

**TENDER FOR SUPPLY AND INTALLATION  
OF HYDROPNEUMATIC PRESSURE  
SYSTEM**

**AT  
IIM AHMEDABAD OLD CAMPUS**

**Bill of Quantities, Specifications  
& Tender drawing**

विद्याविनियोगाद्विकासः

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# GENERAL CONDITIONS OF CONTRACT

## SECTION 1: GENERAL SPECIFICATIONS

### 1.0 SCOPE OF WORK

- 1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.
- 1.2 Scope of Work generally shall include the area shown in the drawings attached.
- 1.3 Over & above Clause 1.1, the plumbing installation may include but not limited to the following:
- a) Hydro-pneumatic pump system with VFD.
  - b) Flow meter
  - c) Pressure Transducers/ Pressure Switches
  - d) Pressure Gauge's
  - e) Control Valve
  - f) Non Return Valve
  - g) Connecting Pipes
  - h) PLC panel for system control
  - i) Civil work related to Plumbing Installation
  - j) Instruments, meters, gauges, required for the installation
  - k) The scope of work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

### 2.0 SPECIFICATIONS

- The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. It may also be noted that the specifications are of generalized nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings.
- 2.1 Work under this contract shall be carried out strictly in accordance with specifications attached with the tender.
- 2.2 Item not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest applicable standards with latest amendments as applicable in the contract or as directed by Engineer in Charge.
- 2.3 Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Indian standards specifications or codes of practice.
- 2.4 Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc.

- 2.5 Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of receipt of tenders. In case there is no I.S specification for the particular work, such work shall be carried out in accordance with the instructions in all respects and requirements of the Engineer-in-Charge.
- 2.6 For the items not covered under any of the specifications stated above, the work shall be executed as per manufacturers specifications/ General good engineering practice/ or as per direction of Engineer in charge and shall be carried out in a manner complying in all respects with the requirement of relevant byelaws of municipal corporation/ Development Authority etc. under the jurisdiction of which the work is to be carried out.
- 2.7 In case of any difference or discrepancy between specifications & the description of Schedule of Quantities, Schedule of Quantities shall take precedence. In case of any difference or discrepancy between specification and drawings, the drawings shall take precedence. In case any difference or discrepancy between the specifications for civil works and specification for Public Health Engineering works, specifications for civil works shall take precedence.
- 2.8 In case of any dispute arising out of the interpretation of any tender condition, the decision of Engineer-In-Charge shall be final and binding on the contractor.
- 2.9 Detail specification for Sanitary & CP fittings like model/ makes shall be selected by Architect/ Owner and the same shall be binding for execution.
- 2.10 All electrical installation shall comply with the requirements of relevant Indian Standards, Indian Electricity rules & Indian Electricity Act amended up to date & local bye laws.

### **3.0 CONTRACTOR'S RATES**

- 3.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, excavation, refilling, bedding, encasing, transportation of lifts/leads and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.
- 3.2 Rates quoted are for all heights and depths required for this work.
- 3.3 All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.
- 3.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/ concrete of appropriate mix and strength as directed by Architect/ Engineer in Charge.
- 3.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.
- 3.6 Rates quoted shall be inclusive of any rework to be carried in the system installation due to the instructions given by Statutory/ Approval authority.
- 3.7 For all the items/ equipments supplied free of cost by the Owner, the contractor's rate shall take care of

- transportation to the site, storage at site, installation, testing & commissioning of those items/equipments.
- 3.8 All rates quoted by the contractor under this contract shall including bailing or pumping out of all the water which may accumulate during the progress of work either through seepage, springs, rain or any other cause.
- 3.9 All rates quoted by the contractor shall include all miscellaneous civil work related to Plumbing work like excavation, refilling, timbering, bedding, encasing, etc. required as per actual site condition.
- 3.10 All water and electricity charges for testing and commissioning of the system shall be borne by the contractor.
- 3.11 In case of discrepancy/ calculation error between rate & amount quoted by the contractor, the quoted rate shall be considered as final to derive the amount.

#### **4.0 DRAWINGS**

- 4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.
- 4.2 Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.
- 4.3 Contractor shall verify all dimensions at site and bring to the notice of the Architect/ Engineer in Charges all discrepancies or deviations noticed. Architect/ Engineer in Charges decision shall be final.
- 4.4 Civil related details like tanks, basement channel, and plant room, sump, etc. to be read in conjunction with structure drawings. In case of any discrepancies, Contractor shall co-ordinate with other agencies & execute as per the best practices.
- 4.5 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.
- 4.6 Any drawings supplied with the tender shall be returned in good conditions along with the tender.
- 4.7 Any drawings issued by the Architect/ Engineer In Charges for the works are the property of the Architect/ Engineer In Charges and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architect/ Engineer In Charges.

#### **5.0 EXECUTION OF WORK**

- 5.1 The contractor must get acquainted with the proposed site for the works and study specifications and conditions carefully before execution.
- 5.2 The work shall be carried out in conformity with the plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and other specialized services drawings.
- 5.3 On award of the work, contractor shall submit a program of execution in the form of a PERT chart or Bar chart for approval of the Architect/ Engineer in Charge. All dates and time schedule agreed upon shall be strictly adhered to, within the stipulated time of completion/ commissioning along with the

specified phasing, if any.

- 5.4 The work shall be executed as per program approved by the Architect/ Engineer in Charge. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the owner/ or due to any other issue not pertaining to the contractor, the contractor shall draw attention to the owner & as per the mutual agreement, the programme of construction shall be modified accordingly and the contractor shall have no claim for any extras or compensation on this account. Here Owner means the authorized person/ agency representing Owner/Client.
- 5.5 The contractor shall cooperate with all trades and agencies working on the site. The contractor shall ensure that all inserts, pipe lines embedded in structural members, sleeves, cutouts, etc. are placed in position in coordination with civil work as and when required. All holes, sleeves, cutouts shall be filled with best quality sealant to make leak proof joint. Location & size of core cutting of the floor slabs in case of suspended plumbing shall be co-ordinated with civil contractor. However, core cutting work is to be carried out by Civil Contractor or any other agency.
- 5.6 The contractor shall take instructions from the Engineer In charge regarding collection and stacking of material in any place with lockable arrangement. For damage/ theft of any material, Contractor shall be hold responsible. No Excavated earth or Building material shall be stacked on areas where other buildings, roads, services, compound walls, etc are to be constructed.
- 5.7 The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where Phased delivery is contemplated, this provision shall apply to each phase.
- 5.8 The installation of the sanitary fixtures and fittings shall be as per the shop drawings approved by the Architect/ Engineer in Charge/ Consultant. The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.
- 5.9 All gaps between wall/ floor and sanitary vessels shall be filled with sanitary grade sealant. CP Brass or SS screws shall be used for fixing sanitary fixtures and accessories in toilet, bath, pantry and kitchen area.
- 5.10 While carrying out pipeline work, in case the contractor encounters any Interference with other services, such as cable, conduits, etc. he shall take sufficient precautions in order to prevent any damage to them. If any damage occurs it shall be rectified to its original condition at his own cost to the satisfaction of Engineer-In-Charge.
- 5.11 The contractor carrying out the construction work shall take effective measures to carefully open out all existing channels, culverts, bridges, pipelines, conduits, water courses, sewer, drains, electrical cables, transmission lines and their supports and all works buried or otherwise where such services have to be interfered with the purpose of the construction of the works. He shall provide and arrange all necessary temporary supports and diversions if necessary across/ under/ even through along sides of the trenches and all other parts of construction work for all such channels, culverts, bridges, pipe lines, conduit
- 5.12 The contractor shall arrange to carry out all works with least interference practicable with public footpath and vehicular traffic and with existing waste water or storm water drainage arrangements and provide all necessary road barriers, fences, notices, lights, gangways, access crossings, diversions for traffic, temporary drains, dewatering channels, chutes pumping or water lifting arrangements and all other facilities for the proper execution of the works to the approval and satisfaction in all respects of the Engineer-in-Charge. Any work carried out by the contractor in this connection shall be deemed as



- temporary works incidental to the construction work.
- 5.13 For any free issue items by Owner, the contractor shall maintain the same properly & install as per good engineering practice.
- 5.14 No structural member shall be chased or cut without the written permission of the Architect/ Engineer in Charge/ Engineer in charge.
- 5.15 The work shall be executed in a manner complying in all respects with requirements of relevant bye-laws of the municipal corporation/ Development Authority/ Applicable Statutory Authority the jurisdiction of which the work is to be executed or as directed by the Engineer-In-Charge.
- 5.16 All plumbing services shall be handed over to Engineer-In-Charge complete in all respects. Incomplete work will not be taken over. Any loss or damage to these services due to any reasons by anybody whatsoever before handing over will be at contractors risk and cost, Any damage to any structural, finishing work done during the testing or rectification shall be made good by the contractor at his own cost and risk.

## **6.0 MATERIALS & WORKMANSHIP**

- 6.1 All materials used in the works shall conform to the list of approved vendor in tender specifications. The approved samples shall be maintained at site till the completion of work.
- 6.2 As far as possible materials bearing I.S. certification marks shall be used with the approval of the Architect/ Engineer in Charge/ Engineer in charge.
- 6.3 Unless otherwise specified and expressly approved in writing by the Architect/ Engineer in Charge, materials of makes and specifications mentioned with tender shall be used. In case of any items, list of approved vendor is not given; the contractor shall submit his recommendation to Engineer in charge with proper technical back up justifying the selection.
- 6.4 Workmanship and general finish shall be of first class quality and in accordance with best workshop practice. All similar items of the Plant and their component parts shall be completely interchangeable.
- 6.5 Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items.
- 6.6 Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to may be readily installed.
- 6.7 All equipment shall operate without excessive vibration and with minimum noise.
- 6.8 All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.
- 6.9 All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings
- 6.10 All materials selected in the work shall be most suitable for duty concerned, free from imperfections, selected for long life and minimum maintenance.
- 6.11 All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by

the Contractor unless it is specifically excluded from his scope.

6.12 All valves shall be closing on clockwise rotation of the hand wheel. The effort required to close/ open under all operating conditions shall be limited to 7 kg. The direction of opening/ closing shall be cast on the hand wheel.

6.13 All flanges shall be drilled in accordance with requirements of IS: 1538. All flanges shall be full or spot faces on the back side. The flange thickness shall be uniform throughout. Flange outside periphery shall be concentric with the bore. Flanges shall be finished smooth on periphery also Castings and fabricated materials shall be finished smooth all over.

## **7.0 INSPECTION AND TESTING OF MATERIALS**

7.1 Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian standards.

7.2 Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for all mandatory tests.

