. Impeller shall not be overhung it will rotate in bearing support at its bottom.

ii. The shaft shall be straight the shaft deflection shall be within 0.125 mm (total dial indicator reading) for the 3 meter length of the shaft.

u) LINE SHAFT

i. The size of the shaft shall be calculated on the basis of maximum combined shear stress. This shall not exceed 30% of the elastic limit, in tension or 18% of the ultimate tensile strength.

ii. The design of the shaft shall also take into consideration the critical speed of the shaft which shall not coincide with the operating speed.

iii. The shaft shall be furnished with interchangeable sections having a nominal length equal to column pipe length. The maximum permissible error in the axial alignment of the coupling axis with the axis of the shaft shall be 0.05 mm in 150 mm.

iv. Shaft shall be provided with shrunk or snug fitted shaft sleeves of compatible wear/ corrosion resistant material precision ground polished where pass through bearings.

v) LINE SHAFTCOUPLING

Couplings shall be designed with a minimum safety factor of 1.5 times the shaft factor.

w) LINE SHAFTBEARINGS

Bearings shall be integral with replaceable sleeves of metallic material with suitable securing arrangement in the bearing housing. Lubrication shall be by a forced water lubrication system.

x) COLUMNPIPE

i. The Standard lengths of the column pipe shall be maximum 2.5 meters. The column pipe shall be of welded flanged design.

ii. The velocity of water in column pipe shall not exceed 2 M/Sec at rated discharge.

y) DRIVER

Driver shall be coupled through flexible coupling to the head shaft.

TESTS INSPECTION

z) PRE –MANUFACTURING INSPECTION /DOCUMENTS

i. Pump manufacturer will submit - (i) Test setup test procedure (ii) Details of instrumentation along with their least counts calibration certificates before commencing manufacturing/testing as per IS 10981CLB.
ii. Engineer In-charge will depute his representative to inspect the test setup.
iii. Only after finalization/ acceptance of test setup test procedures, the manufacturer will commence manufacturing/testing.

aa) HYDROSTATICTEST

i. A Standard hydrostatic test shall be conducted on all pump columns; discharge elbow bowl assemblies at 1.5 times the maximum discharge pressure of the pump or twice the rated pressure, whichever is higher.
ii. The hydrostatic test shall be conducted for a minimum duration of 30minutes.

bb) PERFORMANCETEST

Performance Test will be carried out as per IS 10981 (Class B) 100% QTY. with job motor. Performance test at rated speed shall be conducted at manufacturer's works in presence of third party inspection agency appointed by department / TPI or Engineer-in-charge representatives for all pumps. No negative tolerance on bowl efficiency, overall pump efficiency as well as capacity and head will be permitted.

The performance test shall include determination of head, discharge, power and efficiency over the entire range from shut off to full valve open condition. At least 6 different readings need to be taken in addition to shut off and duty point.

The minimum submergence test shall be carried out at manufacturer's work i.e. the value of minimum submergence available at site should be simulated (i.e. water level above impeller eye) and it should be demonstrated that the pumps run satisfactory and without any vibrations or cavitation or any other harmful effects at this level. At least one pump of each type will be subjected to minimum submergence test.

All the instruments used for testing should be calibrated and latest available calibration certificates are to be submitted before testing. Also the test set up and test procedure shall be submitted for Engineer's approval before testing.

The vibrations and noise levels shall be recorded at manufacturer's works.

cc) STANDARD RUNNINGTEST

i. Bowl assemblies shall be given running test over the full operating range, covering from free discharge with delivery valve fully open to the shut off head. The duration of tests shall be minimum one hour. A minimum of six readings apart from duty point shut off readings shall be taken for plotting the performance curves.
ii. The pump shall be tested for parallel operation at site. The pumps should work satisfactorily in parallel operation with equal load sharing. The velocity of vibrations shall be limited to 4.5

mm/sec at thrust bearing top and noise level should not exceed 85 Db. at a distance of 1.86meters.

dd) Impeller shall be dynamically balanced at rated or reduced speed as per ISO Standard. However the bidders should furnish the co-relation of accuracy limits of unbalance.

ee) Necessary test certificates of the above tests shall be furnished for the purchaser's approval.

ff) Pump bowls shall be offered for Dye penetration test if found defective, it shall be rejected destroyed to avoid reuse. The pump impellers shall be offered for Dye penetration test as per approved procedure. Ultrasonic test of impeller shaft shall be carried out along with above test.

VISUAL INSPECTION

Pumps shall be offered for the purchaser's visual inspection before dispatch. Pump components shall not be painted before inspection. After the inspection, test certificate shall be furnished. Inspection for critical dimensions of components like shafts diameter, wall thickness of column pipes; flange thickness etc. will be witnessed.

Inspection of verification of metallurgy of various components shall be done by reviewing the certificates of the metallurgical tests carried out by the manufacturer.

WELDING

All welding related operation shall be done as per code. Welders shall be qualified as per codes. All welding procedures shall be submitted for approval.

DRAWINGS /DOCUMENTS

The following drawings shall be submitted by the manufacturer.

gg) Preliminary outlined GA (general arrangement) and dimensional drawings, showing details of pump, motor, civil foundation, clearances, minimum submergence, etc.

hh) Performance curves for capacity v/s head, efficiency, and KW requirement shall be furnished. The capacity range shall be zero flow to maximum flow.

ii) Typical cross sectional (CS) drawing showing constructional details with the complete bill of material, bill of quantity (BOM and BOQ) and relevant Standard. Catalogues of all the components with part number shall be furnished.

jj) Pump House General Arrangements drawing of all the pumps with dimensional details.

kk) Test reports for chemical analysis of material of construction (MOC) of major components like impellers shafts bowl assembly etc.

ll) Performance test reports curves for similar model of pumps with a list of installations.

mm) O and M manual and spare part list.

nn) Startup and shut down instructions.

oo) Quality Assurance Plan (QAP) to be submitted for approval prior to the manufacturing.

pp) Dimensional similarity / interchangeability certificates shall be submitted so as to ensure interchangeability of components.

NAME PLATE

Each pump shall be provided with a stainless steel name plate of the manufacturer, indicating minimum following details.

(a) Rated capacity in M^3/hr.

(b) Total head in MWC

(C) Speed in RPM.

(d) Rated Power in KW at 50 Hz.

(e) Test pressure

(f) Make and Model number

(g) Manufacturer's serial number

(h) Weight of equipment

(i) Material of bowl.

(j) Material of impeller and shaft

(k) Details of Thrust Bearings with grade of lubricants

DOCUMENT: DATA SHEET OF VERTICAL TURBINE CENTRIFUGAL PUMP (VT PUMP)

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO FILL BY BIDDER	
1.0	LIQUID DATA			
1.1	Liquid handled	Treated Water / Raw water		
1.2	Specific gravity-kg/dm3	1.0		
1.3	Temperature-Drg.C	Ambient temp.		
1.4	Minimum Sump Level-m	Flooded		
1.5	Max. Permissible Turbidity - ppm	Please Furnish Detail		
2.0	PUMP DATA			
2.1	Make	Please Furnish Detail		
2.2	Pump type	Vertical Turbine		
2.3	Pump Model	Pl furnish		
2.4	Number of pumps - Nos.	As per BOQ		
2.5	Type of duty	Continuous		
2.6	Design capacity-m³/hr.	As per BOQ		
2.7	Bowl Head–mlc	As per BOQ		
2.8	Frictional losses in Column pipe & Disc.	Pl furnish		
2.9	Total Bowl Head*- mlc	As per BOQ		
2.10	Guaranteed Bowl Efficiency at rated capacity- %	% Min. w/o -ve Tolerance Pl furnish		
2.11	Bowl input at Duty Point-kW	Pl. furnish		
2.12	No. of Transmission bearings	Pl. furnish		
2.13	Total Transmission Losses- kW	Pl furnish		
2.14	Total Pump input at Duty Point-kW	Pl furnish		
2.15	Rated Speed of pump set- RPM	Pl furnish		
2.16	Max. Bowl input @ Rated Impel.	Pl furnish		
2.17	Reco. Drive motor rating- KW	As per BOQ		
2.17.1	Min. efficiency of motor	As per Relevent IS Standard		
2.18	Minimum submergence required-m 1. For Solo operation	Pl. furnish		
2.19	Shut off head-m	Minimum 20 % Above Duty point head.		
2.20	Shut Off power-KW	Pl. furnish		
2.21	Max. Length of each Column pipe & Line Shaft-	2.5		

2.22	Max. Pump torque for rated Impeller-Nm	Pl. furnish		
2.23	Prime Mover	Ele. Motor		
2.24	Prime mover torque-Nm	Pl. furnish		
2.25	Location	Indoor		
3.0	CONSTRUCTIONAL FEATURE			
3.1	No. of stage	Pl furnish		
3.2	Casing	Diffuser Bowl Type		
3.3	Impeller	Enclosed		
3.4	Impeller dia. in mm	Max. / Rated / Min.		
3.5	Shaft / Drive Transmission	Direct Coupled		
3.6	Shaft sealing	Mechanical seal		
3.7	Gland packing Type & Size	Mechanical seal		
3.8	Mounting Orientation	Vertical		
3.9	Discharge Head Position	Above Pump Floor		
3.10	Type of Line shaft Bearing	Thordon		
3.11	Type of Line shaft lubrication	Self		
3.12	Type of Thrust Bearing	Heavy duty anti friction		
3.13	Type of Thrust Bearing lubrication	Oil		
3.14	Column Pipe Size & thk -mm	Pl furnish		
3.15	Nozzle orientation & size-			
	Bell Mouth / Opening	Size in mm / Bottom		
	Discharge Flange	Size in mm / Side		
3.16	Type of Starter / location	Pl furnish		
3.17	Flange drilling	As per IS 1538, FF with off center bolt		
3.18	Direction of rotation	CCW/CW when viewed from driving end		
4.0	MATERIAL OF CONSTRUCTION			
4.1	Bell Mouth / Pump Bowl/ Suction Cover / Impeller Guide Piece (M)	Cast Steel WCB		
4.2	Impeller (M)	SS CF8M		
4.3	Pump Shaft (M)	AISI 410		
4.4	Line Shaft (M)	AISI 410		
4.5	Head Shaft (M)	AISI 410		
4.6	Shaft Sleeve (M)	AISI 410		
4.7	Shaft Coupling (M)	SS, AISI 410		
4.8	Casing Wearing Ring (M)	SS CA-15		
4.9	Impeller Wearing Ring (M)	SS CF8M		
4.10	Gland Packing	Mechanical Seal Above 30 KW		
4.11	Column Pipes	MS ERW-min. 7 mm thick		
4.12	Gland	Mechanical Seal		
4.13	Motor Stool	M.S. IS 2062		

4.14	Sole Plates	M.S. IS 2062		
4.15	Hardware in contact with liquid / Non-wetted	In Liq. Contact: SS 304		
4.16	Strainer	Round bars of 3 mm dia. Of SS 304		
4.17	Painting	Pl furnish		
5.0	ACCESSORIES & SERVICES REQUIRED			
5.1	Pin Bush Type Coupling	YES		
5.2	Set of foundation bolts & Nuts	YES		
5.3	Sole Plates	YES		
5.4	Nonstandard / special maintenance	YES		
6.0	WEIGHT			
6.1	Weight of pump unit-kg	Pl furnish		
6.2	Weight of motor-kg	Pl furnish		
6.3	Reco. Crane capacity-Ton	Pl furnish		
7.0	DRAWINGS			
7.1	ISO efficiency Performance curve	Pl furnish		
7.2	GAD Drg. of Pump set	Pl furnish		
7.3	C/S drg. of pump with part list	Pl furnish		
7.4	Catalogue of products	Pl furnish		
7.5	QAP of products	Pl furnish		
7.6	Speed Torque curve	Pl furnish		
8.0	TESTING			
8.1	Hydrostatic test	Witness		
8.2	Performance test	100 % qty Witness with job motor		
8.3	Dynamic balancing test	TC verification required		
8.4	Strip test	TC verification required		
8.5	Visual inspection check	Witness		
8.6	ND Test	Not Required		

Note: 01. Manufacturer / supplier shall submit separate data sheet for each duty.
02. For components (marked-M) material certificates shall be furnished
03. Bidder shall refer electrical specifications for motor requirement and shall offer accordingly.
04.It is compulsory to submit backup guarantee from manufacturer of approved make-offered, valid for whole contract period.

3.0 SLUICE VALVES / GATE VALVES/SCOUR VALVES (Wherever Applicable):

DESIGNFEATURES

- All the valves above or equal to the size of 300 mm nominal bore shall be gear operated.
- It is a general requirement that the valves in the pump house shall be Sluice / Gate / Butterfly Valves and shall be motorized are of Cast iron (DI) body construction valves in the field pipe lines shall be Sluice / Gate / Butterfly Valves and shall be manually operated (through a suitable gear box mechanism in case of valves above 300 mm NB) and are of Cast iron construction unless otherwise stated.
- The valves shall be free from sharp projections, which are likely to catch hold stringy materials.
- Valves shall close with clockwise rotation of the h wheel. The direction of closing opening shall be marked on the h wheel.
- The stuffing box gl shall be of one-piece design.

FEATURES OFCONSTRUCTION

- The pump house valves shall be preferably with a mechanical and electrical indication of valve position an indication of the valve percentage opening. The valves for the field pipeline shall be manually operated. The valves shall be provided with a valve position locking arrangement (mechanical type).
- Sluice / Gate Valves shall be provided with back seating arrangement.
- Renewable body wedge ring shall be provided.
- Valve shall be of double flanged type. Holes drilling flange thickness of valve flange mating companion flanges shall generally conform to the Standard IS 1538-1976.
- The valves shall be completely overhauled before placing in position.