7.3 Testing charges for optional tests shall be paid by the Dept. However, the incidental charges and cost of sample for testing shall be borne by the contractor.

7.4 In case of non-I.S. materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant I.S. specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for such tests.

7.5 The materials should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant I.S. for acceptance. Such materials will be accepted as standard.

7.6 Payments shall be restricted to standard unit mass, or as specified in the schedule, without making any cost adjustment towards mass or any other properties provided the material pass all the tests and tolerance are within the specified limit.

7.7 For examination and testing of materials and works at the site contractor shall provide all testing and gauging equipment necessary but not limited to the followings:

7.8 a) Theodolite b) Dumpy level c) Steel tapes d) Weighing machine e) Plumb bobs, spirit levels, Hammers f) Micrometers g) Thermometers, Stoves h) Hydraulic test machine i) Smoke test machine.

7.9 All such equipment shall be tested for calibration at any approved laboratory, if required by the Architect/ Engineer in Charge.

7.10 All testing equipment shall be preferably located in special room meant for the purpose.

## **8.0 MOCK UP**

8.1 The contractor shall install all pipes, fixtures, clamps and accessories and fixing devices in mock-up shaft and room so constructed as directed by Architect/ Engineer in Charge without any cost. The materials used in the mock-up may be reused in the works if found undamaged.

8.2 The contractor shall have to assemble at least one set of each type of sanitary fixtures and CP fittings



in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect/ Engineer in Charge/ Engineer In charge.

- 8.3 Any tiles or finished surfaces or floors damaged by the contractor while doing his work shall be made good with new tiles or other finishing material. No payment shall be admissible for such repairs. The Architect / Engineer in Charge may, at his discretion get the damaged work repairs to the contractor.

## **9.0 MATERIALS SUPPLYING BY OWNER**

- 9.1 The contractor shall verify that all materials supplied by the Owner conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Architect /Engineer in charge.
- 9.2 If any materials issued to the contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc.

## **10.0 REFERENCE POINTS**

- 10.1 Contractor shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 10.2 All such reference points shall be in relation to the levels and locations given in the Architect/ Engineer in Charge and plumbing drawings.

## **11.0 REFERENCE DRAWINGS**

- 11.1 The contractor shall maintain one set of all construction drawings issued to him as reference drawings. These shall not be used on site.
- 11.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion (as built) drawings. All changes to be made shall be initialed by the Engineer in charge.
- 11.3 One complete set of construction drawings shall be made available to the execution engineer & shall be maintained in good condition throughout the execution activities.

## **12.0 SHOP DRAWINGS**

- 12.1 The contractor shall submit to the Architect/ Engineer In Charge four copies of the shop drawings.
- 12.2 Shop drawings shall be submitted under following conditions:  
a) Showing any changes in layout in the plumbing drawings.  
b) Foundation details, Nozzle Orientation, Equipment layout and piping, wiring diagram.  
c) Manufacturer's or contractor's fabrication drawings for any materials or equipment supplied by him.
- 12.3 The contractor shall submit four copies catalogues, manufacturers drawings, technical data sheet,

equipment characteristic data or performance charts as required by the Architect/ Engineer In Charge.

### **13.0 SITE CLEARANCE AND CLEANUP**

- 13.1 The contractor shall, from time to time clear away all debris and excess materials accumulated at the site.
- 13.2 After the fixtures, equipment and appliances have been installed and commissioned, contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.
- 13.3 On completion of all works, contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at contractors risk and cost.

### **14.0 TESTING**

- 14.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.
- 14.2 Tests shall be performed in the presence of the Engineer In Charge. The engineer in charge shall issue a certificate for approved testing of all systems duly signed & stamped.
- 14.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
- 14.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.
- 14.5 Contractor shall provide all labour, equipment and materials for the performance of the test.
- 14.6 After completion of work and during the maintenance liability period of contract, the work shall be subjected to "Post construction and testing". In case, if the materials incorporated in the work are found to be inferior, though the sample collected from the materials might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same without any cost to the Owner failing which the Owner may rectify the same at the risk and cost of the contractor or the Owner may accept the same as sub standard, and cost be adjusted from the outstanding security deposit as per the terms and condition of the contract for the work.

### **15.0 LICENSE AND PERMITS**

- 15.1 Contractor must hold a valid plumbing license issued by the Municipal authority or other competent authority under whose jurisdiction the work falls.
- 15.2 Contractor must keep constant liaison with the Municipal authority and obtain approval of all drainage and water supply works carried out by him.
- 15.3 Contractor shall obtain, from the municipal authority, completion certificate with respect to his work as required for occupation of the building.
- 15.4 All inspection fees or submission fees paid by the contractor shall be reimbursed by the Owner on production of valid official receipts

## **16.0 HANDING OVER DOCUMENTS**

- 16.1 On completion of work, contractor shall submit one complete set of as built drawings in editable soft copy and two hard prints of 'as built' drawings to the Engineer in Charge. These drawings shall have the following information:
- Run of all piping & diameters on all floors, terrace and vertical stacks.
  - GA Drawings for all pumping equipments with panels, drives etc...
  - Run of all water supply lines with diameters, locations, of control valves, access panels inside the utilities.
  - Location of all mechanical equipment with layout and piping connections & location of electrical panel for the same.
- 16.2 Contractor shall provide four sets of catalogues, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
- 16.3 All 'warranty cards' given by the manufacturers shall be handed over to the Architect/ Engineer in Charge.
- 16.4 Contractor shall provide Operation and Maintenance manual of all major Electro-mechanical equipments.
- 16.5 All test certificates of materials & testing at manufacturer works shall be submitted in one set of hard copy.
- 16.6 All site performance test certificates approved by Engineer in charge shall be submitted in one set of hard copy.

## **17.0 APPLICABLE CODES AND STANDARDS:**

- 17.1 Plumbing system design shall conform to plumbing design codes like National Building code– 2005, Part 9, Section 1, CPHEEO Manual, Handbook on Water supply & Drainage- SP 35, Public Health Engineering Handbook, Uniform Plumbing Code for India.
- 17.2 All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

**LIST OF INDIAN STANDARDS FOR PLUMBING**

The following IS codes shall be referred in execution of PH Engineering works.

<b>IS CODE</b>	<b>SUBJECT</b>
27 - 1992	Specifications for Pig Lead
269- 1989	Specifications for 33 grade Ordinary Portland Cement
407- 1981	Brass tubes for General purposes
456- 2000	Code of practice for Plain & Reinforced concrete.
458- 2003	Specifications for Concrete Pipes.
554- 1999	Dimensions for pipe thread where pressure tight joints are required.
636- 1988	Fire fighting hose ,rubber lined or fabric reinforced rubber lined woven -jacketed
638- 1979	Sheet rubber jointing & rubber insertion jointing
651- 1992	Specifications for Salt glazed stoneware pipes & fittings.
771 (Pt. I &VII)	Glazed Fire Clay Sanitary Appliances.
771- 1979 (Pt. I)	General requirements
771- 1985 (Pt. II)	Specific requirements of kitchen & laboratory sinks
771- 1979 (Pt. III/ Sec 1)	Specific requirements of urinals ( section 1- Slab urinals)
771- 1985 (Pt. III/ Sec2)	Specific requirements of urinals ( section 2- Stall urinals)
771- 1979 (Pt. IV)	Specific requirements of postmortem slabs.
771- 1979 (Pt. V)	Specific requirements of shower trays
771- 1979 (Pt. VI)	Specific requirements of bed pan sinks
771- 1981 (Pt. VII)	Specific requirements of slop sinks
774- 1984	Flushing cistern for water closet and urinals.
775- 1970	Cast iron brackets and supports for wash basin and sink.
778- 1984	Specifications for copper alloy gate & Globe check valves for water works
779- 1994	Water meters (domestic type)
781- 1984	Specifications for cast copper alloy screw down bib taps & stop cocks for water services
782- 1978	Specification for Caulking lead.
783- 1985	Code of practice for laying concrete pipes.
784- 2001	Pre-stressed concrete pipes.
884- 1985	Fire aid hose reel for firefighting (for fixed installation)
901 - 1988	Specification for couplings, double males & double female, instantaneous pattern for Fire Fighting
902 - 1992	Specification for suction hose couplings for Fire Fighting purposes.
903 - 1993	Couplings for fire hose delivery, branch pipe, nozzles specification

IS CODE	SUBJECT
904 - 1983	Specification for 2 way and 3 way suction collecting heads for Fire Fighting purposes.
905 - 1980	Specification for delivery breechings, dividing and collecting instant tenuous pattern for Fire Fighting
906 - 1988	Specification for revolving branch pipe for Fire Fighting
907 - 1984	Specification for suction strainer, cylindrical type for Fire Fighting purposes.
908- 1975	Fire Hydrants, Stand post type
909- 1992	Specifications for underground fire hydrants, sluice valve type
940 - 1989	Portable Fire Extinguisher, water Type (Gas Cartridge) - Specification
941- 1985	Specification for Blower and Exhauster for Fire Fighting.
1172- 1993	Code of basic requirements for water supply, drainage and sanitation
1200-1979 (Pt. 16)	Method of measurements for Laying of water and sewer lines including appurtenant items.
1200-1981 (Pt. 19)	Method of measurements for Water supply, plumbing and drains.
1230	Specifications for CI Rain Water pipes
1239- 2004 (Pt I)	Specifications for Mild steel tubes
1239- 1992 ( Pt. II)	Specifications for Mild steel Tubular & other wrought steel pipe fittings
1300- 1994	Phenol molding material specification
1536- 2001	Specifications for Centrifugally cast iron (spun) pressure pipes for water, gas and sewage
1537- 1976	Specifications for Vertically cast iron pressure pipes for water, gas and sewage
1538- 1993	Cast iron fittings for pressure pipes for water, gas and sewage
1700- 1973	Drinking fountains
1701- 1960	Combination valve , mixing valves
1703- 2000	Ball valve (horizontal plunger type) including floats for water supply.
1711- 1984	Self closing taps.
1726- 1991	Cast iron manhole covers and Frames.
1729- 2002	Cast /ductile iron drainage pipes & fittings for over ground NP pipeline S/S series.
1742- 1983	Code of practice for building drainage
1795- 1982	Pillar taps for water supply purposes
1879	Malleable Cast Iron Pipe Fittings
1978- 1982	Specification for line pipe (M S Seamless )
1979- 1985	Specification for high test line pipe



<b>IS CODE</b>	<b>SUBJECT</b>
2065- 1983	Code of practice for water supply in buildings.
2097 - 1983	Specification for foam making branch pipe.
2104- 1981	Water meter boxes (domestic type)
2171 - 1999	Specification for portable fire extinguisher, dry powder (Cartridge Type)
2190- 1992	Code of practice for selection ,installation & maintenance of portable first-aid fire extinguishers
2267- 1995	Polystyrene molding and extension materials - specification
2326- 1987	Automatic flushing cistern for urinals
2373	Specification for Water Meter (Bulk type)
2379- 1990	Color code for identification of pipe lines.
2401- 1973	Code of practice for selection, installation & maintenance of domestic water meters
2470 (Pt. I to II)	Code of practice for installation of septic tanks
2470- 1985 (Pt. I)	Design criteria & construction
2470- 1985 (Pt. II)	Secondary Treatment & disposal of septic tank effluent
2527- 1984	Code of practice for fixing rain water gutters and down pipes for roof drainage.
2546 - 1974	Specification for galvanized Mild Steel Fire bucket.
2548- 1996(Pt. I)	Plastic water closet seats and covers.
2548- 1996(Pt. II)	Plastic water closet seats and covers.
2556 (Pt. 1 to XV)	Specification for Vitreous (Vitreous China) sanitary appliances.
2556- 1994 (Pt.1)	General requirements
2556- 1994 (Pt.2)	Specific requirements of wash down water-closets
2556- 2004 (Pt.3)	Specific requirements of squatting pans
2556- 2004 (Pt. 4)	Specific requirements of wash basins
2556- 1994 (Pt.5)	Specific requirements of laboratory sinks
2556- 1995(Pt.6)	Specific requirements of urinals & partition plate
2556- 1995 (Pt.7)	Specific requirements of accessories for sanitary appliances
2556- 1995 (Pt.8)	Specific requirements of pedestal close coupled & wash down and siphon water closets
2556- 2004 (Pt.9)	Specific requirements of pedestal type bidets
2643- 1999	Type Threads where pressure tight joints are not mase on the threads dimension, tolerances and designation
2692- 1989	Specification for Ferrules for water services.
2800- 1991 (Pt. I)	Construction of tube well
2800- 1979 (Pt. II)	Testing of tube well
2878 - 2004	Fire Extinguisher, Carbon Dioxide Type (Portable and Trolley Mounted) - Specification.



IS CODE	SUBJECT
2951 (Pt. I to II)	Recommendation for estimate of flow of liquids in closed conduits.
2951- 1965 (Pt. I)	Head loss in straight pipes due to frictional resistance
2951- 1965 (Pt. II)	Head loss in valves & fittings.
3006- 1979	Specification for Chemically resistant glazed S.W. pipes and Fitting
3076- 1985	Low density polyethylene pipes for potable water supply
3114- 1994	Code of practice for laying of Cast Iron pipes.
3311- 1979	Waste plug & its accessories for sinks & wash basins.
3328- 1993	Quality tolerances for water for swimming pools
3389- 1994	Urea formaldehyde molding materials
3486- 1966	Specification for Cast iron spigot and socket drain pipes
3489- 1985	Specifications for enameled steel bath tubs
3589- 2001	Specifications for steel pipes for water & sewage (168.3 to 2540 mm outside dia.)
3597- 1998	Method of test for concrete pipes.
3844- 1989	Code of practice for installation and maintenance of internal fire hydrants Hose reels in premises.
3950- 1979	Specification for Surface boxes for sluice valve.
3989- 1984	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings & accessories.
4038- 1986	Foot valves for water works purposes.
4111 (Pt. I to V)	Code of practice for ancillary structures in sewage system.
4111- 1986 (Pt. I)	Manholes
4111- 1985 (Pt. II)	Flushing tanks
4111- 1985 (Pt. III)	Inverted siphon
4111- 1968 (Pt. IV)	Pumping stations & pumping mains (rising mains)
4111- 1993 (Pt. V)	Tidal out-falls
4120- 1967	Tubs and baths.
4127- 1983	Code of practice of laying of glazed stone ware pipes.
4308 - 2003	Dry Chemical Powder for Fighting B & C class Fires- Specification.
4350- 1967	Specification for concrete porous pipes for under drainage.
4733- 1972	Methods of sampling & test for sewage effluents
4736- 1986	Specification for hot -dip zinc coating on mild steel tubes.
4854 (Pt. I to III)	Glossary terms for valves and their parts
4854- 1969 (Pt. I)	Screw down stop, check & gate valves & their parts
4854- 1968 (Pt. II)	Plug valves & cocks & their parts
4854- 1974 (Pt. III)	Butterfly valves
4927- 1992	Unlined flax canvass hose for fire fighting

<b>IS CODE</b>	<b>SUBJECT</b>
4947 - 1985	Specification for gas cartridge for use in Fire extinguishers.
4984- 1995	Specifications for HDPE pipes for water supply
4985- 2000	Specifications for un plasticized PVC pipes for potable water supplies
5290- 1993	Specifications for Landing valves.
5312 (Pt. I)	Swing check type reflux (non return ) valves
5312- 1984 (Pt. I)	Reflux (non return ) valves – single door pattern
5329- 1983	Code of Practice for sanitary pipe work above ground for building
5330- 1984	Criteria for design for anchor blocks for pen-stocks with expansions joints.
5382- 1985	Specifications for rubber sealing rings for water, gas & sewer mains
5455- 1969	Cast iron steps for manholes
5600- 2002	Specifications for Sewage and drainage pumps
5611- 1987	Code of Practice for waste stabilization ponds (Facultative type)
5714- 1981	Specifications for Hydrant stand-pipe for fire fighting
5822- 1994	Code of Practice for laying of welded steel pipes for water supply
5961- 1970	Specifications for CI grating for drainage purposes
6234 - 2003	Portable fire Extinguisher water Type (Stored Pressure) – Specification.
6279- 1971	Equipment for grit removal
6280- 1971	Sewage screens
6295- 1986	COP for water supply & drainage in high altitude & / or sub-zero region
6392- 1971	Steel pipe flanges
6411- 1985	Specifications for gel coated glass fiber reinforced polyester resin bath tubs
6418- 1971	Cast Iron & malleable flanges for general engineering Purpose
6494- 1988	COP for water proofing of underground water tanks & swimming pools
6587- 1987	Specifications for Spun hemp yarn
7181- 1986	Horizontally Cast Iron Double Flanged pipe for water, gas & sewage.
7231- 1994	Specifications for Plastic Flushing Cisterns for water closet & urinals
7558- 1974	Code of Practice for domestic hot water installations
7634 (Pt. I to III)	Code of Practice for Plastic pipe work for potable water supplies
7634- 1975 (Pt. I)	Choice of materials & general recommendations

<b>IS CODE</b>	<b>SUBJECT</b>
7634- 1975 (Pt. II)	Laying & jointing polyethylene (PE) pipes
7634- 2003 (Pt. III)	Laying & jointing un plasticized PVC pipes
7740- 1985	Code of Practice for road gullies
7834 (Pt. I to VIII)	Injection molded PVC socket fittings with solvent cement joints for water supplies
7834 - 1987(Pt. I)	General requirements
7834- 1987 (Pt. II)	Specific requirements for 45 0 elbows
7834- 1987 (Pt. III)	Specific requirements for 90 0 elbows
7834- 1987 (Pt. IV)	Specific requirements for 90 0 tees
7834- 1987(Pt. V)	Specific requirements for 45 0 tees
7834- 1987 (Pt. VI)	Specific requirements for sockets
7834- 1987(Pt. VII)	Specific requirements for unions
7834- 1987 (Pt. VIII)	Specific requirements for caps
8008 (Pt. I to VII)	Injection molded HDPE fittings for potable water supplies
8008- 2003 (Pt. I)	General requirements for fittings
8008- 1976 (Pt. II)	Specific requirements for 90 0 bends
8008- 2003 (Pt. III)	Specific requirements for 90 0 tees
8008- 2003 (Pt. IV)	Specific requirements for reducers
8008- 2003 (Pt. V)	Specific requirements for ferrule reducers
8008- 2003 (Pt. VI)	Specific requirements for pipe ends
8008- 2003 (Pt. VII)	Specific requirements for sandwich flanges
8090- 1976	Coupling, branch pipe, nozzle used in hose reel tubing for fire fighting
8329- 2000	Centrifugally cast (spun) ductile iron pressure pipes & fittings for water, gas & sewage
8413 (Pt. I)	Requirements for biological treatment equipment
8718- 1978	Specifications for vitreous enameled steel kitchen sinks
8727- 1978	Specifications for vitreous enameled steel wash basin
8835- 1978	Guideline for planning and design of surface drains.
8931- 1993	Specifications for copper alloys Fancy single taps, combination tap assembly & stop valves for water services
9140- 1996	Method of sampling of vitreous & fire clay sanitary appliances
9338- 1984	Specifications for Cast Iron screw down stop valves and stop & check valves for water works purposes
9739- 1981	Specifications for Pressure reducing valves for Domestic water supply system.
9758- 1981	Flush valves and Fittings for water closets and urinals
9762- 1994	Specifications for polyethylene floats for float valves
9763- 2000	Specifications for Plastic Bib taps, pillar taps, angle valves and stop valves for hot & cold water service.

IS CODE	SUBJECT
10221- 1982	Code of practice for coating and wrapping of underground M.S. steel pipeline,
10500- 1991	Specification of Drinking water
11189- 1985	Method of tube well development
11606 - 1986	Method for sampling of cast iron pipes and fittings.
11632 - 1986	Rehabilitation of Tube well
12183- 1987 (Pt. I)	Code of practice for Plumbing in multi-storied buildings (for water supply)
12231 - 1987	UPVC pipes for section & delivery lines of agricultural pumps-Specification.
12235 - 1986	Method of test for UPVC pipe for potable water supply
12288 - 1987	Code of practice for use and laying of Ductile Iron pipes.
12469 - 1988	Specifications for pumps
12592- 2002	Precast concrete frame & cover ( SFRC frame & cover )
12701-1996	Specifications for rotational molded polyethylene water storage tanks
12709 - 1994	Glass fiber reinforce plastic(GRP) pipes, joints & fittings for use for potable water supply – Specification.
12818 - 1992	Spn. for UPVC ribbed screen casing & plain casing pipes for bore / tube well
12820 - 1989	Dimensional Req. of Rubber Gaskets for Mechanical Joints & push in joints for use with Cast Iron Pipes & fittings for carrying water, Gas & sewage.
13095 - 1991	Butterfly valves for general purposes
13114 - 1991	Spn. for forged brass gate, globe & check valves for water works purposes
13382-2004	Cast Iron specials for mechanical & push-on flexible joints for pressure pipelines for water, gas & sewage
13592- 1992	Specifications for PVC soil, waste & rain water (SWR) including ventilation pipes
13593 - 1992	UPVC pipes fittings for use with section and delivery lines for Agricultural pumps – Specification.
13916 – 1994	Code of practice for installation of GRP piping system.
13983-1994	Specifications for stainless steel kitchen sinks & drain boards for domestic purpose
14333-1996	Specification for HDPE pipes for sewerage system.
14402-1996	GRP pipes, joints & fittings – Specification.
14735-1999	UPVC injection molded fittings for UPVC – SWR pipes – Specifications.
IS CODE	SUBJECT
14845- 2000	Resilient seated cast iron air relief valves for water works purposes – Spn
14846- 2000	Specifications for sluice valve for water works purposes

	(50 to 1200 mm size )
15265 - 2003	Specifications for flexible PVC pipes or polymer reinforcement thermo plastic hoses for suction and delivery lines for Agricultural pumps.
15328 - 2003	UPVC non pressure pipes for use in underground drainage and sewerage system - Specifications.
15450- 2004	Polyethylene/Aluminum/Polyethylene composite pressure pipes for hot and cold water supplies - Specifications.