Necessary joining materials viz. bolts, nuts, washers, packing etc. shall be provided by the contractor at his cost. The valves associated piping shall be fixed so as to have axis perfectly horizontal. The Valves associated piping shall be supported on RCC pedestals the associated piping shall be shall be secured with suitable clamping arrangement. For an easy access to the valves‟ manual operating wheel/ handle, necessary approach with operator’s sting space shall be provided for all the valves of the pump house of the field pipelines.

- If required the contractor shall also carry out drilling of holes of appropriate diameter in flanges in required numbers.
- A wheel shall be provided for emergency operation. The h wheel drive shall be mechanically independent.
- The valve design shall take care of the pressure drop across the valve disc in case of partial

opening of the valve shall take care of the erosion cavitation effect on the body disc during such operation.

- Valve(s) subjected to back pressure shall have the valve seat, disc the operator suitably designed to ensure trouble-free operation.
- Valve body shall be of Cast Iron (CI) material with flanged ends in pump house.
- 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 the shock load due to accidental closure of the valve disc.
- 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.
- Valve seats shall be of a design that permits removal replacement at site shall be securely clamped on the body or disc of the valve.
- Seat material shall be suitable for the operating conditions holing fluid may be suitably reinforced, if required.
- 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.
- The valve bearings shall be of 'self-lubricated' type shall not have any harmful effect due to handling fluid.
- Adjustable thrust bearing(s) shall be provided to hold the valve disc securely in the center of the valve seat.
- Operator (mechanical or electrical actuator) shall be used for opening, closing, controlling or holding the valve disc at the intermediate positions as when required. Operator sizing shall be done on the basis of the maximum torque requirement of the valve for seating/ unseating/ controlling/ holding the disc at the intermediate positions the time required for valve operation.
- Irrespective of whether the valve is operated by a power actuator or not, each Sluice Valve / Gate Valve shall be provided with a wheel for manual operation. The h wheel associated gearing arrangement shall be designed to limit the maximum manual effort to around twenty (20) kg for valve operation. Valves located at inaccessible position, shall be provided with extension spindle floor st or h lever/ round chain to facilitate manual operation.
- Valve to be operated through gearing arrangements / or by power actuator, shall be provided with adjustable mechanical stop limiting device to prevent over travel of the valve disc in „open‟ or „closed‟ position.

REQUIREMENT FORVALVES

The valves shall satisfy the following requirements.

Size	: As per Data-sheet
Body test pressure	: As per Data-sheet
Seat pressure	: As per Data-sheet

MATERIAL OF CONSTRUCTION (MOC)

Body (Pump House)	: Cast Iron -CI
Body (Field Valves)	: Cast Iron -CI
Spindle	: Stainless steel SS410.
Operation (Pump House Valves)	: Motorized controlling operation through Electric Actuator (only ON / OFF operation is not acceptable)
Operation (Field Pipeline Valves)	: Manual operation through a suitable gear box
Application	: Raw Water

Material test certificate shall be furnished.

INSPECTION PERFORMANCETESTS

- Manufacturer shall conduct all tests stage inspections required to ensure that the equipment offered by him conform to the specification requirement.
- Test certificates for all shop tests shall be furnished to Engineer-In-Charge for approval.
- The Engineer-In-Charge or his Representative shall witness the tests.
- The Contractor shall arrange for inspection of valves at manufacturer's premises shall arrange for testing of valves for body test pressure seat test pressure of all the valves to be supplied in presence of Engineer-In-Charge in line with the approved Quality Assurance Plan.
- Defects noted during inspection, test operation of valves shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-In-Charge.

TESTS FORVALVE

(a) MATERIALTEST

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

(b) NON-DESTRUCTIVETEST

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

(c) HYDROSTATICTEST

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

(d) PERFORMANCETEST

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

(e) TESTS ATSITE

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

CLEANING

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

PAINTING

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

TECHNICALPARTICULARS

a.	Applicable Standard	:	IS - 14846-2000 / API 600/603/ BS1414
b.	Application	:	Raw Water
c.	Liquid data	:	Specific Gravity 1.0kg
d.	Type	:	Double flanged
e.	Hand wheel	:	Required for operation
f.	Bolts and nuts	:	Carbon steel
g.	Body test pressure	:	As per Data Sheet
h.	Seat test pressure	:	As per Data Sheet
i.	Connection	:	To be provided on pipeline in between pump Discharge the common header
j.	Flange thickness and holes	:	As per IS: 1538(latest)

H WHEEL

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

TESTS INSPECTION

- All valves shall hydrostatically tested by the manufacturer before dispatch. The pressure shall be obtained without any significant hydraulic shock. Testing shall be carried on before application of paint or other similar treatment unless otherwise agreed between the

purchasers the manufacturer. There shall be no air entrapped within the part of the valves subjected to test pressure.

- Valve shall be offered by vendor for visual inspection before shipment. Valves shall be tested as per the relevant Standard.
- The hydrostatic testing shall be witnessed by the purchaser or his representative / TPI.

MATERIAL OFCONSTRUCTION

- All sluice valves at the pump-house shall be of body Cast Iron, Spindle SS.
- All valves shall be supplied with matching companion flanges with necessary bolts, nuts gaskets.

NOMINALPRESSURES

- Valve shall be designated by nominal pressure (PN) defined as the maximum permissible working pressure (MPa) at 20 deg. C temperature as under:
- PN 0.25, PN 0.6, PN 1.0, PN 1.6 and PN 2.5

TEMPERATURERATINGS

All valves shall be suitable for continuous use at their PN designation within the temperature range of $-10\ ^{0}$ c to $65\ ^{0}$ c.

BODYENDS

Flanges shall be at right angles to the axis of the bore concentric with the bore. Flanges shall be drilled unless otherwise specified bolt holes shall be off centers.

BEARINGS

The bearings shall be suitable for the maximum loads imposed during service.

MATERIALS

This Standard is based on materials specified in IS unless otherwise agreed; the materials shall be of a grade equivalent to those given in IS or superior. Other material may be used as per agreement between the manufacturer the purchaser.

OPERATION

All valves shall be capable of operated at a differential pressure across the wedge. Worm gear or any other suitable type of operator can be used.

DIRECTION FOROPERATION

- Unless otherwise specified, manually operated valves shall be closed by turning h wheel in a clockwise direction when facing the hand wheel.
- All operating device 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 operating device shall be packed with grease for life time operation. Operating device

shall be totally enclosed weather proof for general application.

- Operating device shall be self-locking type. Valve shall be capable of being locked in at any intermediate positions.

The operating device h-wheels shall be marked „CLOSE" or „SHUT" to indicate the direction of closer. The operating device shall be provided with arrangement to indicate the valve position.

TEST CERTIFICATES:

The manufacturer shall issue a test certificate confirming that the valves have been tested in accordance with this Standard stating the actual pressures medium used in the test.

SUBJECT : DATA SHEET FOR CAST IRON SLUICE/ GATE/SCOUR VALVE

SR. NO.	PARTICULARS	DESCRIPTION	DATA TO FILL UP BY CONTRACTOR
1.0	Make	Pl. furnish detail	
2.0	Manufacturing Std.	IS : 14846 – 2000 or latest	
3.0	Size range and Qty.	As per BOQ	
4.0	Fluid / Specific gravity	Water / 1.0	
5.0	Pressure Rating	PN : 1.6	
6.0	Stem	Rising Spindle	
7.0	Ends	Flanged, FF as per IS-1538 having off center bolt	
8.0	Bonnet	Bolte	
9.0	Disc.	Solid	
10.0	Operation	Electric Actuator operated	
11.0	Seat- Body & Disc	Renewabl	
12.0	Direction of Closing	Clockwise (marked on HW)	
13.0	Repacking /Back Seat Bush	Required (above 300 mm size)	
14.0	Channel & Shoe Arrangement	Required (600mm & above)	
15.0	Gear Box arrangement	Required (350 mm & above)	
	Material Of Construction		
17.0	Body / bonnet /Disc	C.I IS 210 GR.FG 260	
18.0	Stem	SS, AISI – 304 (M)	
19.0	Body & Disc seat	SS, AISI – 304 (M)	
20.0	Stem nut & Stuff. Box	Bronze IS 318 GR LTB2	
21.0	Stuffing box & Gland	DI, GR 500/7	
22.0	Channel & Shoe lining	S.S. BS 970 Gr 304 S16	
23.0	Gland Packing	Greasy Jute Packing	
24.0	Bolts, studs & nuts	CS IS 1367 Class 4.6/4	
25.0	Hand wheel /Cap	CI	
26.0	Details applicable require for Electrically Operated Valve		

26.1	Actuator make / model	Pl. furnish detail	
26.2	Actuator Torque capacity / RPM	Pl. furnish detail	
26.3	Power supply	3 Phase, 415 V, AC, 50 Hz.	
26.4	Valve opening/closing	Vendor to specify	
27.0	Electric Actuator Requirements	Fwd. & reverse integral starter for local & remote mode & cable up to actuator motor with all accessories as per	
28.0	Body/Shell test	24 Kg /	Required
29.0	Seat test	16Kg /	Required

NOTE: 01. Manufacturer / supplier shall submit separate data sheet for each duty.
02. For components (marked-M) material certificates shall be furnished
03. Actuator of MOV shall be as per specifications of Elect. Actuator attached separately

4.0 DUAL PLATE CHECK VALVES (NON RETURN/REFLUX VALVES) (Wherever Applicable):

DESIGN REQUIREMENTS FOR DUEL PLATE CHECK VALVES (DPCV)

a) The design manufacture of the valves shall comply with all currently applicable statutes, regulations safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the contractor of this responsibility.

b) The non-return valves shall be of Dual Plate Check Valve (DPCV) type design. It shall be free from sharp projections.

c) The valves shall be designed for minimum head loss

d) The valves shall have flanged ends. Flange confirming to IS: 1538.

e) The valve shall be suitable for mounting on a horizontal pipeline flow direction shall be clearly embossed on the valve body.

f) Valves shall possess high speed closing characteristics be designed for minimum slam condition when closing.

g) 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.

h) 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.

i) Sealing shall be metal to metal. The disc shall be stable shall not vibrate under full or partial load conditions. The pressure designation of the valve shall be as per the Datasheet.

CLEANING

Prior to factory inspection, all manufacturing waste such as metal chips debris all other foreign

matter shall be removed from interior of valve. All mill scale, rust, oil, grease, chalk all other deleterious material shall be removed from the interior exterior surfaces.

PAINTING

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

TESTS INSPECTION

- Valves shall be manufactured tested as per the relevant Standard, i.e. as per API 594 / 598 (with PN rating as per Data Sheet), with its latest revisions.
- Valves shall be offered for visual inspection dimensional checks.
- The hydrostatic water tightness testing shall be witnessed by the purchaser Manufacturer/ contractor shall submit the manufacturing quality assurance plan of the valve to TPI get approval of Engineer-In-Charge before manufacturing.

MATERIAL OF CONSTRUCTION TECHNICAL PARTICULA

SR. NO.	DESCRIPTION	PARTICULARS
1	Standard	API 594 / 598
2	Size	As per Data-sheet
3	Working pressure	As per Data-sheet
4	Type	Duel Plate Check Valves (DPCV)
5	Ends	Flanged, with companion flanges, nut, bolt, Gaskets.
6	Other requirements	Liquid handled – Raw Water/Clear Water

SR. NO.	DESCRIPTION	PARTICULARS
7	Body	C.I IS 210 GR.FG 260
8	Bolts, studs and nuts	Carbon steel IS 1367 class 4.5
9	Body test	As per stard
10	Seat test	As per stard
11	Face to face dimension	As per stard
12	Companion flanges erection hardware	Required as per IS 1538 (table IV and VI)

SUBJECT: DATA SHEET FOR DUAL PLATE CHECK VALVE (NON RETURN/REFLUX VALVES)

SR. NO.	PARTICULARS	DETAILS	PARTICULARS
1.0	Make	Pl. furnish detail	
2.0	Standard	API 594	
3.0	Size in mm / Qty	As per BOQ	
4.0	Fluid	Water	
5.0	Sp Gravity	1.0	
6.0	Pressure Rating	PN 1.6 / Class 300	
7.0	Ends	Flanged, flanges as per IS-1538 Table IV & VI	
8.0	MATERIAL OF CONSTRUCTION		
8.1	Body	CS, ASTM A 216 Gr WCB (M)	
8.2	Plates	CS, ASTM A 216 Gr WCB (M)	
8.3	Body Seat	SS to BS 970 Gr 304 S16(M)	
8.4	Plate Seat / Face	SS to BS 970 Gr 304 S16(M)	
8.5	Hinge Pin / Stop pin	SS, AISI 410 (M)	
8.6	Springs	S.S AISI –304 (M)	
8.7	Bolts, studs & nuts	Carbon Steel IS :1367 Class 4.6 / 4 hot dipped galvanised	
9.0	ACCESSORIES		
9.1	Drain Plug	Not Require	
9.2	Lifting Eye Bolts	Require	
9.3	Support foot	Not Require	
9.4	By Pass Arrangement	Not Require	
10.0	DRAWINGS		
10.1	General outline	Pl. furnish detail	
10.2	C.S. drawing with parts	Pl. furnish detail	

10.3	QA plan	Pl. furnish detail	
11.0	TESTING		
11.1	Shell test	To be witnessed	24 Kg /
11.2	Seat test	To be witnessed	16 Kg /

M – Denotes material test certificate required

5.0 BUTTERFLYVALVES (Wherever Applicable):

Butterfly valves shall be with flanged ends and confirm with IS: 13095 / 1991 (or latest). It is a general requirement that the BFVs near Pump House shall be motorized and are of Cast Iron (CI) body BFVs on field pipe lines shall be manually operated (through a suitable gear box mechanism) and are of Cast iron construction unless otherwise stated. Fabricated valve shall not be allowed paid.