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## SECTION 2: SPECIAL CONDITIONS

### 1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

### 2. SCOPE OF WORK

- The general character and the scope of work to be carried out under this contract are illustrated in Drawings, Specifications and Schedule of Quantities.
- The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative.
- The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing / Sanitary system as described in the Specifications and as shown on the drawings.
- This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.
- The Plumbing / Sanitary System shall comprise of following:
  - a. Hydro pneumatic system with pressure vessel and VFD
  - b. PLC Panels, Pressure switches and other item for satisfactory functioning of the system.
  - d. Other Miscellaneous Items.
  - e. Approval from Local Authorities
  - f. Wiring & earthing from MCC panels to various plumbing systems, control wiring & interlocking.
  - g. Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, frame works, fire proofing, providing sleeve, cover plates, making good structure and finishes to an approved standard.
  - h. Balancing, testing & commissioning of the entire plumbing system.
  - i. Test reports, list of recommended spares, as-installed drawings, operation & maintenance manual for the entire plumbing system.
  - j. Training of Owner's staff.

### 3. ASSOCIATED CIVIL WORKS

Following civil works associated with Plumbing / Sanitary installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Plumbing / Sanitary contractor.

- i. All PCC and/or RCC works related to water tanks, foundation for machines, pumps & large equipment.
- ii. All fabrication works related to angle iron frame work at the edges to protect these from damage.



- ii. Masonry drains channels and sumps in basement / cellars / plant rooms.

#### 4. ASSOCIATED WORKS

All associated **ELECTRICAL WORKS** listed below are excluded from the scope of this contract.

These shall be installed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Plumbing / Sanitary contractor.

- i. Providing power supply with earthing at the incoming of control panel in plant room.

#### 5. BUILDING AUTOMATION SYSTEM

The scope of Plumbing / Sanitary Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

- i. Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.
- ii. Potential-free 'NO' contacts for monitoring 'RUN' status of equipment wherever required.
- iii. Necessary contactor with potential-free contacts and Stop/Manual/ Auto switches to be provided for all 1-phase equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.
- iv. Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.
- v. The space provision in all the equipment panels (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing / Sanitary contractor. Separate current transformers shall be provided by Plumbing / Sanitary contractor for monitoring current / KWH (wherever required) through BAS.
- vi. The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing / Sanitary contractor. All transducers shall be supplied by BAS contractor.
- vii. The low voltage BAS Cables shall be brought up to the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing / Sanitary contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing / Sanitary system, lies solely with the contractor.
- viii. All necessary Hardware/ Software shall be made available by the Plumbing / Sanitary Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS.

## **6. IMPORTED EQUIPMENT**

The successful tenderer shall submit upon award the following to facilitate the Owner in their application for concessional duty for equipment/material proposed to be directly purchased and imported by them.

- a. Four copies of pro-forma invoice from Manufacturer/Supplier drawn in the name of Owner identifying FOB price from the country of origin and Freight cum Insurance up to site.
- b. Four sets of Technical Literature, high lighting model number and all technical details of the actual equipment/material offered by them.
- c. Successful bidder shall indicate packing specification for imported equipment / material.
- d. Successful bidder shall furnish undertaking from local agents for all imported equipment that they will provide all technical data & engineering information on the product through their principles, all back-up services during detailed engineering testing and commissioning and service during and after the defects liability period.

## **7. PROJECT EXECUTION AND MANAGEMENT**

The contractor shall ensure that senior planning and erection personnel from their organization are assigned exclusively for this project. They shall have a minimum of 5 years experience in this type of installation.

The contractor shall appoint one Project Director, holding senior management position in the organization.

The contractor shall have on full time basis a minimum of two erection engineers & three senior supervisors, along with all necessary and fully equipped erection staff at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, modem, computers, plotter and photocopier. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

The Contractor shall arrange to have mechanized & modern facilities of transporting material to place of installation for speedy execution of work.

## **8. PERFORMANCE GUARANTEE**

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the Plumbing / Sanitary system as installed shall maintain the design conditions as described under "Basis of Design" and relevant clauses in the specifications.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipments individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

## **9. BYE-LAWS AND REGULATIONS**

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

## **10. FEES AND PERMITS**

The contractor shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation.

## **11. DRAWINGS**

The Plumbing / Sanitary Drawings listed under Appendix-I, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment and water supply / drainage piping etc.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

## 12 TECHNICAL DATA

Each tenderer shall submit along with his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

## 13. SHOP DRAWINGS

13.1 All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room, Typical toilets drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III and quoted by the tenderer in technical data part of Appendix - IV.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/ installation.

13.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

13.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

13.4 Samples of all materials like valves, pipes, insulation, control wires etc shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

13.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

13.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.

13.7 Plumbing / Sanitary Contractor shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, HVAC & Low Voltage Contractors to ensure adequate clearances are available for installation of services for each trade.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

13.8 Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

#### **14. QUIET OPERATION AND VIBRATION ISOLATION**

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the desired NC levels.

#### **15. ACCESSIBILITY**

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall bear clear nomenclature / shall be clearly marked.



## **16. MATERIALS AND EQUIPMENT**

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

## **17. MANUFACTURERS INSTRUCTIONS**

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

## **18. ELECTRICAL INSTALLATION**

The electrical work related to Plumbing / Sanitary services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All equipment shall be connected and tested in the presence of an authorized representative of the contractor.

The Plumbing / Sanitary system shall be commissioned only after the contractor has certified in writing that the electrical installation work for Plumbing / Sanitary services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturer's instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for Plumbing / Sanitary services, lies solely with the contractor.

## **19. COMPLETION CERTIFICATE**

On completion of the Electrical installation for Plumbing / Sanitary, a certificate shall be furnished by the contractor, counter signed 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 entire electrical installation for Plumbing / Sanitary system duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

## **20. BALANCING, TESTING AND COMMISSIONING**

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.



## 21. COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the plant room, one set of these consolidated control diagrams.

## 22. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Plumbing / Sanitary system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

***“Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual”.***

## 23. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

## 24. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

### 24.1 Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

### 24.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

## 25. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. Starting and stopping times for various equipments, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

## 26. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the Plumbing / Sanitary installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of three years beyond the defects liability period.

### 26.1 Operation contract Plumbing Systems

- i. 24 hours a day, year round.
- ii. All stand-by equipment to be operated as per mutually agreed program.
- iii. Proper entry and up-keep of relevant log books.
- iv. Maintain complaints register. Submit weekly report.
- v. Proper housekeeping of all areas under the contract.
- vi. Prepare daily consumption report and summary of operation.

### 26.2 Terms of payment

- i. Monthly at the end of each month on pro-rata basis.

### 26.3 All Inclusive Maintenance Contract

- a. Routine Preventive Maintenance Schedule to be submitted
  - i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
  - ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.

iii. Monthly status report.

iv. Entire Plumbing / Sanitary & Drainage installation to be painted in fourth year (from commissioning) before the expiry of operation and maintenance contract.

b. Uptime during maintenance contract

i. 98% uptime of all systems under contract.

ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.

iii. There shall be no reimbursement for the extended period.

iv. Break-downs shall be attended to within ten hours of reporting.

v. Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.

c. Manpower

i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.

ii. Statutory requirements of EPF, ESIC and other applicable labor legislations to be complied with; and monthly certification to that effect to be submitted.

iii. Duty allocation and Roaster control shall be contractor's responsibility.

iv. No overtime shall be payable by Owner for any reason whatsoever.

d. Shut Downs

i. Routine shut downs shall be permitted only during winter season.

ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

e. Payment Terms

i. Quarterly payment at the beginning of each quarter on pro-rata basis.