SCOPE OFWORK

This Standard cover double flanged Cast iron valves for general purpose. Valves covered under this Standard are manually or electrically operated. It covers valves of nominal pressure designations up to including 2.5 MP with ends flanged in accordance with appropriate table (IV and VI) of IS 1538 (latest). Mating / companion flanges shall also be drilled having thickness as per IS 1538.

REFERENCE

The Indian Standard are necessary adjuncts to this Standard.

TERMINOLOGY DEFINITION

Terminology definition covered in IS: 13095 are generally applicable.

VALVE - ENDCONNECTION

Double flanged valve

A valve having flanged ends for connection to pipe flanges by individual bolting.

SERVICEAPPLICATION

(a) Valves shall be suitable for one or more of the following applications.

(i) Tight shut off - A valve having no visible leakage on the disc in closed position under test conditions.

(ii) Regulating - A valve intended for regulating purpose which may have a clearance between the disc the body in close position.

(iii) Low leakage - A valve which has specified maximum leakage rate on the disc in the closed position.

(b) Vacuum Condition

Where valves are to be used under vacuum conditions, the detailed design provision shall be mutually agreed between the purchaser the manufacturer.

NOMINALPRESSURE

Valve shall be designated by nominal pressure (PN) defined as the maximum permissible working pressure (MPa) at 20 ^{0} C temperatures as follows:

PN 0.25, PN0.6, PN1.0, PN 1.6, PN 2.0 and PN 2.5

PRESSURE / TEMPERATURE RATING

Maximum permissible gauge working pressure operating temperatures shall be in accordance with Standard IS: 13159 (Part I): 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.

BODYENDS

a) Double Flanged Body Ends

Valve shall be of double flanged type. Holes drilling flange thickness of valve flange mating companion flanges shall conform to the Standard IS 1538- 1976. Flanges as per any other specific requirements of the purchaser may also be given as agreed to between the manufacturer the purchaser or as per IS: 13159 (part I): 1991.Flanges shall be at right angles to the axis of the bore concentric with the bore. Flanges shall be drilled unless otherwise specified bolt holes shall be off centers. Tapped by the design of the valve

b) Wafer Body ends (where ever applicable)

i. Body ends shall be capable of being fitted between the pipe flanges complying with the requirements of flange drilling.

ii. The joint faces shall be at right angles to the axis of the bore concentric with the bore.

iii. Holes may be provided, where required by the design, for the passage of the bolts securing the flanges 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.

FACE TO FACEDIMENSIONS

Face to face dimensions of double flanged wafer types of valve shall be as per Standard. Face to face dimensions are 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 Including	
0	250	±2
250	500	±3
500	800	±4
800	1,000	±5
1,000	2,400	±6

BODIES

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

DISC SHAFT

The disc 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 or in two pieces separately attached to the disc. Any means of attachment between the shaft the disc shall be such as to preclude components becoming loose in service.

SEATING LININGS

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

BEARINGS

The bearings shall be suitable for the maximum loads imposed by the shaft during testing in service for valves DN 350 above, a bearing shall be provided to take the axial thrust; spring retaining clips (cir-clips) shall not be used as thrust bearing suitable sealing shall be provided for the shaft where it passes outside the pressure containing en closer.

MATERIALS

This Standard is based on materials specified in relevant IS. The materials shall be of a grade equivalent to those given in datasheet or superior.

OPERATION

a) Manual Operation

All valves shall be capable of operated at a differential pressure across the disc as marked on the valve. Lever, worm-gear/ traveling nut type or any other suitable type of operator can be used.

Direction for Operation

- Unless otherwise, specified manually operated valves shall be closed by turning h wheel or lever in a clockwise direction when facing the h 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 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 position.

  The operating h-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.

TESTING

All valves shall hydrostatically tested by the manufacturer before dispatch as directed by Engineer-In-Charge. The pressure shall be obtained without any significant

Hydraulic shock. Testing shall be carried on before application of paint or other similar treatment. There shall be no air entrapped within the part of the valves subjected to test pressure.

a) Performance Testing

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

b) 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 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.

c) <u>Seat Test</u>

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 manufacturer the purchaser to avoid the possibility of damage under the condition of the test.

NOMINAL DIA MM	MINIMUM TEST DURATIOIN IN MINUTES	
	BODY TEST	SEAT TEST WHEN APPLICABLE
Up to 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 2000	5.00	3.00

d) 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 past the valve disc during test valves shall be drop tight. Seat test shall be carried out in both the direction of valve if agreed between the manufacturer the purchaser. The seat pressure applied on upstream side shall be equivalent to 1.1 times the maximum permissible working pressure at 20 ^{0} c shall be applied with water.

e) For regulating type valves seat test shall not be applicable.

f) Disc Strength Test

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 table-3. 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 structural integrity of disc body. Any leakage past the seat shall not be the

criteria for rejection of the valve (Sampling test sample as per IS 2500).

g) Maximum permissible leakage shall be as given in Table in Para6.17.

TESTCERTIFICATES

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

VALVE TYPE	LEAKAGE RATE
Tight shut-of	No visible leakage for duration of test
Low leakage	0.1 mm^2 /s X DN (sec 5)
Regulating	Not specified (outside the scope of this Standard)

INSPECTION

The Engineer-In-Charge or his authorized 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 IS at factory.

WITNESSING OFTESTS

The contractor should witness the tests.

MARKING

Marking shall be cast integral on the body or on a plate securely attached to the body. The markings shall be in accordance with IS: 9866 -1981.

PREPARTION FORDISPATCH

(c) Valve shall be complete in all respect when dispatched. Each valve shall be drained, cleaned, prepared suitable protected with 2 coats of red oxide on un-machined surfaces rust preventive coats on machined flanged surfaces for dispatch in such a way as to minimize the possibility of damage deterioration during transit storage. Painting other than specified on the finished valve shall be as per the agreement between the manufacturers the purchaser.

(d) Disc shall be unseated when dispatched, but care shall be taken to ensure that there is no risk of damage to the disc.

(e) When specified, the body ends shall be suitably sealed to exclude foreign matter during transit storage.

(f) Components shipped unattached shall be adequately protected identified to permit correct

field assembly.

FIXING OFVALVES

- Loading at store unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. The arrangement of housing the valves shall be with chambers stable firm foundations. The chamber top roof cover with removable lid shall be provided so that it shall be possible to remove or replace or recondition the valves seats to remove the parts without removing the valves from the pipe work. For this suitable flange adapters may be provided.
- Valves used on pipeline shall be straight through type non checkable. Each valve or its operation equipment shall bear an approved name plate stating its function. All operation spindles, gears head stocks shall be provided with adequate points for lubrication.

BYPASS ARRANGEMENT (Wherever Applicable):

Each Butterfly Valve shall be provided with by-pass arrangement of Sluice Valve.

DOCUMENT: TECHNICAL DATA SHEET FOR CI BUTTERFLY VALVE.

SR. NO.	PARTICULARS	DETAILS	DATA TO BE FILLED BY THE
1.0	CONSTRUCTIONAL FEATURES		
1.1	Make	Pl. furnish detail	
1.2	Standard	IS 13095 or BS EN 593	
1.3	Size in mm/Qty	As per BOQ	
1.4	Location	Indoor/Outdoor	
1.5	Fluid	RAW Water /Treated Water	
1.6	Sp Gravity	1.0	
1.7	Pressure Rating	PN1.6	
1.8	Ends	Flanged, flanges as per IS-1538 Table IV & VI	
1.9	Disc.	Duo eccentric	
1.9.1	Eccentricity-1 in mm	Pl. furnish detail	
1.9.2	Eccentricity-2 in mm	Pl. furnish detail	
1.10	Operation	Gear Box arrangement	
1.11	Other requirements	Valves shall be with HW	
2.0	MATERIAL OF CONSTRUCTION		
2.1	Body	C.I IS 210 GR.FG 260	
2.2	Disc	C.I IS 210 GR.FG 260	
2.3	Stem	S.S. AISI – 410 (M)	
2.4	Body seat	S.S. AISI – 410 (M)	
2.5	Disc seal	EPDM Rubber	
2.6	Clamping ring	S.S AISI –304	
2.7	Bolts, studs & nuts	CS, IS :1367 Class 4.6 / 4 hot dipped galvanised	

3.0	ACCESSORIES		
3.1	Gear Box	Required (150 mm above)	
3.2	By-Pass Arrangement	Not Required (600 mm above)	Not
3.3	Support foot	Required (900 mm above)	
4.0	DRAWINGS		
4.1	General outline	Pl. furnish detail	
4.2	C.S. drawing with parts	Pl. furnish detail	
4.3	QA plan	Pl. furnish detail	
5.0	TESTING		
5.1	Shell test	To be witnessed	24 Kg /
5.2	Seat test	To be witnessed	16 Kg /

M – Denotes material test certificate required
Actuator of MOV shall be as per specifications of Elect. Actuator attached separately

6.0 EXPANSION BELLOW (Wherever Applicable):

GENERAL

SS Expansion joint shall be a metallic flexible connector fabricated of plies of metal to provide stress relief in piping systems due to thermal, mechanical other movements. It provides flexibility concurrent movements.

a) Compensate, Lateral, Axial, and Torsion Angular movements.
b) Low movement forces
c) Reduced fatigue factor
d) Reduced heat loss

OPERATINGPRINCIPLES

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

e) To protect piping by absorbing any difference in dimension due to temperature variation or line movement.
f) It shall be protect equipment such as supports and anchors, pumps and valves etc., other equipment.
g) It shall be useful for simple connection of misaligned pipes.
h) Movement Accommodation:

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

TESTING

An SS Expansion joint is assessed on every vital performance criterion:-

a. UTS

b. Radio graphic test

c. Liquid Penetration test

d. Deflection

e. Heat build-up

f. Life Cycle Test with load

g. Vacuum test

h. Hydraulic test

i. Stiffness test

j. Vibration test.

DESIGN

SS Expansion Joint by the user should be based on the following points.

MECHANICAL DATA

i) 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 and IS: 6392 Table 23 for PN 2.5 may be done for these M. S. flanges of the expansion bellows.

j) All Bellows shall be hydro tested, by our internal inspection department at 24 kg/sq.cm pressure For PN 1.6 and 37.5 kg/sq.cm for PN 2.5.

k) M.O.C. of Bellows element liner shall be SA 240 TP304.

l) M.O.C. of Tie Rods and Nuts shall be IS1367.

m) M.O.C. of Weld ends and Lugs shall be IS2062.

Piping Stress Analysis for the piping system where the Expansion Joint is to be fitted can be provided by the contractor on specified data.

ACCESSORIES INSTALLATION

a) ACCESSORIES

i) CONTROLUNITS

The Control Unit assembly, consisting of two or more control rods and 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 limits the extension 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 destructive movements can effectively be encountered by using control units.

ii) PROTECTIVE SHIELDS /COVER

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 and protects the SS Expansion Joint from fire during a flash fire.

iii) INTERNALSLEEVES

A device which minimizes contact between the inner surface of the bellow and the liquid flowing it, so as to protect the inner surface from corrosion to ensure that no foreign materials remain on the corrugation.

iv) COMPANSION/ COUNTERFLANGES

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.

b) INSTALLATION OFACCESSORIES

i) INSTALLATION

- 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 and belting anchor points should be selected particularly where change in direction of piping elbows are near to the pump etc.

ii) ANCHORINGPOINTS

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.

iii) BUCKLING

- 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 correct installation. Transport
- Expansion Joints to area of installation in packed condition. Flange face of companion flanges in pipeline should be smooth 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 flanges have been

complete anchors supports have been established. This is to avoid any accidental damage due to welding splatter or sharp objects 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.

DOCUMENT: TECHNICAL DATA SHEET FOR METALLIC EXPANSION BELLOWS

SR. NO.	PARTICULARS	DESCRIPTION	BLANK DATA TO BE FILLED BY BIDDER
1.0	LIQUID DATA		
1.1	Fluid / Specific gravity	RAW Water/Treated Water	
1.2	Temperature	ambient	
2.0	EXPANSION BELLOWS DATA		
2.1	Make	Pl. furnish	
2.2	Manufacturing Standard	EJMA / ASME	
2.3	Size range and quantity	As per SOQ	
2.4	Overall length in mm	As per SOQ	
2.5	Pressure Rating	PN : 1.6	
2.6	Axial expansion in mm	5	
2.7	Axial compression in mm	15	
2.8	Mode of installation	Horizontal	
2.9	Ends	Flanged, FF as per IS-1538 having off center	
2.10	No of Convolution	Pl. furnish	
2.11	Thickness of Weld End	Pl. furnish	
2.12	Thickness of internal sleeve	Pl. furnish	
2.13	Qty. & Position of Rods	Min. 3 nos @ 120 Deg. interval	
3.0	MATERIAL OF CONSTRUCTION		
3.1	Bellows (M	SS 304	
3.2	Internal Sleeves (M	SS	
3.3	Flanges (M	CI / MS	
3.4	Lugs	CI / MS	
3.5	Rods	IS 1367 VI 1994 Cl 4.6	
3.6	Hardware	C.S IS 1367	
4.0	TESTING		
4.1	Hydrostatic Test pressure	24 kg / sq.cm	

M- Denotes material test required

7.0 ELECTRICALLY OPERATED TRAVELLING CRANE (EOT) HOIST (Wherever Applicable):

CRANE and HOIST

(a) GENERAL DESIGNREQUIREMENTS

- All mechanical equipment shall be simple robust design, easy for erection, inspection, adjustment painting dismantling. Fastenings shall be to hold the parts in place under all specification conditions of service. Steel castings, steel forged wrought steel wheels sheaves shall be anchored properly. All shaft loads shall be transmitted through suitable keys, splices or pins not by press. Wherever practicable, machinery shall be mounted on self-supporting steel frames or bedplates or on structural steel supports. All working parts shall be accessible for servicing. The crane travel shall be by hoist shall be motor driven. The capacity of lift as per design of pumping station.
- The crane shall be guaranteed by the manufacturer of accepted modern design free from inherent design in either workmanship or materials; to safely fully hold its rated load without any deflection in its structure or mechanism. All material shall be the best of their kinds. Any part proved defective within one year from date of erection testing at site shall be replaced free of charge by supplier.

(b) CRANE STRUCTURE

- The crane structure shall conform to IS: 807 latest edition shall be designed to withstand stresses arising from simultaneous travel of the rated load of the crane along the bridge the travel along the track to withstand the effect any Possible combination of forces due to the loads, live loads, local bending, inertia force, earthquake in the area as specified, with adequate factor of safety. The bridge structure of the crane shall be of single girder construction to safely carry full rated load of the crane without undue vertical or lateral deflection or vibration. Girder shall be connected to the top side of each truck in such a manner that skewing will be prevented. The trolley supporting rails shall be laid on top of bridge steel rail stops shall be provided at end of the bridge. Trolley stops should be spring type to reduce shock impact on the structure. All joints in the tension zone of the girder shall be radio graphically tested test certificate furnished for approval before dispatch of the crane.
- Each bridge end truck (crane has two end trucks) shall consist of two channels connected to from a ring box section. Trucks shall be so designed that the loading is equally distributed to each channel.

(c) TROLLEY

Trolley shall consist of a welded frame of structural steel sections adequately braced to resist vertical, lateral torsion strains, properly machined to receive the hoisting drums, wheels, axles etc. All the mechanical equipment shall be mounted on machined pads. These pads shall be permanently welded to the supporting structures after final alignments. Trolley frame shall be provided with safety stops, jacking pads, equipment covers railing as required. The trolley wheel bearings shall have heavy-duty roller bearings antifriction type.

Wherever bearing caps are provided they shall be provided with fittings for adequate lubrication. On the bottom of the trolley frame, on each side, a double end spring bumper shall be provided to engage stops at each end of the bridge.

(d) WHEEL AXLES

- Wheel axles shall be stationary type made from steel ground to size to receive the inner race of the roller bearings. Axles shall be prevented from turning or working endwise by means of a key plate fitting into a milled slot in the end of the axle bolted to the end trucks. Wheels shall generally conform to IS: 3177. Wheel shall be double flanged type for end trucks. They shall be accurately machined to suit the rail on which they are to operate. Axles and shafts shall be made of high strength low alloy steel.
- All bearings shall be of antifriction type of adequate capacity. Due allowance shall be made for impact side thrusts. Truck trolley wheels shall be provided with roller bearings. Other bearings may be ball bearings. Bearings shall be made of steel.
- All gears shall conform to relevant Indian Standard also to IS: 3177 straight spur helical gears shall normally be used for all motions. Gear boxes shall generally conform to IS: 3177. Gear shall be cut from forged steel blanks.
- Adequate provision shall be made for proper lubrication of all gears, bearings pulley. Bearings shall be designed for grease lubrication of all gears, bearings pulley. Bearings shall be designed for gear lubrication by grease gun.
- Each trolley shall move over the inside of the bottom flange of the I-beam. The gear pulley assembly should be so located that there is no fouling with the bridge drive pulley shaft. The trolley shall be spur gear type.

(e) RUN WAY RAILS

The contractor along with the crane shall furnish suitable runway rails of adequate size. The erection of runway rails is also included in Contractor's scope. The runway lengths of the rails will be as indicated in the Technical Data Sheets. However, these lengths are tentative only the actual length of rails will be determined at a later date depending on the final dimensions of the building. Bridge stops will be provided at each end of the rails. The contractor shall provide all clamps fittings necessary for fixing the rails.

(f) LADDERS

The contractor shall be provided with necessary access from operating floor to gantry girder level.

ELECTRICALLY OPERATEDHOIST

a) DESIGNREQUIREMENTS

- Electric hoists shall be complete with hoisting motor, wire rope drum, wire rope, hook necessary gearing, sheaves electromagnetic brakes for hoisting. Weather dust- proof push button station, connector panel creep speed arrangement all wiring,
- Flexible trailing cable, limit switches, travel stops, ear-thing terminals other accessories to meet the full requirements of the Engineer-In-Charge. The Engineer- In-Charge will provide electric supply at one point in pump house.
- The hoist will be required to operate in the local climatic conditions. All the parts of the hoist trolley shall be designed to withstand such atmospheric conditions without any deterioration.

b) FEATURES OFCONSTRUCTION

All though, this is an EOT crane, there shall be an optional provision of manually operating through a chain drive, from the pump-house floor. The hoist shall have the following requirements:

i) DRUMS

Rope drums shall be MS seamless type, as per ASTM 106, Gr. B made out of tested quality of plates. Drums shall be machine grooved right left with grooves of a proper shape for the rope used. Grooving shall be of proper length to held all rope needed to make the required lift plus the two dead laps at each anchor point, without overlapping. Drum shall be flanged at both the ends. Flanges shall project above the rope by a distance not less than two-rope diameter.

ii) SHEAVES

Rope sheaves shall be rolled steel. Grooves shall be machined to the proper shape for the rope used. Sheaves shall be equipped with anti-friction type bearings. Sheaves shall be fully guarded so that the rope cannot come off.

iii) GEARS

Gears shall be from solid forged steel blanks or shall be of stress-relieved welded steel construction or built-up from steel billets welded together to form a one- piece gear section.

iv) BEARINGS

All anti-friction bearings are to be of Standard make and interchangeable with corresponding other Standard sizes of the bearings. Bearings shall have a minimum life expectancy of 40,000 hours may be ball, roller, or removable bronze-bushing type except that motor bearings shall be of the ball or roller type.

v) ROTATING STATIONARY SHAFTS

Shafts axles shall have ample strength rigidity adequate bearing surfaces for their duties.

vi) LUBRICATION

A centralized grease lubrication unit with h operated grease pump shall be provided for anti-friction bearings.

vii) HOISTROPE

Hoist ropes shall be extra flexible, improved plough steel rope with a well lubricated hemp core having six strs of 37 wires per str with an ultimate tensile strength of 160/175 kg/sq. mm. The rope shall be fastened to the drum with an attachment having strength equal to that of the rope. The rope shall be of sufficient length so that two full laps shall remain on the drum at the extreme low position of the hook. Reverse bends or cross bends are to be avoided. The breaking loads for the hoist ropes shall not be less than six times the calculated load in the ropes at the drum, based on rated load on hooks, plus the weight of the bottom block, plus the weight of rope. Wire slings with U-blots (2 nos.) shall be supplied with the hoist hook.

viii) HOOKS

Hooks shall be solid, forged, heat treated alloy steel of rugged construction of the single hook type provided with a Standard depress type safety latch. They shall have swivels operate on ball or roller thrust bearings with hardened races. Lock to prevent hooks from swiveling shall be furnished.

ix) BRAKES

Hoisting motors shall be equipped with electrically released, spring set, friction, shoe type brakes having torque capable of holding 125% of the full rated hook load. Brakes shall apply when either the motor controller or the main power switch is in "OFF" position, or in the event of power failure. Breaker should be equally effective in both the direction of rotation.

ELECTRICALREQUIREMENTS

- Drive motor shall be as per IS: 325 companion specification enclosed. Motor shall be designed for frequent reversal, braking acceleration. Pullout torque shall be 2.15 times the rated torque. Pendant control switch, controller's resistors, controls, electrical protective devices, cables conductors, earthling guards etc. shall be as per IS: 3938. Limit switches shall be provided for over-hoisting over- lowering of two extreme ends of trolley travel.
- Control gear such as switch fuse, contactors, and relays shall be mounted in separate wall mounted panel in pump house.

PENDANTCONTROL

Pendant controls shall be provided with the pendant, which can be operated from a convenient position on the operating floor. The control push buttons shall be of spring returning type shall be of reputed make subject to owner's approval. The pedant switch box shall be capable of withstand rough hling. The mass of the pendant shall be supported independently of the electric cable by means of chain or wire rope the pendant shall be effectively earthed.

TESTING INSPECTION AT MANUFACTURER'SWORKS

- The manufacturer shall conduct in presence of Engineer-In-Charge all tests required to ensure that the equipment furnished shall conform to the requirements of the specification in compliance with the requirements of the applicable codes.
- Hook shall be tested in line with IS: 1875. Besides chemical mechanical tests, proof load test (at 125 % rated load) deflection test shall be conducted. Suitable NDE (e.g. UT DPT) shall be carried out before after loads test.
- Welds shall be subjected to suitable NDE e.g. RT/UT or DPE/MPE.
- Prior to dispatch, the crane shall be assembled subjected to check for deflecting span, load, alignment, no load full load and overload tests.

TESTS ATSITE

- After assembly erection at site, the crane shall be subjected to commissioning tests as laid down in the Indian Standard IS: 3177 IS: 3832 including deflection overload test.
- Thecontractor′sauthorizedrepresentativeatsiteshallsubmitthereportsonthetests to client. The contractor shall furnish all test gadgets instrument necessary for conducting tests at site.

PERFORMANCEGUARANTEE

The equipment shall guarantee to meet the performance requirements by the specification rectification shall be carried out until satisfactory results are obtained before clearance for dispatch to site.

ACCEPTANCE

After erection crane, the owner will test all crane operation controls to determine that crane performance is satisfactory. Acceptance can take only if crane perform to the entire satisfaction of Engineer-In-Charge. The supplier shall depute to site his engineer to

supervise the installation instruct the owner in operation maintenance.

TECHNICAL DATA TO BE SUBMITTED WITHPROPOSAL

Following technical information shall be furnished with the proposal.

- General arrangement drawings of the HOT crane with EOH showing overall dimensions clearance required.
- A write up on the crane controls along with the drawing indicating power control schemes.
- Calculations supporting motor horsepower selection for hoisting cross travel long travel motions.
- Calculation for selecting rope size, no. of falls F.O.S. (Factor of Safety)
- Calculation for selection of brake along with manufacturers brake selection charts/catalogues.
- List of vendors for bought out items.
- Details of manufacturing test facilities as available with the manufacturer.
- Experience list about the supply of similar cranes.

TECHNICALPARTICULARS

1	Location	:	Pump house/Intakewell
2	Crane rail support	:	R.C.C.brackets

[A] ELECTRICALLY OPERATED TRAVELLING (EOT) CRANE

3	Quantity	:	As per BOQ
4	Span	:	As per Pump house size
5	Run way length	:	As per Pump house size
6	Operating floor	:	Pump house floor level
7	Test load	:	125% of rated load of pumps, motor accessories.