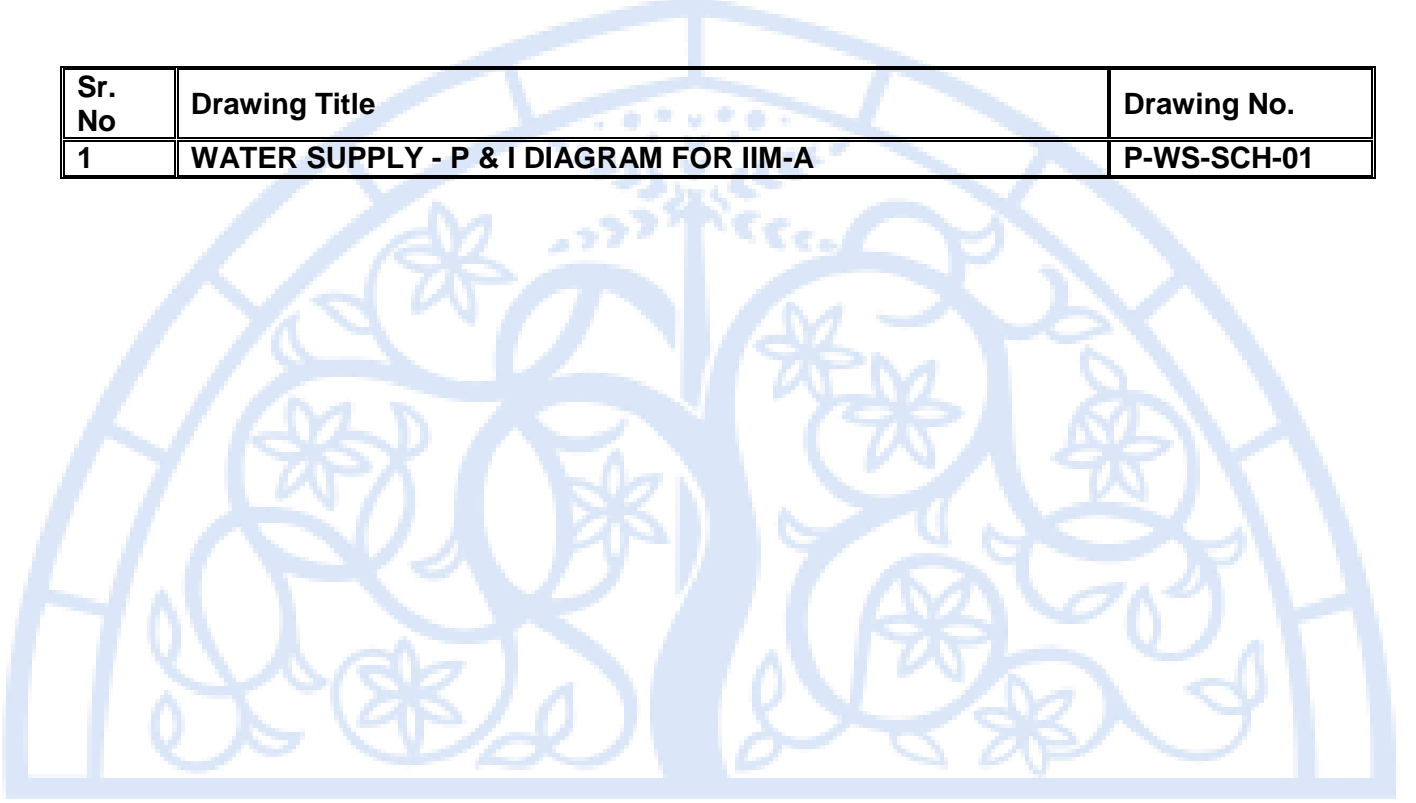
## 27. PARTIAL ORDERING

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderer.

**APPENDIX-I**

**LIST OF DRAWINGS**

Sr. No	Drawing Title	Drawing No.
1	WATER SUPPLY - P & I DIAGRAM FOR IIM-A	P-WS-SCH-01



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**LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS****PLUMBING SYSTEM**

<b>Sr. No.</b>	<b>Details of Materials / Equipment</b>	<b>Manufacturer's Name</b>
8	Flow Control Devices	Aquaplust / Con-Serv / Jaquar / RST
15.	Cast Iron Pipes & Fittings Manhole covers and frames	
	a. As per IS:3989 (Pipes & Fittings)	KAPILANSH / NECO
	b. As per IS:1729 (Manhole covers and frames)	NECO /
	c. As per IS:1536 (CI Class LA Pipes)	Electro Steel Calcutta / IISCO / Kesoram Calcutta
	d. D.I. Manhole Covers & Frames	NECO / Equivalent
	e. CILA fittings	Kartar valves & fittings
17.	C.I. Pipe Joints	Aqua Bond / Drip Seal
18.	GI / M.S Pipes (IS : 1239 and IS : 3589)	AST pipes / Jindal / Tata Steel
19.	GI pipes fittings	Unik / Zoloto M
20.	GI pipe sealant	Henkel - LOCTITE 55
21	Pipe clamp & supports	Chilly / Euroclamp
22.	D. I. Pipes	Welspun / Jindal / Lanco Kalahasthi
27.	CPVC pipes	Supreme / Ashirwad / Astral
32.	SS Pipes	Viega / Tata Steel / Jindal Steel / SAIL
33.	GM / Forged Brass Valves	Danfoss / Honeywell / Zoloto
34.	Sluice Valves	Indian Valve Company / Kirloskar / Marck / Zoloto
35.	Butterfly Valve	Audco / CRI / Danfoss / Honeywell / Zoloto
36.	Check Valve – Wafer Type	Advance / Danfoss / Kirloskar / Zoloto
37.	Check Valve – Dual Plate	Advance / Danfoss / Kirloskar / Zoloto
38.	Pressure Reducing Valve	Fouress / Honeywell / RB / Zoloto
39.	Solenoid Valve	AIRA / Avcon / Danfoss / Honeywell
40.	Thermostatic valve	Oventrop
41.	Air Release Valve	Arco / Fouress / ITAP / Zoloto
42.	Ball Float Valve	Esseti / HBD / Zoloto
43.	NRV – Ball type – Sewage application	Danfoss / Silverspark
44.	Y Strainer	Emerald / Marck / CAIR / Zoloto
45.	Hydro pneumatic System	Wilo - Mather & Platt / Grundfos / Kirloskar / KSB
48.	Transfer Pumps	Wilo - Mather & Platt / Grundfos / Kirloskar / KSB
49.	Self-Priming Pumps	Wilo - Mather & Platt / Johnson / Kirloskar
52.	Mechanical Seal	Burgmann / Sealol
53.	Couplings	Lovejoy
54.	Anti Vibration Mounting & Flexible Connections	Cori / Dunlop / Flexionics / Resistoflex
55.	Pressure Gauge	Emerald / Fiebig / H Guru
56.	Water Meter (Mechanical Type)	Actaris / Capstan / Kaycee / Kranti / Sant
57.	Electronic Flow Meter	Krohne (Forbes Marshall) / Rockwin
58.	Level Controller & Indicator (Water)	Auto Pump / Cirrus Engineering / Technika / Techtrol
59.	Paints	Asian Paints / Berger / ICI / Shalimar Paints



64.	Three Way Motorized Valve	Honeywell / Invensys / Johnson Control
65.	Welding Rods	ADOR / Cosmos / Esab / Super Bond (S)
66.	Fastener	Fisher / Hilti
	Pressure Transducers	Danfoss/ Honeywell/ Equivalent

**LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS**  
**ELECTRICAL SYSTEM**

Sr. No.	Details of Materials / Equipment	Manufacturer's Name
1	Power Distribution Panel and Motor Control Centre (Can be selected as per project location)	Antia Electricals / Arrow Engineers / Popular Switchgear / Power Control Engineering / Scoot Engineering / Sterling & Wilson / Square"D"Automation / Zenith Engineering or Equivalent
2.	Final Distribution Board	ABB / GE Power Controls / Hager (L&T) / Havells / MDS Legrand / Siemens / Schneider Electric (MG) or Equivalent
3.	Motor	ABB / Bharat Bijlee / Kirloskar / Siemens
4.	Soft Starter	ABB / Allen Bradley / Schneider / Siemens
5.	Variable Speed Drives	ABB / Danfoss / Siemens
6.	Starter, Contractor, Push-Button	GE Power Controls / Larsen & Toubro ((ESBEE) / Schneider Electric (MG) / Siemens / Vaishno Electricals
7.	Air Circuit Breaker ( 3/4 Pole )	ABB( E-Max) / GE Power Controls (M-Pro) Spetronics) Larsen & Toubro (U-Power) C-Power) / Schneider Electric (Master Pact NW) Enerpact ) / Siemens (3 WL)
8.	Moulded Case Circuit Breaker (MCCB)	ABB (Isomax/ T – Max) / GE Power Controls (Record Plus/ LM/ LM Pro) / Larsen & Toubro (D-Sine) / MDS Legrand / Schneider Electric (Compact MS/ Simpact) / Siemens ( 3WL) or Equivalent.
9.	Motor Protection Circuit Breaker(MPCB)	ABB / GE Power Control / Hager ( Marketed by Larsen & Toubro) / Schneider Electric / Siemens
10.	Automatic Transfer Switch (ATS)	ASCO USA (Marketed by Tricolite) / GE Power Control
11.	Miniature Circuit Breakers (MCB)	ABB / GE Power Controls / Hager (L&T) / Havells(Export Range) / MDS Legrand / Schneider Electric (MG) – Multi – 9 / Siemens or Equivalent
12.	Residual Current Circuit Breaker (RCCB)	ABB / GE Power Controls / Hager (L&T) / Havells (Export Range)/ MDS Legrand / Schneider Electric (MG) / Siemens or Equivalent
13.	Power/Aux. Contactor	ABB / GE Power Control / Larsen & Toubro / Schneider Electric (Telemecanique) / Siemens
14.	Change Over Switch	Havells / H H Elcon / HPL – Socomec / L&T
15.	Control Transformer/Potential Transformers	Automatic Electric / Gilbert & Maxwell / Indcoil / Matrix / Pragati / Precise
16.	Current Transformer (Epoxy Cast Resin)	Automatic Electric / Gilbert & Maxwell / Indcoil / Matrix / Pragati / Precise
17.	Protection Relay	
	a. Numeric Type	ABB / Areva / L&T / Prok Devices Pvt. Ltd. / Siemens
	b. Electromagnetic Type	ABB / Areva / L & T
18.	Indicating Lamps LED type and Push Button	Altos / GE Power Controls / L&T (ESBEE) / Schneider

		Electric (MG) / Siemens /
19.	Overload relays with built in Single Phase preventer	Teknik / Vaishno Electricals
20.	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display	ABB / GE Power Controls / Larsen & Toubro Schneider Electric(Telemechanique) / Siemens or Equivalent
21.	Dual Energy Meter with centralized metering & billing system	ABB / Automatic Electric / CG Scumberger Conzerv / IME / L & T / Nippen / Schneider Electric Secure or Equivalent
22.	Prepaid Meters & accessories	Schneider Electric / Nippen / Actaris / Conzerve / Secure
23.	Electromagnetic Meters	Automatic Electric / Rishabh (L&T)
24.	Static Power Meter & Logger (SPML) With RS 485 port	Conzerv / Ducati / IME / Larsen & Toubro Nippen / Schneider Electric
25.	Power Capacitor	ABB / Ducati / GE Power Controls / Matrix Meher (Larsen & Toubro) / Siemens (Epcos)
26.	Automatic Power Factor Correction Relay (Numeric Type)	Areva / BELUK (Germany) / Conzerv / Datar Ducati / Siemens
27.	Thyristered APFC Control Panel	ABB / Datar / Ducati / Meher(Larsen & Toubro) / Power Matrix Solutions / Siemens
28.	PVC insulated XLPE aluminium/copper conductor armoured MV Cables up to 1100 V grade	Anchor / Finolex / Havells / RR Kabel or Equivalent
29.	LT Jointing Kit / Termination	Raychem / Safe Kit
30.	Cable Glands Double Compression with earthing links	Baliga Lighting / Comet / Cosmos
31.	Bimetallic Cable Lug	Comet / Cosmos / Dowell's (Biller India) Hax Brass (Copper Alloy India)
32.	PVC insulated copper conductor stranded flexible wires (FRLS) -	Anchor / Finolex / Havells / RR Kabel or Equivalent
33.	Metallic / GI Conduit (ISI approved)	AKG / BEC / NIC / Vimco
34.	Accessories for Metallic /GI Conduit (ISI approved)	Prakash Engineering Works / Sharma Sales Corporation Super Sales Corporation
35.	PVC Conduit & Accessories (ISI approved)	AKG / BEC / D Plast / Duraline Polypack / Precision
36.	a) Switch & Socket	MK India / Anchor / Clipsal (Neo-Series) / MDS Legrand (Exelute)
	b) Electronic Switches (applicable only for electronic switching of Hotel Guest Rooms)	ABB(EIB Solution) / Clipsal ( ULTI Switches) Mertin( EIB Solution) / Minixon
34.	Industrial Socket	
	a. Splash Proof	Clipsal / Gewiss / MDS Legrand / Neptune Balls RR-PCE / Schneider Electric
	b. Metal Clad	BCH / MDS
35.	Selector Switch, Toggle switch	Kaycee / Salzer (Larsen & Toubro)
36.	Timer	ABB / BCH / GE Power Control / Larsen & Toubro MDS Legrand / Schneider Electric (Telemechanique) Siemens
41.	Fire Sealant & Fire Retardant Paint	BTHM Engineering / Birla 3 M / HILTI / Promat
42.	Lighting & Surge Voltage Protection	ABB / Hager ( Marketed by L&T) / Obeo Betterman Schneider Electric

**APPENDIX-IV****SCHEDULE OF TECHNICAL DATA**

1.	<b>HYDROPNEUMATIC PUMPS</b>	<b>(VFD)</b>
	<b>Pump</b>	
	Make	
	Type & Model	
	Discharge in cum/hr	
	Head (Meters of WC)	
	Number of Pumps	
	Total system flow (cum/hr)	
	Shut off Head (Meters of WC)	
	Efficiency (%)	
	No. of Stages	
	Suction End I.D.	
	Delivery End I.D.	
	Details of N.P.S.H.	
	Vibration Isolation Detail	
	Skid Details	
	Operating Weight	
	Overall Dimension (MM)	
	Mechanical Seal Detail	
	<b>Material</b>	
	Body	
	Impeller	
	Type of Impeller	
	Shaft	
	Is it suitable for direct coupling	
	<b>Motor</b>	
	Make	
	Model	
	Power Requirement (HP / KW)	
	R.P.M.	

Rating	
Over Load Capacity	
Class of Insulation	
Details of Additional protection in winding	
Motor Efficiency	
It is suitable for direct coupling to pump?	
Type of rotary movement	
Method of Starting	
Size and type of cable for connections.	
Number of variable frequency drive	
Detail of VFD	
<b><u>Pressure Vessel</u></b>	
Make	
Model Number	
Material of construction (Vessel/Bladder)	
Dimension	
Overall capacity	
Cut-in/Cut-out setting	
Capacity at specified cut-in/cut-out	
Overall dimension of skid mounted system	
Weight (Static/Dynamic)	

**4. ELECTRICAL ACCESSORIES**

**4.1 Make of the following:**

- a. Motor Control Centre (Electrical Panel)
- b. Vacuum circuit breaker
- c. Air circuit breaker
- d. MCCB
- e. MCB
- f. Rotary switch
- g. Soft Starter
- h. Auto-transformer Starter
- j. Automatic Star Delta Starter
- k. Direct on line Starter
- l. Contactor
- m. Current Transformer (cast resin type)
- n. Single phase preventer
- o. Push Button
- p. Change over switch
- q. Ammeter & Voltmeter  
KWH meter
- r. Relay
- s. Indication lamp
- t. Cables
- u. Wires
- v. Variable Frequency Drive.



5. **ELECTRICAL TECHNICAL DATA SHEETS:**

5.1 **For MCC + PDBs + MLDBs/SLDBs/DBs (To be filled by the bidders)**

Sr. No.	Description	Recommended Specification	Confirmation by the Bidders
1	Type of Panel	a. MCC non draw out type compartmentalized. b. Panels non raout type, non compartmentalized	
2	Type of Mounting	Free standing Floor Mounted	
3	Fault kA	25kA -1 Sec for MCC	
4	Thickness of CRCA sheets		
a	Structural members	2mm	
b	Covers and doors	2mm	
c	Base channel	MCC - ISMC 100	
d	Gland plate	3mm	
5a.	Painting/ Process	Synthetic Enamel Paint as per seven tank process Oven baked.	
b	Paint shade; a. Inside b. Outside	RAL – 7032 RAL - 7032	
6	Details of bus bars	Electrolytic grade Copper of specified rating for details see constructional features mentioned in specifications	
7	Cable Entry	For MCC & other Panels Top or Bottom depending upon location of Panel.	
8	Enclosure Protection/ Ventilation	For MCC – IP -52 with louvers for Ventilation.	
9	Control Wiring/ Power Wiring	Insulated 660Volts Cu wire.	
a.	Voltage Circuit	1.5 sq mm	
b.	Current Circuit	2.5 sq mm	
c.	Minimum size of Power wiring CKt	16 sq mm	
10	Maximum Operating Height	2100	
11	Mounting height of Relays/Meters Control Switches	Range 350mm to 1900mm	

**5.2 Constructional Features of MCC (To be filled by the bidders)**

Sr. No.	Description	Recommended Specification	Confirmation by the Bidders
1	MCC		
a.	Bus bar Chamber	400mm ht	
b.	Metering Chamber	400mm ht	
c.	Incoming Compartment	1000mm wide Module Single Tier	
d.	Overall Height	2100 mm	
e.	Overall Depth	1300 & 900 mm	
f.	Overall Length	( To be indicated by the bidder)	
g.	Construction	IP-52 with louvers for ventilation	
h.	Current Density	1.25 Amp / Sq.mm	
i.	Main Bus	1.6 Amp / Sq.mm	
ii.	Branch Bus Rating	75% of aggregate Switches connected. 1.25 Amp / Sq.mm Density	
iii.	Neutral Bus	Half of the size of phase bus	
iv.	Earth Bus	Half of the size of phase bus	
j.	Incoming and outgoing feeders.	As per SLD	
2	AHU Panels		
a.	Accessibility	front accessible only	
b.	Overall Depth	300 mm	
c.	Overall Height	700 mm	
d.	Incoming compartment	Individually one module of 600mm wide with direct entry of incoming cables with cable bus bars for terminating multiple incoming cables. incoming metering units and outgoing cables as per SLD.	

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### **SECTION-3: BASIS OF DESIGN**

The Plumbing – Water Supply Systems for the project is designed keeping in view the following:

#### **1.1 Current Scenario:**

At the old campus of Indian Institute of Management, Ahmedabad, the total water supply is done from an existing Elevated Sump Reservoir (ESR) at the Utility Block.

The water supply presently is being done from an ESR at 100ft height from Ground Level. Thereby, having a pressure of 3.2 kg/cm<sup>2</sup> at the starting point of the distribution network.

Since the length of the network is such that it is not feasible to achieve the desired pressure at the final block from the ESR, the site has an intermediate UGT with Hydro-pneumatic pump set, which not only caters to the water demand, as also provides the additional boost to the water supply so as to achieve the required pressure at the end tap in all residential blocks.

The structural capabilities of the ESR have now withered due to the age of the building and various environmental & geographical effects. Hence the client is requiring, replacing the traditional method of gravity based water distribution to modern electro-mechanical hydro-pneumatic pump system.

#### **Opportunities & Threats of the existing system:**

##### **Opportunities:**

Existing pipe network is of C.I. 'LA' Class & Galvanized Mild Steel, buried within the premises and catering to the requirements. Hence new piping network would not be required.

##### **Threats:**

With the new pumping system, to be installed, the physical bearings of the existing system would be tested, and there are chances that the pipe line may not be able to withstand the pressure from pump up to the end tap. Thereby, demanding a replacement of the entire piping network within the campus.

#### **Strengths and Weaknesses:**

##### **Strengths:**

The campus has full time in-house engineering team to monitor the mechanical and electrical systems, hence attending to the various maintenance calls would be instant and fast.

##### **Weaknesses:**

The currently laid pipes and the connections are not clearly available due to the absence of detailed consultant drawings. Hence the entire system would only be highlighted when the actual ruptures within the pipes would appear. Hence the new proposal would have to worked out based on certain assumptions, which may or may not be in reply with the actual scenario at site.

**02: CONCEPT OF THE SYSTEM**

The following services are envisaged for the complex:

- 2.1 Water Treatment System for meeting the domestic water quality requirement with chemical parameters in acceptable limits as per IS: 10500; SP:35(S & T) 1987, which are considered safe for potable water quality.
- 2.2 Domestic water supply through Hydro-pneumatic System for making water available at the residual pressure 1.5 kg / sq.cm.
- 2.3 Common Domestic Water Supply line and Garden Irrigation branch outlets for horticulture operation.

**03: DESIGN CALCULATIONS:****3.1 Water Requirement**

The consumption is at present is maximum goes to 12-13 lac litres per day.

Nearly 600,000 litres is consumed for domestic uses, while the rest is consumed in irrigation of the landscaped areas within the campus.

The total population at site is approx. 3000 persons.

Based on the above, the approx. per capita consumption is 200 LPD.

Hence for the new proposal, the water demand is considered as 1,200,000 litres per day as per the following peak demands:

- 60% domestic demand during 0600 hrs to 0900 hrs.
- 100% irrigation demand during 0900 hrs to 1800 hrs.
- 20% domestic demand during 0900 hrs to 1800 hrs.
- 20% domestic demand during 1800hrs to 2100 hrs.

The above equates to the following:

Sr. No.	Demand	Litres	Percentage Use	Time		Total Demand
				From	To	
01	Domestic	600,000	60%	06:00 Hrs	09:00 Hrs	360,000 Ltrs
02	Irrigation	600,000	100%	09:00 Hrs	18:00 Hrs	600,000 Ltrs
03	Domestic	600,000	20%	09:00 Hrs	18:00 Hrs	120,000 Ltrs
04	Domestic	600,000	20%	18:00 Hrs	21:00 Hrs	120,000 Ltrs

From the above table, therefore, it can be inferred that:

Demand per hour during:

- 06:00 Hrs to 09:00 Hrs will be 2000 LPM
- 09:00 Hrs to 18:00 Hrs will be 1400 LPM

18:00 Hrs to 21:00 Hrs will be 500 LPM.