[B] TRAVELLINGTROLLEY

8	Trolley type	:	Spur gear type
9	Wheels	:	Rim toughened, heat

10	Shaft	:	High strength low alloy Steel
11	Gears	:	From steel blanks
12	Frame	:	Rolled steel
13	Load chain	:	Alloy steel

ELECTRICALLY OPERATED HOIST

14	Type of hoist	:	Spur geared, electrically Operated
15	Capacity	:	As per Data Sheet
16	Lift	:	As per Data Sheet
17	Hoist drive	:	Electric motor
18	Gearing	:	Totally enclosed
19	Break	:	Electrically released spring set or friction disc type
20	Drum	:	Steel plates
21	Sheaves	:	Rolled steel
22	Bearing	:	Anti-friction roller bearing
23	Wire rope	:	6 Strs - 7 wires
24	Motor	:	Variable speed motor.
25	Control	:	Pendant
26	Creep speed control	:	As per requirement
27	Hook Approach	:	0.5 Mtr.
28	Lifting speed	:	As per requirement
29	Ladder	:	Required for servicing Crane and hoist

DOCUMENT: DATA SHEET OF ELECTRICALLY OPERATED TRAVELING CRAN/HOIST

SR. NO.	PARTICULAR	DESCRIPTION	BLANK DATA TO BE
1.0	REQUIREMENT DATA		
1.1	Item	E.O.T. Crane with Electrical Hoist	
1.2	Location	Indoor in Pump House/Intakewell	

1.3	Quantity	as per price bid	
1.4	Capacity in TON	as per price bid	
1.5	IS Standard	IS - 807 & 3177	
2.0	CRANE DATA		
2.1	Make	Pl. furnish detail	
2.2	Model	Pl. Furnish detail	
2.3	Type	Single / Double Girder	
2.4	Class of Hoist	Medium Duty Cl – II as per IS 3177 with latest amendments	
2.5	Lift in m.*	as per site requirement	
2.6	Span in m*	as per site requirement	
2.7	Bay length in m.*	as per site requirement	
2.8	No. of Falls	Pl. Furnish	
2.9	Travel speed in mtr./min. • Longitudinal • Cross	Pl. Furnish detail	
2.10	Main Hoist speed-	Pl. Furnish	
2.11	Creep speed in m./min.	Pl. Furnish detail	
2.12	Fixed Girder Required	Pl. Furnish detail	
2.13	Type of Suspension	Hook	
2.14	Track	Pl. Furnish detail	
2.15	Brakes	Electromagnetic type	
2.16	Method of Operation	Pendant Push Button	
3.0	CONSTRUCTIONAL FEATURE		
3.1	End Carriage	Pl. Furnish detail	
3.2	Bridge	Box Type/Standard I beam Type	
3.3	End Stopper	Steel End Stopper on either side of the bridge.	
3.3.1	Wheel Base	Pl. Furnish detail	
3.4	Gear	Made of EN 24 / EN 9 - precision machined, teeth cutting by hobbing machine & duly hardened.	
3.5	Wire Rope	Pl. Furnish detail	
3.6	Hook	Forged steel single shank type – confirming to IS 15560 with thrust brgs., latch & anti-locking	
3.7	Rope Drum & Sheaves	MS Drum with grooving as per IS 3938	
3.8	Wheels	Made of Forged Steel confirming to IS 2707 GR- II duty/Steel cast EN – 9,	
SR. NO	PARTICULAR	DESCRIPTION	BLANK DATA TO BE FILLED
3.9	Shaft	High Tensile Steel	

3.10	Trolley	MS Frame with wheels of Forged steel / EN – 9	
3.12	Bearings	All moving parts be supported on SKF/FAG anti fric.Ball/Roller brgs.	
3.13	Maintenance Platform/ access walkway	Maintenance basket type Platform for One man seat Required	
3.14	Painting	Required. Furnish detail.	
4.0	ELECTRICAL DETAILS		
4.1	Supply Condition	415 V +/- 10 % variation 50 Hz +/- 5 % variation +/- 10 % Combined variation	
4.2	Motor Standard	IS	
4.3	Control Voltage	110 V	
4.4	Class of Insulation / Drg. of	F / IP 55	
4.5	Temperature	Ambient- 50 Drg. C	
4.6	Make	As per Tender specs.	
4.7	Type of Motor	Hoist	
4.8	Main Hoisting	Pl. Furnish detail	
4.9	L.T.	Pl. Furnish detail	
4.10	C.T.	Pl. Furnish detail	
4.11	Method of starting	Pl. Furnish detail	
4.12	Type of cooling	Pl. Furnish detail	
4.13	Total Connected Load-	Pl. Furnish detail	
5.0	ACCESSORIES & SERVICES REQUIRED		
5.1	Mech. Stopper for LT	YES	
5.2	Pendant with hanging	YES	
5.3	Limit Switches for • over hoisting • over lowering • over cross travel • over long travel	YES	
5.4	Trailing cable system	YES	
5.5	Control Panel	YES	
5.6	Isolation Switch for ele. Power	YES	
6.0	WEIGHT		
6.1	Weight of Hoist in kg	Please furnish	
6.2	Weight of Bridge in kg	Please furnish	
7.1	GA & Dimensional drg. of	Pl furnish	
7.2	Data as required by IS 3177-77, Appendix-B, clause 2.2	Pl furnish (In Separate Sheet)	

7.3	Complete Electrical circuit Diagram	PI furnish	
7.4	Catalogue of products	PI furnish	
7.5	QAP of products	PI furnish	
8.0	TESTING		
8.1	Visual inspection and Dimensional Check	Witnessing	
8.2	Performance test	Witnessing	
8.3	Overload test at 125% load	Witnessing	
8.4	Deflection Test	Witnessing	
8.4	Material Test certificates	Required	

Note: 01. Manufacturer / supplier shall submit separate data sheet for each duty.
02. For components (marked-M) material certificates shall be furnished
03.(*) Contractor shall visit the site and obtain the data about span, lift, bay length, etc suitable for existing pump house and shall furnish in data sheet

8.0 PIPES SPECIALS (Wherever Applicable):

GENERAL

- The scope of work is to manufacture and supply pipes, which shall be in conformity with IS: 3589 – 2000 (latest) and 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) 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 total thickness of external 3 LPE coating shall be 3.7 mm on body of pipe 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 coved with suitable protectors such that the pipe ends does not get damaged during transportation, loading unloading work. Also, varnishing will be carried out at the inside out side 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 field joint coating. The spiders on both ends of the pipe shall be of adequate size stiffness to keep the pipe in circularity during handling 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 vender shall avoid the welding of the spider pipe with the main pipe 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 and suitable Epoxy Paint (Total DFT 200 microns). All the piping work out side of the Pump House including the pump discharge piping discharge header shall be externally coated with 3 LPE coating of 3.7 mm DFT on body of pipe 3.3 mm on weld joint.
- The pipes shall be of uniform bore 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 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 fittings shall be drilled with the help of drilling jig. The blank flanges are to be machined drilled.
- All nuts bolts used for jointing the pipes fittings shall be of cast steel or hot dipped galvanized.
- The approximate quantity for the pipe fittings shall be furnished in schedule of quantity.
- The quantity of pipes is for tender purpose only. So during ordering of pipes and fittings, Contractor has to measure the actual quantities required as per execution of the site and 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 and 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 Die Penetrating Testing to ensure the soundness of the weld joints. After installing the Reducers at site, selected portion Radiographic Testing of site weld joint shall be carried out after Weld Visual Inspection.

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

9.0 INSTALLATION, TESTING COMMISSIONING

ERECTION –GENERAL

- The Contractors staff shall include adequate competent erection engineers with proven, suitable, previous experience on similar contracts to supervise the erection of the Works sufficient skilled, semi-skilled unskilled labor to ensure completion of Works in time. The Contractor shall not remove any representative, erector or skilled labor from the Site without prior approval of the Engineer's Representative.
- The Contractor shall ensure that no installation or erection work shall commence until full unconditionally approved working drawings, signed stamped by the Employer are available at Site.
- The contractor's erection staff shall arrive on the Site on dates to be agreed by the Engineer-In-Charge. 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.
- One erection engineer who shall be required to be the contractor's representative shall be conversant with the erection commissioning of the complete Works. Should there be more than one erector, one shall be in charge the Contractor shall inform the Engineer-In-Charge or his representative in writing which erector is designated as his representative is Engineer-In- Charge. Erection engineer is to report to Project Manager.
- The Contractor shall be responsible for setting up erecting the plant to the line levels of reference of the positions, levels dimensions alignment, appliances labor in connection therewith. The checking of setting out of any line or level by the Engineer-In-Charge or his representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.
- 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 shall bring any deviations from the required position, lines or dimensions to the notice of the Engineer-In-Charge. Plant shall be erected in a neat workmanlike manner on the foundations at the locations shown on the approved drawings. Unless otherwise directed by the Engineer-In-Charge, 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 his cost make good, repair or replace the damage, promptly effectively as directed by the Engineer-In-Charge to the Engineer-In-Charge satisfaction.

- The Contractor shall align all equipment holding down bolts shall inform the Engineer-In-Charge before proceeding with grouting-in the items concerned. The Contractor shall ensure that all equipment is securely held remains in correct alignment before, during after grouting-in.
- The approval by the Engineer-In-Charge of the contractor's proposals for rigging 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 effectively to the satisfaction of the Employer.
- 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 girders of steel or concrete. If it is required to reduce bending stresses deflection, the beams girders shall be provided with temporary supports.
- During erection of the plant, the Engineer-In-Charge 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 deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the Engineer-In-Charge.

LEVELING GROUTING OFMACHINERY

- 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.
- Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness conformity to drawings the inspection records shall be signed by the Engineer-In-Charge as approval for undertaking the installation of the

components. Any damage, shortfalls etc. shall be made good to the satisfaction of the Engineer-In-Charge.

- 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 roughened 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 air form 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-In-Charge representative. All lines 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.

RECORDS, PROCEDURES REPORTS

- The Contractor shall maintain records pertaining to the quality of installation/erection work 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 duly signed by TPI to the Engineer-In-Charge 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 alignment records.
- All the above mentioned records shall be submitted in the final form duly countersigned by the Engineer-In-Charge or his representative attesting conformity to specifications his approval of installation, duly incorporating all the additions, alternations, information as required by the Engineer-In- Charge on the basis of preliminary reports giving the progress of the work. Such records not withsting, any records submitted earlier with bill of supply/progress etc., shall be duly bound submitted to the Engineer-In-Charge in six copies by the Contractor on his notification of the mechanical completion of erection.

GENERAL PREPARATIONS BEFORE COMPLETION OF THEPLANT

The following documents should be completed in accordance with the Contract schedule before completion of erection. The Engineer-In-Charge the Contractor shall preserve control these documents in a safe appropriate place on Site in order the both parties personnel can make use of them at any time.

TECHNICALDOCUMENTS

- Operation Maintenance manual
  Design documents including the contractor's design data, drawings Specifications.
- Tools test equipment list
- Spare parts list
- Lubricant list

PROCEDURES

- Mechanical testing procedure
- Electrical testing procedure
- Instrumentation testing procedure
- Detailed Pre-commissioning Commissioning procedure
- Detailed Performance Test procedure

GENERAL COORDINATIONDOCUMENTS

- Detailed organization charts for Pre-commissioning Commissioning showing lines of authority's responsibility, functions of all key personnel.
- The job description of the members of the team.
- The scheduled dates of assignment of each member to Pre-commissioning Commissioning Organization.
- A detailed schedule showing the time sequence which the Contractor anticipates to follow for the various steps in Completion of Erection, Pre- commissioning of each unit equipment.
- The regulations for safety, hygiene discipline.
- The practical organization of the relationship (meetings, reports, etc.) between the Contractor the Employer at the phases of Pre-commissioning.
- Emergency communication route.

MANPOWER

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

COMPLETION OFERECTION

- The completion of Plant under erection by the Contractor shall be deemed to occur, if all the units of the Plant are structurally mechanically complete will include among other such responsibilities the following:
- Plant in the Scope of the Contract has been erected, installed grouted as per specifications.
- Installation checks are completed approved by the Engineer-In-Charge.
- The erected Plants are totally ready for commissioning checks.
- At the stage of completion of erection, the Contractor shall ensure that all the physical,

aesthetic workmanship aspects are totally complete the Plant is fit sound to undergo tests on completion subsequent pre- commissioning checks.

- Upon achieving the completion as described above, the Contractor shall notify the Engineer-In-Charge by a written notice intimating completion of erection notify the Engineer-In-Charge for inspection. The Engineer-In- Charge or his representative shall proceed with the inspection of such units within 14 days of such notice.
- The Engineer-In-Charge shall certify completion when there are no defaults in the Works or the Engineer-In-Charge shall inform the Contractor list of deficiencies for rectification hereinafter referred as Punch list the Contractor shall complete the rectification work within a jointly agreed period before pre-commissioning activities obtain the Engineer-In-Charge′s acceptance or approval of the same before proceeding with the same.
- The Engineer-In-Charge may inform the Contractor that the works are accepted with the „Punch" list (items which do not hamper operability, safety or maintainability) allow the Contractors to proceed with the pre- commissioning checks when the Contractor undertakes to complete such ousting works within an agreed time during defects liability period. Taking over shall be based on rectification of all deficiencies as advised by Punch lists.
- 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-In-Charge for Completion, Contractor rectification of all deficiencies as noticed by the deficiency/Punch list, acceptance by the Engineer-In-Charge of such rectification′s, prior to Tests on Completion.
- Minor defects, which, in the opinion of Engineer-In-Charge, do not hamper operability 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- In-Charge′s decision in this regard is final.
- The commissioning period as notified by the Contractor shall be deemed to occur beyond the date of Completion shall include all periods of pre- commissioning, trials Tests on completion.
- 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-In- Charge to achieve Mechanical Completion before undertaking the tests on Completion within the specified erection period. The Engineer-In-Charge 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-In-Charge.

PRE-COMMISSIONING

- After the Completion of erection, Pre-commissioning activities listed below shall be carried out to make the Plant ready for Commissioning. All instruments, materials provisions necessary for conducting site tests shall be provided by the Contractor at his own cost.
- Upon completion of erection of each piece of equipment, facility or discrete part of the plant, mechanical checks tests shall be carried out according to the contractor′s check list. The mechanical checks tests shall be to establish that:
- The Plant is erected in accordance with the contractor′s construction drawings, pipe work drawings, instrument diagrams, etc. issued for the Plant.
- The materials are installed mechanically function in accordance with the Contract Applicable codes as listed in the Contract are followed for Materials workmanship.
- Items such as painting, thermal insulation final clean-up which do not materially affect the operation or safety of the Plant will be excluded. All these items shall be listed completed after Pre-commissioning or commissioning at the discretion of the Contractor, but before acceptance.

The Contractor shall prepare maintain at site test forms records which shall include:

i. Description of type of test or check,
ii. Date times of test or check,
iii. Identification of equipment facilities,
iv. Test pressure, test data results, including remarks, if any,
v. Signature of the contractor′s personnel attesting to data recorded, if any.

- Checks, tests records thereof shall be carried out by the Contractors construction forces.
- Engineer-In-Charge or his representative shall attend such check test wherever the Engineer-In-Charge "or his representative′s witness or attesting of the check or test is required. For this purpose, the Contractor shall keep the Engineer-In-Charge 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 test.
- Any item, if found incomplete or requiring repair or adjustment, it shall be marked as such on the test records then reported by the Contractor to the Engineer-In-Charge the contractor′s personnel in charge of the relevant construction area.
- Checking procedures shall be repeated until all the items on the check list are cleared.
- A complete set of test records shall be held over to the Engineer-In- Charge on completion.
- The tests on the different Mechanical Electrical equipment shall include but not limited to:
- Pumps, Piping Valves
- 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.

- Leakage tests shall be carried out on all erected pipe work, pumps valves immediately after erection where possible before being built-in.
- Operating tests shall be conducted on valves.
- The pump set shall be tested for performance. The vibration noise levels shall be checked to be within the specified.
- The pump shall be tested throughout the operating range with all working (excluding standby) for all the pumps. No negative tolerance shall be permitted on any parameters visibly head, discharge efficiency. All the pumps will be tested for efficiency at duty point after installation.

PUMPMOTORS

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

CRANES

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

INSTRUMENTATION

The tests on the instrumentation equipment shall include but shall not be limited to:

- All cables shall be tested for polarity, continuity insulation resistance. The common mode DC voltage at each signal input terminal shall be measured recorded.
- 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 decreasing signals

The following tests methods shall be used:

- Pressure operated devices – dead weight testers or portable calibrators
- Level operated devices – actual level variation or simulation thereof. Instrument zero reading shall be checked against a benchmark.

- 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. It will 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 the correct stroking verified. Valve positioners, electro-pneumatic converters gauges shall be checked during these tests.
- All systems shall be checked for “fail-safe” operation.
- 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 machine.
- The Contractor shall also demonstrate the data transfer as per data transfer schedule between Pumping Stations.

COMMISSIONING

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 Engineer-In-Charge 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
v. A request for issuance of a Mechanical Completion Certificate in respect of that part.

Within fourteen (14) days from the date of receipt of the Contractor′s written notice, the Engineer-In-Charge 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.
iii. When the Engineer-In-Charge rejects the contractor′s notice, the Contractor shall take any necessary action to complete or correct the items marked give the Engineer-In-Charge a second Notice of Mechanical Completion.

Commissioning activities of the Plant listed below shall be carried out to enable the start-up operation after the issuance of a Mechanical Completion Certificate by the Engineer-In-Charge. Procedures are described as below:

i. Commissioning Procedure shall be carried out in a methodical sequence as follows

A) Warming up,
B) Start-up,

C) Initial running,

D) Operability adjustment,

E) Stable operation

F) Final adjustment

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 Maintenance Manual as necessary.

The Contractor shall check the operating conditions of the plant by constantly monitoring operating data.

The Contractor shall specify for each discrete part of the plant the operational data to be recorded the manner in which the data is to be taken.

All the operating data shall be recorded by the Engineer-In-Charge on the forms to be mutually agreed. A copy of the operating log analytical data from initial operation through to the completion of Performance Test shall be made available by the Engineer-In-Charge to the Contractor for evaluation.

10.0 INSPECTION TESTING AT MANUFACTURER'SPREMISES

GENERAL

a) All inspection testing shall be carried out in accordance with the Specification in absence of Specification relevant Indian Standard or internationally approved equivalent Standard.

b) The Contractor shall carry out at the place of manufacture tests of the Plant /Equipment at any part of the Works.

c) The Engineer-In-Charge shall be entitled to attend the aforesaid inspection /or tests by his own duly authorized designated representatives.

d) The Engineer-In-Charge his duly authorized representative shall have access to the contractor′s premises at all suitable times to inspect examine the material workmanship of the mechanical electrical plant equipment during its manufacture there. If part of the plant equipment is being manufactured on other premises, the Contractor shall obtain permission for the Engineer-In-Charge or his duly authorized representative, to inspect as if the plant equipment was manufactured on the Contractors own premises. Testing (including testing for chemical analysis physical properties) shall be carried out by the Contractor certificates submitted to the Engineer-In-Charge′s representative who will have the right to witness or inspect the above mentioned inspection /testing at any stage desired by him.

e) The procedure for the testing inspection to be carried out during or following the manufacture of the materials to ensure the quality workmanship of the materials to further ensure that they conform to the Contract in whatever place they are specified shall be as described below.

i. The Contractor shall give the Engineer-In-Charge at least 10 clear days' notice in writing of the date the place at which any plant or equipment will be ready for inspection/testing as provided in the Contract. The Engineer-In-Charge or his duly authorized representative shall thereupon at his discretion notify the Contractor of his intention either to release such part of the plant equipment upon receipt of works tests certificates or of his intention to inspect. The Engineer-In-Charge shall then give notice in writing to the Contractor, attend at the place so named the said plant equipment which will be ready for inspection /or testing. As when any plant shall have passed the tests referred to in this section, the Engineer-In-Charge′s representative shall issue to the Contractor a notification to that effect.

ii. The Contractor shall forward to the Engineer-In-Charge 3 duly certified copies of the test certificates characteristics performance curves for all equipment.

iii. If the Engineer-In-Charge′s representative(s) fails to attend the inspection /or test, or if it is agreed between the parties that the Engineer-In-Charge′s representative(s) shall not do so, then the contractor may proceed with the inspection /or test in the absence of the Engineer-In-Charge′s Representative provide the Engineer-In-Charge with a certified report of the results thereof as per (ii)above.

iv. If any materials or any part of the works fails to pass any inspection / test, the Contractor shall either rectify or replace such materials or part of the works shall repeat the inspection /or test upon giving a notice as per (i) above. Any fault or shortcoming found during any inspection or test shall be rectified to the satisfaction of the Engineer-In-Charge before proceeding with further inspection of wiring of that item. Any circuit previously tested, which may have been affected by the rectification work, shall bare-tested.

v. Where the plant equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled tested as one complete working unit, at the maker "works.

vi. Neither the execution of an inspection test of materials or any part of the works, nor the attendance by the Engineer-In-Charge′s representative(s), nor the issue of any test certificate shall relieve the Contractor from his responsibilities under the Contract.

vii. The test equipment, meters, instruments etc., used for testing shall be calibrated at recognized test laboratories at regular intervals valid certificates shall be made available to the Engineer-In-Charge′s representatives at the time of testing. The calibrating instrument used as Standard shall be traceable to National/International Standard. Calibration certificates or test instruments shall be produced from a recognized/Laboratory for the Engineer-In-Charge′s consent in advance of testing if necessary instruments shall be recalibrated or substituted before the commencement of the test.

viii. The Contractor shall not pack for shipment any part of the plant until he has obtained from the Engineer-In-Charge or his authorized representative his written approval to the release

of such part for shipment after any tests required by the contract have been completed to the Engineer-In-Charge's satisfaction.

ix. The following Testing shall be carried out for all the equipment as applicable.

A) Visual Inspection.

B) Material Certificates for all the specified material shall be furnished.

C) Welding Qualifications

D) Dimension Checking

E) Stage Inspections (in process inspection)

F) Dynamic balancing for all rotating parts

G) Hydrostatic / Leak testing for all pressure parts, Pneumatic Leak Test wherever applicable

H) Operation check

I) Liquid Penetration Tests and Magnetic Particle Tests (for machined surfaces of pressure parts).

J) Ultrasonic test for forging materials viz.,

Plates of thickness 20mm above for pressed / formed parts such as heads, etc.

Plates, flanges bars of thickness / dia 40mm above used for fabrication of pressure load bearing members rotating parts

K) Radiographic testing for all butt welded parts, as per applicable codes.

L) Hardness tests for all Hardened surfaces.

f) 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 or based on the datasheets / drawings /specifications.

INSPECTION TESTS

(i) PUMP

a) All pumps shall undergo witness performance tests at the pump manufacturers Works at full load full speed with one of the type tested job motor.

b) Minimum submergence test shall be undertaken for one pump to verify that the pumps meet the minimum submergence committed.

c) A Standard hydrostatic test shall be conducted on all pump columns; discharge elbow bowl assemblies at 1.5 times the maximum discharge pressure of the pump or twice the rated pressure, whichever is higher. The hydrostatic test shall be conducted for a minimum duration of 30minutes.

d) Impeller pump rotating assembly shall be dynamically balanced as per ISO 1940 / Gr. 6.3 at rated speed or reduced speed.

e) Standard running test shall be conducted as per BS 5316 Part 2 Class B / ISO 3555 / IS: 10981 Class - B at the rated speed at manufacturer's works to measure the capacity, total

head, and efficiency power. **However, no negative tolerance shall be permitted on the tested pump efficiency**. Pump efficiency shall be more than guaranteed pump efficiency at rated speed at duty point given by agency. Coating / painting shall not be applied on the impeller casing prior to testing. These tests shall form the basis for pump acceptance except for vibration noise. The pump shall be tested over a range comprising shut off head to maximum flow. Minimum six readings (apart from duty point shut off) approximately equidistant shall be taken for plotting the performance curve. The following formula shall be taken for computing the power input to the pump:

$$\text{Power input to the Pumpin kW:} \quad \frac{Q \times H}{367.2 \times \eta_p}$$

Where, Q = Discharge inM3/hr

H = Total head in mwc

η_p = Efficiency of pump.

If the vibration, noise level readings taken during performance test show higher than that permitted, vendor shall guarantee to show that the values shall be maintained at site after erection. Any cost of rectification needed on this count shall be borne by the Contractor.

f) The contractor shall carry out performance test of pumps at site to prove the committed guaranteed parameters in the presence of Engineer in – charge / his authorized representative. All necessary calibrated instruments required for measurement of discharge, head, and power etc. to be arranged by the contractor. Pumps not meeting min guaranteed parameters shall not be accepted till required parameters are achieved in performance testing.

The test procedure is to be submitted by the contractor in advance for approval of Engineer-In–Charge.

(ii) VALVES

a) There shall be no visible evidence of structural damage to any of the valve component during testing.

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 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.

TEST FOR VALVES

A) The following test shall be carried out for butterfly valves:

a) Seat leakage test at rated pressure.
b) Body hydrostatic test at 1.5 times the rated pressure.
c) Disc strength test at body test pressure.
d) Valve operation.
e) 15 □ opening closing test.

B) The following test shall be carried out for sluice valves:

a) Seat leakage test at rated pressure
b) Hydrostatic test at 1.5 times the rated pressure
c) Valve operation with without actuator

C) The following test shall be carried out for Non Return valves:

a) Seat leakage test at rated pressure
b) Body hydrostatic test at 1.5 times rated pressure
c) Operation

(iii) PIPEWORK:

a) Testing of pipes fitting shall be carried out in accordance with relevant Indian Standard internationally approved Standard. Pipes shall be hydrostatically tested for 1.5 times the rated pressure.
b) Agency will maintain the registers all record during pipe manufacturing work get certified by respective authorities like department /TPI.
c) For all inspection works, transportation, lodging and boarding for all the representative engineers from respective authorities shall be arranged by the agency.
d) Pipe manufacturing registers shall be maintained and data shall be posted in soft form in to the computer by agency.
e) 3 LPE material testing shall be carried out at pipe manufactures lab during PQT. It will also be carried out at an independent government approved lab, i.e. GIRDA, CIPET etc. the frequency of test shall be as decided by the Engineer-In-Charge.
f) Agency shall prepare a planning preferably in the form of Bar chart review progress of actual work v/s target from time to time take corrective actions for timely completion.
g) The agency shall have a field laboratory for various field related testing work will all the equipment.
h) Agency will arrange „C" value testing after fully commissioning of the project of this, then will submit a procedure to department /TPI for review and approval.
i) Back log for internal external coating of field joints shall be not more than 10 weld joints on pipe line, i.e. agency shall complete coating work after 10 weld joints are completed; otherwise without completing the coating on pipe, further welding on pipeline shall not be allowed. This will be a „HOLD" point for site activities.

j) Authorized engineer of agency shall remain present during pipe manufacturing as well accompany to the representatives of engineer in-charge during inspection work at manufacturing site / test lab.

(iv) E.O.T.CRANE

The cranes shall be completely assembled in the contractor's or subcontractor's Works shall be subjected to the tests as specified in IS 807/IS 3177 or relevant internationally approved Standard. The Contractor shall provide the test weights.