3.2 **Source of Water**

The water supply provisions at site are as under:

1. Main water tank at service tower: - Main Bore Well Supplying to this UGT
2. Overhead tank at service tower: - Transfer Pumps in Plant Room providing water to OHT.
3. Water tank near residence gate: - Separate Bore Well Supplying to this UGT.
4. AMC water supply: - 30000 litres near AZAD gate

3.3 **Water Storage**

The water storage provisions at site are as under:

1. Main water tank at service tower: - 5 lac UG
2. Overhead tank at service tower: - 2.5 lac
3. Water tank near residence gate: - 5 lac UG

3.4 **Water Quality**

It is proposed that for the entire site, the water quality shall be as per standards mentioned in IS: 10500.

**04: WATER TREATMENTS:**

In case required, the following treatments can be proposed:

1. Basic Filtration: Disc Filters / Helical Filters / Pressure Sand Filters / Activated Carbon Filters / Multi-grade filters, are the options available for basic filtration of water, mainly targeting to remove the Suspended Solids in the incoming water from Bore Well.
2. Basic Treatment: Ionic Exchange of Dissolved Solids which, in higher proportions, result in calciferous depositions in the pipe line, thereby increasing the loads on the pumps and pipes. These treatment methods could be:
  - a. Softening: Replacing the  $\text{Ca}^{++}$  &  $\text{Mg}^{++}$  ions with  $\text{Na}^{++}$  ions, which are neutral ions, thereby generating  $\text{CaCl}_2$ , &  $\text{MgCl}_2$  ions, which are removed through back wash of the system. The water is subjected to NaCl Solution, during the treatment, which is also referred to as Brine Solution.
  - b. Descaling: Treated Water is then subjected to Anti-scalant chemicals, for removal of all forms of Silicates from the water.
3. Specialized Treatment: The above mentioned treated water, would be further treated to monitored standards, through specialized treatments as Reverse Osmosis and Ultra-violet radiation

However, as per the water test report received, the water is potable water and no treatment is needed for the same.



**05: WATER DISTRIBUTION:**

The water shall be distributed in the entire campus through the currently laid C.I. / D.I. Pipes, G.I. Pipes and CPVC Pipes, as per requirement.

This tender does not involve any works related to the water supply network provisions.

The main piping ring and headers are 200mm Dia. C.I. / D.I. Pipes with provision of Butterfly Valves / Gate Valves within valve chambers.

**06: WORKMANSHIP**

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Owner's Site Representative. All materials and/or Workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

**07: MATERIALS**

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Owner's Site Representative / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

#### **SECTION 4: TECHNICAL SPECIFICATIONS**

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal & external services as follows:

- a. Water supply pipe connection from Hydro-pneumatic Pumping System to Main Supply Line headers.
- b. Connection to various mechanical equipments to be supplied and installed within the Plant Room .

The Contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.

The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Owner.

#### **4.1 Piping Material:**

1. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install for water supply as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
2. Without restricting to the generality of the foregoing, the water supply system shall include the following:
  - a) All water supply lines to various parts of the building including connection to vertical stack/ main source line.
  - b) Pipe protection and painting.
  - c) Connections to existing main water supply header.
  - d) Ball valve/ butterfly valve/ Non Return valve/ Float valve/ Pressure relief valve/ Air valve, masonry chambers & other appurtenances.
  - e) Supports/ Clamps, Excavation& refilling of pipe trenches, required civil work.
  - f) Water meters, gauges, etc. required.

#### **GENERAL REQUIREMENTS**

1. All materials shall be new and of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
2. Pipes and fittings shall be of fresh material & shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
3. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections. As far as possible all bend shall be formed by means of a hydraulic pipe bending machine for pipe up to 65 mm diameter.
4. Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passage etc.
5. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

6. Pipe shall be securely fixed to wall and ceiling by suitable clamps at intervals specified.
7. Tender drawings indicate schematically the size and location of pipes. The contractor on the award of the work shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.
8. Pipe sleeves, 50 mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fiberglass and finished with retainer rings.
9. All pipe work shall be carried out in a work men like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work so that particular area work shall be carried out in one trench.
10. Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.
11. The contractor shall make sure that the clamps, steel structural supports brackets, clamp saddles and hangers provided for pipe supports are adequate.

#### **4.1.1 DUCTILE IRON PIPES & FITTINGS**

##### **4.1.1.1 SCOPE**

This specification covers the requirements for manufacture, supplying, lowering, laying, jointing, testing and commissioning of Ductile Iron pipes with fittings for the water conveyance & distribution system.

##### **4.1.1.2 MATERIAL**

4.1.1.2.1 DI pipes (Class K9) and fittings (Class 12) shall be in accordance with IS: 8329 and IS: 9523 respectively. Pipes and fittings shall be procured from reputed manufacturers. The Contractor or their authorized representative shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and for witnessing the test and manufacturing.

4.1.1.2.2 The pipes and fittings shall be stripped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects. In the case of spigot and socket pipes and fittings the socket shall be without the centre ring.

4.1.1.2.3 In the case of flanged pipes, the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically off the centre line. The bolt holes shall be concentric with the bore and bolt holes equally spaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipe shall be correctly aligned.

4.1.1.2.4 The materials used in the manufacture of pipes and fittings shall comply with requirements specified in IS: 8329 and IS: 9523.

#### 4.1.1.2.5 Dimensions and Tolerances

4.1.1.2.5.1 The internal diameter, thickness and length of barrel, dimensions of pipes and fittings shall be as per relevant tables of IS 8329/IS 9523 for different class of pipes and fittings. Each pipe shall be of uniform thickness throughout its length.

4.1.1.2.5.2 The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS 8329/IS 9523.

### 4.1.1.3 TESTING

#### 4.1.1.3.1 Mechanical Test

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329/ IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 8329. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to the Contractor or his authorized representative. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/ IS: 9523.

#### 4.1.1.3.2 Brinell Hardness Test

For checking the Brinell hardness, the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS: 1500. The test shall comply with the requirements specified in IS: 1500/ IS: 8329.

#### 4.1.1.3.3 Retests

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

#### 4.1.1.3.4 Hydrostatic Test

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

### 4.1.1.4 JOINTING

#### 4.1.1.4.1 General

Jointing of DI pipes and fittings shall be done as per IS: 12288 and manufacturer's recommendations. After jointing, extraneous material, if any, shall be removed from the inside of the pipe. Rubber sealing rings/ gaskets used for jointing shall conform to IS: 638, IS: 12820 and IS: 5382.

#### 4.1.1.4.2 Spigot and Socket joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS: 12820.

In particular that the spigot end of the pipe shall be ensured to be jointed is smooth and has been properly chamfered, so that the rubber ring as per IS: 12820 and IS: 5382 is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the pipe supplier.

**4.1.1.4.3 Gaskets for Flanges**

All gaskets used between flanges of pipes shall be of Styrene Butadiene Rubber or EPDM thickness 3 mm suitable for clear water conveyance and as specified by manufacturer.

**4.1.1.4.4 Flanged joints**

These shall be of PN 16 rating and shall comply with dimensions and drilling details as specified in IS: 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All material shall be supplied by a reputed manufacturer. Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

**4.1.1.5 COATING**

**4.1.1.5.1 General**

Unless otherwise specified, DI pipes and fittings shall be coated with Bitumen in accordance with relevant IS specification. All buried DI pipes and fittings shall also have factory or site applied polythene sleeving. Coating shall not be applied to pipe and fittings unless its surface is clean, dry and free from rust. Pipe coatings shall be inspected at site and any damage or defective areas shall be made good.

**4.1.1.5.2 Coating**

Bitumen coating shall be of normal thickness of 75 microns unless otherwise specified. It shall be cold applied compound complying with the requirements of relevant Indian standards, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

The outer surface of the pipe shall have Zinc coating with finishing layer of Bitumen over it as per IS: 8329.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

**4.1.1.5.3 Cement mortar lining**

All pipes and fittings shall be internally lined with cement mortar in accordance with IS: 8329. Cement mortar lining shall be applied at the factory in conformance with the above mentioned standards. Pipe linings shall be inspected on site and any damage or defective areas shall be made good. Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be 3mm for up to DN 300 mm pipes.

**4.1.1.6 MARKING**

**4.1.1.6.1** Marking shall be done as per IS 8329 and IS 9523 or any other relevant IS codes.

**4.1.1.7 RATES**

**4.1.1.7.1** D.I. pipes and fittings of specified diameter & pressure class.

**4.1.1.7.2** Laying the pipe wherever necessary and wastage.

**4.1.1.7.3** Over ground installation with supports/clamps, accessories required.

**4.1.1.7.3.1** Underground installation with trenching, bedding, and encasing, etc. civil work as specified in schedule of quantities.

- 4.1.1.7.4 Making joint, coating, in lining, painting the pipe line if mentioned in schedule of quantities.
- 4.1.1.7.5 Making all damage good to original condition after completion of installation work.
- 4.1.1.7.6 Testing the entire system and rectification of defects if any.
- 4.1.1.7.7 All necessary materials, labor and use of tools.

#### 4.1.1.8 MODE OF MEASUREMENT

- 4.1.1.8.1 The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, supports, clamps, civil work, painting if mentioned in schedule of quantities. It shall also include required civil work for underground installation if mentioned in schedule of quantities.

#### 4.1.1.9 MODE OF PAYMENT

- 4.1.1.9.1 Mode of payment shall be Unit length of pipe line laid or fixed. No extra payment shall be made for fittings, making joint, supports, clamps, civil work, painting if mentioned in schedule of quantities. It shall also include required civil work for underground installation if mentioned in schedule of quantities.

### 4.1.2 VALVE

#### 4.1.2.1 GUN METAL/ BRASS COPPER ALLOY GATE/ GLOBE/ CHECK VALVE

##### 4.1.2.1.1 SCOPE

The item includes provision valves of type, size & pressure class as mentioned in the schedule of quantities including fixing, testing & commissioning.

##### 4.1.2.1.2 MATERIAL

- 4.1.2.1.2.1 Full way valve shall be of either Brass fitted with a cast iron hand wheel or Gun metal fitted with a C.I. hand wheel or copper alloy as the case may be. The weight of the full way gate valve shall be as per the table given below with a tolerance of 5 percent.

Diameter in mm	Flanged arch (Kg)	Screwed arch (Kg)
15	1.021	0.567
20	1.503	0.680
25	2.495	1.077
32	3.232	1.559
40	4.082	2.268
50	6.691	3.232
65	10.149	6.804
80	13.381	8.845

- 4.1.2.1.2.2 Check/NRV shall be either brass or Gun metal body with single door design
- 4.1.2.1.2.3 The valves shall have either screwed ends or flanged ends

#### 4.1.2.2 BALL VALVES



- 4.1.2.2.1 All ball valves shall be heavy duty of approved make. Valves shall have suitable for pressure of PN 1.0/1.6.
- 4.1.2.2.2 Ball valves up to 80 mm shall have forged brass body, SS spindle & Teflon seat rings.
- 4.1.2.2.3 Ball valve shall conform to IS: 9890 or BS: 1868

#### **4.1.2.3 SLUICE VALVES**

- 4.1.2.3.1 Sluice valves shall conform to IS 14846 with PN 1.0/1.6 rating as specified. Valve body shall be cast iron & spindle, valve seat & wedge nut shall be of gun metal. The valve shall be generally non rising spindle design. The valve shall be provided with C.I. hand wheel for exposed installation & cap top for underground installation.
- 4.1.2.3.2 Valve shall be generally flanged ends & fitted by means of non corrosive bolt, nuts & asbestos fiber gaskets.