TECHNICAL SPECIFICATION OF MOTORS (Wherever Applicable):

11.0 L.T.MOTORS (PRIME MOVER)

1. GENERAL

- The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site; erection, testing commissioning of Squirrel cage induction motors complete with instrumentation controls safety devices, equipment, lubricating system oil.
- The scope of supply shall include spares for 5 years of operation of the pumping station, special tools testing devices, all parts accessories etc. which are essential for construction, operation maintenance of all the motors even though these are nor individually or specifically stated or enumerated.
- Corresponding components of all the motors associated equipment spares shall be of the same material, dimensions finish shall be interchangeable.
- The motor shall perfectly match in respect of speed, runaway speed, moment of inertia overload capacities, couplings any other requirement with that of pump

2. STARDS

Sr. No.	Standard	Description
1	IS 325	Squirrel cage induction motors
2	IS 12615	Energy efficient induction motors- three phase squirrel cage
3	IS 4691	Type of enclosures
4	IS 900	Code of practice for installation maintenance of induction motors
5	IS 6362	Method of cooling
6	IS 4029	Testing of induction motors
7	IS 2223	Dimensions of flange mounted as induction motors

8	IS 2253	Designations for types of construction mounting Arrangements of rotating electrical machines.
9	IS 2254	Designations of vertical shaft motors for pumps
10	IS:4722	Rotating electrical machines
11	IS:4728:1975	Terminal marking direction of rotation for rotating electrical Machinery.
12	IS:6362:1995	Designation of methods of cooling for rotating electrical Machines.
13	IS:7816:1975	Guide for testing insulation resistance of rotating machines.
14	IS:12065:1987	Permissible limits of noise level for rotating electrical machines.
15	IS:12075:1987	Mechanical vibrations of rotating electrical machines
16	IS:4889:1968	Method of determination of efficiency of rotating electrical Machines.
17	IS:12802:1989	Temperature rise measurement of rotating electrical machines.
18	IS:12824:1989	Types of duty classes of rating for rotating electrical machines

3. TECHNICALPARAMETERS

Sr. No.	Description	Technical Parameter
1	Motor Rating	As per the requirement of Pump.
2	Type of motors	3 Phase Induction Motor, TEFC
3	Quantity	As per BOQ
4	Motor duty	Continuous, S1
5	Application Standard	IS 325
6	Motor Energy efficiency class	EFF2 as per IS- 12615:2018 or Latest Amendment
7	Design Temperature	50 Deg C amb.
8	Rated Speed	Contractor to specify
9	Supply voltage and frequency Conditions Voltage : Frequency : Combined V and F Variation	 415 V ± 10% 50 Hz ± 5% ± 10%
10	Insulation class	Class F temperature rise as per class B

11	Starting Method	As Per BOQ
12	Cable termination details	Al conductor, XLPE / PVC insulated, armored 0.433 kV grade cable
13	Cable termination box protection	class IP 55
14	Space heater	230 V
10	Bearing temperature sensing	Required
15	Winding temp. sensing	Pl. Furnish
16	Minimum Efficiency	As per Manufacture

4. DESIGNCRITERIA

4.1 Rating and Temperature rise

a) All motors shall be of continuous rated type

b) The motors shall be designed for maximum ambient temperature of 50□ C; with the temperature rise of the stator winding by resistance method over the ambient air temperature no exceeding 70□C for both class B class F insulation.

c) In case of continuous operation at extreme supply voltage variation limits, the temperature rise limits as specified above shall not exceed by more than 10□ C for motors of output up to including 200KW.±10%

d) Each motor shall be assigned a maximum continuous rating (MCR) corresponding to this temperature rise.

e) Wherever the basis for motors ratings are not specified in the corresponding mechanical specification sections, maximum continuous motor ratings shall be at least 50% above the maximum load dem of the driven equipment under entire operating range as specified elsewhere including voltage frequency variation.

f) The rated supply voltage, voltage and frequency variations in the supply are mentioned elsewhere. Motors shall be capable of delivering its maximum continuous rating with supply variations. The motor can start satisfactorily under the extreme conditions.

g) All motors shall be so designed that the maximum inrush currents, locked rotor pull out torques developed by them at highest voltage frequency limits do not endanger the motor the driven equipment.

i) Induction motors shall be designed to be capable of withstand the voltage torque stresses developed due to the difference between the motor residual voltage incoming supply voltage equal to 150% of the rated motor voltage during changeover of buses.

J) The voltages at all motors during start up shall be maintained at a value which ensures that there is sufficient accelerating torque developed by the motor to give a safe run up time.

k) The maximum system transient impedance shall be used in calculating voltage drops relating to motor starting, restarting re-acceleration requirements.

l) During starting or re-acceleration of a motor, either individually or in a group, the voltage dip at the motor terminals shall not vary more than 15% from rated voltage when started direct on line under the worst operating scenario i.e. largest motor started with minimum number of power sources minimum fault level.

5. TORQUE REQUIREMENTS

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

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

6. NO. OF STARTS

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

7. STARTINGCURRENT

The ratio of starting Current/rated current (MCR corresponding to the specified temperature rises) shall not exceed 6 .In case of DOL starter. But with soft starter it shall be between 2 to 3 times.

8. STARTINGTIME

a. For motors with stating 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 stating 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.

9. CONTROL

All the motors shall be suitable for control through circuit breaker / MCCB as specified.

10. ENCLOSURE METHOD OFCOOLING

The motors shall be of totally enclosed closed Fan Cooled, (TEFC).

11. VIBRATION LEVEL and NOISELEVEL

The vibrations as measured at motor bearings shall be within the limits specified in IS: 12075/ BS: 4999 Part -142. The motor shall also be capable of withstand the vibration produced by the driven equipment. The Noise levels shall comply with IS: 12065.

12. CONSTRUCTIONALFEATURES

a) Motor its components (such as stator, rotors, end shields, terminal boxes, and bearings heat exchangers) shall be designed to be readily interchangeable as integral units for the same design rating.
b) All nonmetallic components used shall be of resistant to flame propagation.
c) All enclosures shall be designed to provide an effective sealing between the primary

secondary air circuits. All totally enclosed type of motors shall have suitable means of breathing of drainage to prevent accumulation of from condensation. Drain holes diameter shall not exceed6mm.

d) The cooling fans shall be capable of being connected for rotation in either direction or due care for cooling etc., especially where identical motors are to be provided for opposite direction of rotation, such as for a pair of conveyor without replacing or removal of fans or any other parts.

e) Motors shall preferably be capable of being connected for rotation in either direction with due care for cooling etc., specially where identical motors are to be provided for opposite direction of rotation, such as for a pair of conveyor without replacing or removal of fans or any other parts.

f) All heavy parts of the motors shall be provided with necessary arrangement: such as lifting lugs/eye bolts for lifting or Holding during erection or overhaul.

g) 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%.

h) Space heaters or internal electric heaters shall be provided on motors rated above 30 KW to maintain the windings in a dry condition during periods of still. The heaters shall be suitable for use on 240 volts, 50Hz AC Supply.

Space heater shall remain ON when motor is in operation

j) Temperature Detectors

At least six nos. of simplex or duplex platinum resistance type embedded temperature detectors, evenly distributed around the stator, and shall be provided for all HT motors. These shall be located at locations where high temperatures are expected during operation. Resistance of the temperature detector at 0□ C shall be one hundred (100) ohms. Temperature detector lead insulation class shall be the same as stator winding insulation call. 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.

13. WINDING INSULATION

a) Winding insulation shall be of class B or better for LT AC motors. It shall be of proven high quality reliability.

b) All windings insulation shall be non-hygroscopic, oil-resistant to flame propagation. All windings shall be impregnated suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site.

c) All winding overhangs leads shall be adequately supported, braced blocked.

d) Cage windings all joints shall be designed to give an adequate safety factor on the fatigue

due to thermal mechanical stresses, taking into account the specified starting running conditions. All electrical joints connections shall be of brazed or welded construction.

14. BEARINGS

a) Bearings shall be of roller type, except where motor speed shaft loading dictate otherwise. Vertical motors shall normally have rolling type guide thrust bearings. The latter may however be of Kings bury tilting pad type where heavy axial loads are to be supported.
b) Temperature of lubricating oil as it leaves the bearing shall be not exceeding 71□C.
c) Bearing shall comply with the relevant Indian or International Standard. The bearings housing shall be correctly packed with lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

15. TERMINAL BOXES ASSOCIATEDFITTINGS

a) The cable boxes terminations shall be designed to enable easy disconnection replacement of cables. Leads from terminals to the windings shall be adequately sized braced to withstand the heating forces produced by maximum fault current.
b) Terminals shall be suitable for receiving aluminum conductor XLPE/PVC insulated cables. Motor shall be supplied with compression type tinned brass cable gls Crimping type tinned copper lugs for the termination of cable. The termination lugs shall conform to DIN46329.
c) Clearance between the lugs/bare live parts of different phases between lugs/bare live parts earth shall be as per relevant Standard. The terminal boxes shall be capable of withstand a system fault level. A suitable provision of releasing the pressure developed during faults shall be made. Terminal boxes shall be suitable for top bottom entry of cables.
d) LT motor terminal box shall be capable of being turned through 360□ in step of90□C.

16. EARTHINGTERMINALS

Two independent Earthing points shall be provided in accordance with IS: 3043, on opposite sides of the motor for bolted connection.

17. RATING PLATE

In addition to the requirements as called for in relevant IS, the rating plating plate shall indicate the following:

a) Maximum continuous rating in KW corresponding temperature rise, as applicable for cooling medium temperature as specified.
b) Bearing identification numbers (in case of ball / roller bearing recommended lubricant)

18. PAINT and FINISH

a) All external parts shall be finished painted to produce a neat durable surface which would prevent rusting corrosion. The equipment shall be thoroughly degreased, sharp edges scales removed treated with one coat of primer two coats of enamel paint shade no 631 as per IS:5 for indoor motors shade no. 632 as per IS: 5 for outdoor motor. Motor fans shall also be painted to withstand corrosion.

b) All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plate. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

19. PRE COMMISSIONING TEST OF PUMP and MOTOR:

- The test shall be carried out as per IS: 9137 code of acceptance test of pump Class C, in general as started below in particular.
- The purpose of the field test is not to ensure whether pump performance as regards parameter i.e. H, Q and power etc. within acceptance limit as per IS: 9137.The purpose is to ensure that the pump performance is generally acceptable or otherwise.

Final acceptance shall be as per following criteria.

i) As regards H/Q characteristic for acceptance it shall be checked whether motor is not getting overloaded within the specified head range.

ii) Flow measurement shall be taken by the flow meter to be provided by contractor.

iii) The head shall be measured with calibrated pressure gauge of accuracy 1% or better. At least 3 pressure gauges shall be got calibrated from two different institutions with prior approval of the Engineer in charge. The calibration shall be point to point not mere for percentage error. The gauge shall be fitted at suitable place from the discharge nozzle. It may be noted that pressure gauge shall be installed at least 2 times diameter away from discharge nozzle delivery valve be placed at least four times diameter away from discharge nozzle. Such conditions shall be simulated at site condition no allowance for this deficiency shall be considered. The decision of Engineer in Charge shall be final.

iv) The input power to motor shall be measured by 2 wattmeter method. The watt meters shall be of Laboratory grade having accuracy of min. 0.5% these should be digital type.

v) The speed shall be measured by non-contact tachometer with digital display calibrated. The field test shall be taken with entire head range in such a manner that it would cover at least 6 points (i.e. duty point, 2 above duty points, 2 below duty point shut off). The guarantee for head discharge shall deem to be fulfilled as per clause.

The field performance test at site is absolutely essential as above (i) to (v) the manufacturer shall also be asked to attend the same.

20. PRE COMMISSIONING CHECKS and TEST OF HTMOTOR:

1. Check IR and PI value. If require improve IR and PI by drying out to obtain the required insulation resistance values. Approval of the drying methods shall be obtained from Owner before applying heat.
2. Align motor with the pump
3. Check cable connection at motor phase, neutral side and Circuit breaker side space heater connection.
4. Check motor Earthing at two places measure earth resistance
5. Set winding and air temperature gauges for alarm and trip set value are as per OEM recommendation and simulate the values.
6. Carryout DC simulation test of the breaker. See that breaker trips by Operating all relays one by one.
7. Test motor protection relay by secondary injection relay test set and see that settings are done as per recommendation.
8. Switch on DC supply at motor beaker keeping breaker in racked out position. See that space heater becomes “on”. Measure current taken by the space heater circuit. And note down for future reference.
9. Run motor in decoupled condition, check direction of rotation, it should be as required for the pump. Note down no load current in decoupled, vibration on motor bearings in decoupled condition.
10. Stop motor, Coupled motor with Pump. Give start kick and check direction of rotation.
11. Run pump motor set with discharge valve in closed position. Observe and note down no load current in coupled condition, vibration at all the bearings for future reference.
12. Run motor on load opening pump discharge valve note down no load current in coupled condition, vibration at all the bearings for future reference.
13. Each Pump- motor set is to run separately continuously for 72 hours at full load temperature of various parts including winding, bearing etc. are to be observed. Measurement of discharge at rated head is to be measured.

21. PRE COMMISSIONING CHECKS and TEST OF LTMOTOR:

1. Check IR and PI value. If require improve IR and PI by drying out to obtain the required insulation resistance values. Approval of the drying methods shall be obtained from Owner before applying heat.
2. Align motor with the pump
3. Check cable connection at motor phase , neutral side and Circuit breaker side space heater connection
4. Check motor Earthing at two places measure earth resistance
5. Set winding and air temperature gauges for alarm and trip set value are as per OEM recommendation and simulate the values.

6. Carry out DC simulation test of the breaker. See that breaker trips by operating all relays one by one.
7. Test motor protection relay by secondary injection relay test set and see that settings are done as per recommendation.
8. Switch on DC supply at motor beaker keeping breaker in racked out position. See that space heater becomes “on”. Measure current taken by the space Heater circuit. And note down for future reference.
9. Run motor in decoupled condition, check direction of rotation, it should be as required for the pump. Note down no load current in decoupled, vibration on motor bearings in decoupled condition.
10. Stop motor, Coupled motor with Pump. Give start kick and check direction of rotation
11. Run pump motor set with discharge valve in closed position. Observe and note down no load current in coupled condition, vibration at all the bearings for future reference.
12. Run motor on load opening pump discharge valve note down no load current in coupled condition, vibration at all the bearings for future reference.
13. Each Pump- motor set is to run separately continuously for 72 hours at full load temperature of various parts including winding, bearing etc. are to be observed. Measurement of discharge at rated head is to be measured.

TECHNICAL DATA SHEET FOR INDUCTION MOTOR:

SR. NO.	PARTICULAR	DESCRIPTION	TO BE FILED BY BIDDER
1.0	Make	Pl. Furnish	
2.0	Application	Pl. furnish as per applicable	
3.0	Type of motor	Squirrel cage induction	
4.0	Motor Ratings in KW	As per BOQ	
5.0	No. of units/Qty.-nos	As per BOQ	
6.0	Supply neutral	Solidly earthed	
7.0	Rated voltage	415 V	
8.0	No. of Phase &	3 Phase & 50 Hz.	
9.0	Full load Amp.-A	Pl. Furnish	
10.0	Supply condition	Pl. Furnish	
11.0	Synchronous	As per BOQ / Tender	
12.0	Duty condition as per IS	S1 suitable for continuous operations	
13.0	Method of starting	DOL / Star delta / Soft Starter /ATS etc. as applicable	

14.0	Guaranteed Motor Efficiency @ full load @3/4 load @ ½ load	Motor shall be as per IS:12615-2018, IE3 as per BOQ. Pl. furnish	
15.0	Power Factor @ full load @3/4 load @ ½ load	As per IE3 as per IS:12615-2018. Pl. furnish.SS	
16.0	Starting torque % of full load torque	Sufficient starting torque to start the maximum full load of driven equipment. Pl. furnish.	
17.0	Pull out torque % of full load torque	Sufficient to bring the motor to normal speed in minimum time. Pl. furnish.	
18.0	Starting time at specified minimum starting	Pl. furnish (As per Tender)	
19.0	Permissible running time at full load at	Pl. furnish (As per Tender)	
20.0	Locked rotor current withstand time (safe stall time) at 110%	Pl. furnish (As per Tender)	
20.1	At rated temp. (Hot)	Pl. furnish (As per Tender)	
20.2	When cold	Pl. furnish (As per Tender)	
21.0	Class of insulation &	Pl. furnish (As per Tender)	
22.0	Design temperature	50° C	
23.0	Location	As per Tender	
24.0	Hazardous area	As per Tender	
25.0	Atmosphere	As per Tender	
26.0	a) Type of Cooling	Pl. furnish.	
	b) Type of enclosure	Pl. furnish. For Motor & TB: min. IP 55:	
27.0	Terminal box	As per Mfg. Standard	
28.0	Earthing Terminals	Required as per IS. Min. 2 no.	
29.0	External cable	As per the SLD / Tender	
30.0	Shaft - Hollow /	Pl. furnish (As per Tender)	
31.0	Type of Couplings	Pl. furnish (as per Tender)	
32.0	Type of bearings	Pl. furnish (As per Tender)	
33.0	Colour shade of	Epoxy Grey shade 632 as per	
34.0	Space heater for motors	Confirm as per SLD / SOQ / Tender	
35.0	RTD / Thermistors	Confirm as per SLD / SOQ / Tender	
36.0	Winding	Pl. Furnish	

37.0	Standard to be followed	IS 12615, 325, 8225, 4889, 4772, 4029, 4691 and other relevant Indian Standard or	

Note: 1) Manufacturer / supplier shall submit separate data sheet for each duty / rating.
2) Other specifications not mentioned in datasheet, shall be considered as per tender specification / IS.

12.0 ELECTRO MAGNETIC FLOW MEASURING SYSTEM (Wherever Applicable):

A. Generally, the flow meter shall be as follows:

Flow metering System

Each flow metering system shall consist of the primary transducer (Sealed to IP-67 for above ground / non-submerged application and IP-68 for below ground within chamber for submerged application), Earthing electrode / rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit.

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

The signal converts / power supply units shall be provided with a 4-20 mA output signal, linear with flow and suitable for retransmission to remote instrumentation. The above units shall operate from a 230 VAC / 24V DC supply.

The contractor shall provide sufficient suitable cable to allow for the primary transducers to be situated up to **30** meters from their signal converters, unless a longer length is specified.

The Contractor shall provide full details of the cable; he proposes to use. The general specifications for **electromagnetic flow meter** shall be as under:

Sr. No	Description	Particulars
1	**General**	
1.1	Items	Electromagnetic flow Meter
1.2	Service	Water Flow Measurement and analysis
1.3	Fluid	Raw water /Treated water
1.4	Area Classification	Non Hazardous
1.5	Temperature	Ambient
2	**Flow Sensor**	
2.1	**MOC**	

a	Electrode / Sensor MOC	SS316/SS316L/SS304/SS304L/Hastellon/Titamium
b	Flow tube MOC	SS316/SS316L/SS304/SS304L/Metallic Alloy
c	Coil Housing MOC	SS316/SS316L/SS304/SS304L/Die cast alluminium/Carbon steel (cs)/Sheet steel
d	Earthing Ring/Electrod MOC	SS316/SS316L/SS304/SS304L/Hastellon/Titamium
e	Liner MOC	Neoprene
2.2	Process Connection	•Flanged
		•Reducer- Expander is accepted for ≥ 500 mm pipe diameter and shall be in contractor scope.
		•Contractor may allow to reduced flow meter size as per below.

Pipe Dia	**Reduction alllowed**
≥500 mm to <1000 mm	50 mm reduction of pipe line
≥ 1000 mm to <1500 mm	100 mm reduction of pipe line
≥ 1500 mm	150 mm reduction of pipe line

		•The Tapper flange degree of reducer and expander to the flow meter shall be same as flow meter flange dimensions
a	Flange MOC	Carbon steel (CS) / SS304/SS304L/SS316/SS316L
b	Flange Standard	IS 1538/AWWA/DIN/EN 1092/JIS/ANSI or equivelant
c	Counter Flange	Counter flange shall be in contractor scope and dimention of flange shall be same as flow meter flange dimension.
2.3	Housing Ingress of Protection(IP)	IP 68 or NEMA 6P
2.4	Pressure Rating	PN 16 (16 Kg/cm2)
2.5	Spool Piece	Spool piece of each size of flow meter to be provided by contractor.
		Bidders are required to provide required Spool piece as per below table and it is to be kept at nearest GWIL ofice/ GWSSB Office? Nearest Head work or store.

Flow Meter Quantity (Nos)	**Spool Piece Quantity(Nos)**
1	1
≥ 2 to ≤ 5	2
> 5 to ≤ 20	5
> 20	10

3	**Flow Indicator and Transmitter**	
3.1	Type	Microprocessor Based (Remote/ Integral Mounted) •Remote mounted where Building available. •Integral tpe where Building are not available/ Remote area
3.2	Power	•230 VAC type flow meters in case of Indoor/ Where Buildings is available

	Supply	•Contractor shall provide inbuilt battery-operated flow meters in case of outdoor/ remote area(min battery life 5year)
		•In case of battery operated flow meter, contractor must replace all batteries after completion 5th year without any additional cost to tenderer. Further 1% of capex cost will be released upon successful completion of this task
		•If battery fails during O and M period, contractor has to replace battery without any additional cost implication to client
		•In case of 230VAC flow meter, contractor has to supply and lay cable from the source of power supply to Flow meter, also installed UPS with inbuit stabilizer/ Constant voltage transformer to provide stabilized voltage to instruments. Contractor has to provide UPS with minimum of 2 hours battery back - up at full load.
3.3	Accuracy	± 0.5 % at 0.3 to 4 m/s velocity of measured value
3.4	Transmitter Ingress of Protection	•≥ IP 68 or equivalent for remote type display.
		•IP 68 or equivalent for integral type display.
3.5	Transmitter MOC	Die-cast Aluminium/ Polycarbonate /SS316 with anticorrosive paint/PU finish with glass window enclouser
3.6	Output	Digital Output-Modbus/ HART or equivalent
3.7	Communicati on	Flow meter will communicate to PLC / Data Logger/ RTU through Digital output.
3.8	Display	Min. 2 line LCD
		•Actual Flow rate/ Instantaneous Flow rate
		•Cumulative Flow/ Sum/ Totalizer
		•Alarm Indicator
		Actual Flow rate and Totalized reading can be display simultaneously
3.9	Display	Minimum 8 Digits
3.1 0	Data Logger/Local Storage (Internal/ External)	•Flow meter reading can be log/ store locally in data logger for every 15 minutes
		•Minimum 30 days storage required in Data logger.
3.1 1	Communicati on protocal	•Push - pull type where flow meter is 230 VAC flow meters
		•Push type where flow meter is inbuilt battery operated
		•Communication from the Flow Meter (Both ways) Remote Terminal Unit(RTU) to Centralized Monitoring Station(CMS) shall be through any cellular technology provided through reliable Telecom Service provider(TSP).
		•In case of GSM/ GPRS based communication system required SIM cards and its subscription; recurring charges shall be borne by Tenderer/bidder as per below. * SIM card and its subscription shall be bone by contractor for first 3 year of O and M * After succesful completion of 3rd year O and M (i.e 4th year to 8 th year O and M period) SIM card and its subscription change shall be borne by department
		•However bidder is responsible for performing variouse activitiese like coordinator activation and maintainance of the same.
		•In case of 230 VAC flow meter ,time stamped data shall be transfer from meter RTU to CMS at every 15 Minutes.

		•In case of battery operated flow meter ,time stamped data for every 15 minutes shall be shaved locally and after every 12 hour data will be transfered from flow meter RTU to CMS.
3.12	Zero and Span Adjustment	•Required
		•Zero and span adjustment can be done with the help of Password.
		•Protection of all parameters(calibration and revenue parameters) to be protected with thee help of factory set password.
		•Contractor shall share Password of flow meters to client at the end of every year. Further the release of subsequent quaterly O and M charges will only allowed upon successful confirmation of receiving of the same.
3.13	Facility for on line diagnosis (local indication as well as Central Monitoring Station Indication	Required as following:
		Diagnostic
		•Continuous self test shall include(But not limited to):
		•Flow Meter On-Off
		•Circuit Break Alarm
		•Major error/ alarm like non-function of device, battery failure etc. will trigger immediately at central monitoring System
3.14	Cable Gland	Required
3.15	Cable length(sensor to transmitter	For remote type flow meter, cable to be supply as per site requirement along with 5-meter extra cable.16 Gauge copper cable is required
3.16	Data Protection	Stored parameter and measured flow data should not ger erased during power failure.

Flow (Instantaneous and Totalized) readings shall be continuously displayed locally as well as in remote at Panel mounted PLC / HMI and at Master control SCADA at control room

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

The Flow meters shall be calibrated according to the ISO-8316. Standard. Performance Type Testing Certification (ISO 9104) strictly not acceptable. The suppliers shall also have a testing facility in India or abroad so that methodology and procedures can be verified. The testing facility shall be duly accredited in accordance with ISO 17025 standards in India.

Test bed shall be accredited by national /international certifying authority (FCRI and NABL) as per ISO 8316 (Calibration by Volumetric Method) or ISO 4185 (Measurement of fluid flow in closed conduits - weighing method).

Minimum 10% or one no. (Whichever is higher) of flow meters of each size shall be wet calibrated at accredited facility / test bed as mentioned above either at manufacturer works or any other such

facility in India. Flow meters shall be tested for accuracy, calibration and sealed in presence of the Client Engineers / TPI / PMC at manufacturer's works / Calibration Facility. All electro-magnetic flow meters shall be provided with manufacturer's calibration certificates.

Also 10% of Total quantity other than tested at manufacturer place (Minimum one of each size) of the flow meter shall be reviewed and inspected at FCRI Lab. Dispatch clearance of flow meter will be given only after submission of FCRI inspection report.

I) **Remote Terminal Unit (RTU):**

- It is bidder's responsibility to install new flow meter along with remote terminal unit for wireless communication with centralized monitoring system.
- It is bidder's responsibility to install remote terminal unit on existing flow meter for wireless communication with centralized monitoring system.

Sr. No.	Description	Particulars
1.1	• Panel-IP 54 in case of Indoor/Where Building is available • Panel- ≥ IP 65in case of outdoor/ remote area	To Mount Flow Meter Display, Data logger, GPRS Modem, 1 KVA voltage stabilizer with built in Surge protector device etc.
1.2	Data Logger (Internal/ External)	To Store Local Flow Data (every 15 minutes Data) and Alarm Data (Instantaneously) to be Log/ store for 30 Days
1.3	MODEM	Transmit Flow Data to Centralised Monitoring Station/ State Level Data Server
1.4	MOC	CRCA sheet
1.5	Thickness of Panel Wall	Minimum 1.5 mm
1.6	Thickness of Gland Plate	Minimum 2 mm
1.7	Panel Color	Paint Finish as per RAL- 7032 (follow 7 tank Process)

Note:

1. **It is compulsory to submit backup guaranty from manufacturer of make suggested on duly stamp paper valid for whole contract period.**

13.0 ABBREVIATION

1	ANSI	AMERICA NATIONAL STARDS INSTITUTE
2	LOA	LETTER OF AWARD

3	BKW	BRAKE KILOWATT POWER
4	CI	CAST IRON
5	DI	DUCTILE IRON
6	NDT	NON-DESTRUCTIVE TEST
7	DPCV	DUAL PLATE CHECK VALVE
8	MOC	MATERIAL OF CONSTRUCTION
9	TEFC	TOTALLY ENCLOSED CLOSED FAN COOLED
10	AWWA	AMERICAN WATER WORKS ASSOCIATION
11	NB	NOMINAL BORE
12	PN	NOMINAL PRESSURE
13	BIS	BUREAU OF INDIAN STARDS

14.0 Vendor list

LATEST GUJARAT WATER SUPPLY and SEWERAGE BOARD (GWSSB) APPROVEDVENDOR LIST SHALL BE MADE APPLICABLE. CAN BE DOWNLOADED FROM GWSSB OFFICIAL WEBSITE.