#### **4.1.2.4 BUTTERFLY VALVE**

- 4.1.2.4.1 All butterfly valves shall be heavy duty cast iron of approved make. The valves shall be suitable for PN 1 or PN 1.6 rating as specified & shall conform to IS: 13095 or BS: 5155. Valve shall be either wafer type design or flanged ends. Valve body shall be of cast iron & disc shall be of C.I. / C.S with EPDM disc seal & SS spindle. Valve shall have manual handle/ lever operation.

#### **4.1.2.5 NON-RETURN VALVES**

- 4.1.2.5.1 Non return valve shall be either lift single/ multi door type or spring operated check valves.
- 4.1.2.5.2 For sizing more than 50 mm, generally NRV shall be of Cast Iron body, CI / CS door.
- 4.1.2.5.3 Single door Non return valve shall conform to IS 5312 up to 600 mm. Size above 600 mm shall have multi door design. Spring operated shall conform to API 594/598 standard having spring for non slam action.
- 4.1.2.5.4 Material of Valves for hot water application shall withstand the temperature up to 80 deg. C.
- 4.1.2.5.5 Generally all internal valves (within the building) shall be of Gun Metal unless otherwise specified. All external installation on pipe line, plant rooms, etc. shall be of cast iron unless otherwise specified.
- 4.1.2.5.6 All valves up to 50 mm shall have screwed ends while all valves beyond 50 mm size shall have flanged ends. Flange dimensions shall conform to IS: 1538 Table IV & VI or IS: 6392 PN 1.0/1.6

#### **4.1.2.6 FIXING**

- 4.1.2.6.1 The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts, flanges, hardware, gaskets, tail piece, etc. During installation, flow direction on the valve shall be checked.
- 4.1.2.6.2 Valves shall be preferably installed in horizontal position, except butterfly valves which can be fixed in the vertical position.
- 4.1.2.6.3 Screwed valves after few turns shall be applied with Teflon tape over the threaded ends to obtain complete water tightness. Flanged joint shall be fixed with non corrosive bolts & nuts with suitable thickness asbestos fiber gasket conforming to IS 638 for water tightness.

#### **4.1.2.7 TESTING**

- 4.1.2.7.1 The valves shall be body & seat tested at manufacturer's works as per the relevant standard & duly stamped. Test certificate shall be submitted for material & hydraulic testing.
- 4.1.2.7.2 After fixing in the pipelines, the system shall be hydraulically tested for 1.5 times working pressure or 10 kg/cm<sup>2</sup> whichever is higher for minimum 4 hrs without any pressure drop. In case of leakage, contractor shall rectify/replace valves at his own cost
- 4.1.2.7.3 Valves shall also be tested for its hand wheel/ lever function by frequent on-off operation.

#### **4.1.2.8 RATES**

- 4.1.2.8.1 Valve of required type, size & pressure rating.
- 4.1.2.8.2 Fixing & jointing material.
- 4.1.2.8.3 Painting.
- 4.1.2.8.4 Making all damage good to original condition after completion of installation work.
- 4.1.2.8.5 Testing.
- 4.1.2.8.6 All necessary materials, labor and use of tools.

#### **4.1.2.9 MODE OF MEASUREMENT**

- 4.1.2.9.1 The measurement shall be for each unit valve of specified diameter fixed.

#### **4.1.2.10 MODE OF PAYMENT**

- 4.1.2.10.1 The contract rate shall be for each unit of valve of specified diameter fixed. No extra payment shall be made for G.I. fittings used in fixing of the valve.

#### **4.1.2.11 PRESSURE REDUCING VALVE**

##### **4.1.2.11.1 SCOPE**

- 4.1.2.11.1.1 The item includes provision of pressure reducing valve of specified diameter with all accessories as mentioned in the schedule including fixing.

##### **4.1.2.11.2 MATERIAL**

- 4.1.2.11.2.1 Pressure reducing valve is a device with suitable means of connection for insertion in a vertical pipe line for controlling the water pressure.
- 4.1.2.11.2.2 Each pressure reducing valve (PRV) set/ assembly shall be installed with pressure reducing/regulating valve, isolating valves & pressure gauges on inlet & outlet, strainer at inlet & pressure relief valve on outlet as called in BOQ.
- 4.1.2.11.2.3 PRV shall be of brass housing, spring bonnet with adjustable opening having adjustable knob for pressure adjustment. Valve shall be vertical flow type, conforming to IS: 9739-1981.
- 4.1.2.11.2.4 Each PRV shall contain loading neoprene diaphragm & a full floating, self aligning, ignition resistant seat. Valve shall be of single stage pressure reduction type.
- 4.1.2.11.2.5 Strainer provided at the inlet shall be of replaceable porous sintered metal type.
- 4.1.2.11.2.6 Each pressure relief valve shall be of the fully enclosed type and fitted with hand easing gear. Each pressure relief valve in a pressure reducing station shall have a flow capacity

equal to that of the pressure reducing valve.

4.1.2.11.2.7 Pressure relief valves in locations other than reducing stations shall have flow capacities equal to that of the associated equipment.

#### **4.1.2.11.3 FIXING**

4.1.2.11.3.1 The valve shall be fixed in position on the pipe line as shown in the drawing or as directed. The screwed or flanged joint shall be made to obtain complete water tight joint.

4.1.2.11.3.2 The force of the diaphragm shall operate against the force of an adjustable spring. The inlet pressure shall have no influence in either the opening or closing the valve, hence, the outlet pressure shall remain constant at all times.

4.1.2.11.3.3 Adjustment of Pressure:

The knob fitted on top of the PRV shall be turned toward (-) or (+) sign to reduce/ increase the outlet pressure as desired range.

Inlet pressure	:	Max 16 bar
Outlet pressure	:	1.5 to 6 bar adjustable
Maximum pressure drop	:	1 bar

4.1.2.11.3.4 Valves shall be either screwed ends or flanged ends with all required jointing/ fixing accessories like tail piece, hardware, Teflon tape, gaskets, etc.

#### **4.1.2.11.4 TESTING**

4.1.2.11.4.1 The joints shall be tested to a hydraulic pressure of 1MPa (10 kg/cm<sup>2</sup>) or 1.5 times working pressure whichever is higher along with testing of pipe line for a minimum duration of 2 hrs.

#### **4.1.2.11.5 RATES**

4.1.2.11.5.1 Pressure reducing valve set/ assembly having pressure reducing valves of specified diameter, isolating valves & pressure gauges on inlet & outlet, strainer at inlet & pressure relief valve on outlet including fixing.

4.1.2.11.5.2 Fixing & jointing material.

4.1.2.11.5.3 Painting.

4.1.2.11.5.4 Making all damage good to original condition after completion of installation work.

4.1.2.11.5.5 Testing & commissioning.

4.1.2.11.5.6 All necessary materials, labor and use of tools.

#### **4.1.2.11.6 MODE OF MEASUREMENT**

4.1.2.11.6.1 The measurement shall be for each set of valve of specified diameter fixed.

#### **4.1.2.11.7 MODE OF PAYMENT**

4.1.2.11.7.1 The contract rate shall be for each set of valve of specified diameter fixed.

#### **4.1.2.12 AIR VALVE**

##### **4.1.2.12.1 SCOPE**

4.1.2.12.1.1 The item includes supplying of single, double action or kinetic air Valve of specified diameter as mentioned in the schedule including fixing.

#### **4.1.2.12.2 MATERIAL**

4.1.2.12.2.1 Single air valve shall have single small or large orifice for releasing air during pipe filling and ventilating the pipe during emptying. Air valves up to 50 mm diameter directly shall be screwed on the main.

4.1.2.12.2.2 Double air valve shall have two ball chambers, on outlet of large capacity shall be provided for admission and release of bulk volume of air during emptying and filling of the main, another of small outlet type for the escape of smaller quantities of air accumulating under pressure. They shall be of flanged type.

4.1.2.12.2.3 Air valve body, bonnet , glands, caps, joints support rings shall be best gray iron of selected grade, 200 of IS-210-1978 specification for gray iron castings.

4.1.2.12.2.4 Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

4.1.2.12.2.5 Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminum bronze.

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

4.1.2.12.2.7 Air valve shall be provided with isolation valve with IS certification mark and isolation valve.

#### **4.1.2.12.3 FIXING**

4.1.2.12.3.1 The Air Valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted by means of flange joints or screwed joint to the pipe line.

#### **4.1.2.12.4 TESTING**

4.1.2.12.4.1 The Air Valve and the joints shall be tested hydraulically to a minimum pressure of 10 kg/cm<sup>2</sup> or 1.5 times working pressure whichever is greater for minimum 4hrs without any leakage.

#### **4.1.2.12.5 RATES**

4.1.2.12.5.1 Supplying and fixing Air Valve of specified diameter and type with isolation valve.

4.1.2.12.5.2 Fixing & Jointing material & specials.

4.1.2.12.5.3 Painting.

4.1.2.12.5.4 Making all damage good to original condition after completion of installation work.

4.1.2.12.5.5 Testing & commissioning

4.1.2.12.5.6 All necessary materials, labor and use of tools.

#### **4.1.2.12.6 MODE OF MEASUREMENT**

4.1.2.12.6.1 The measurement shall be for each unit of Air Valve fixed.

#### **4.1.2.12.7 MODE OF PAYMENT**

4.1.2.12.7.1 The contract rate shall be for each unit of air valve fixed.

#### **4.1.2.13 BALL FLOAT VALVE**

##### **4.1.2.13.1 SCOPE**

4.1.2.13.1.1 The item pertains to provide Ball float valve including fixing, testing & commissioning.

##### **4.1.2.13.2 MATERIAL & FIXING**

4.1.2.13.2.1 The valve shall be of copper or as specified in schedule of quantities.

4.1.2.13.2.2 Size of float valve shall be as specified in schedule of quantities.

4.1.2.13.2.3 Connecting rod to ball float shall be of brass & shall withstand high pressure encountered on it.

4.1.2.13.2.4 It shall be brazed or soldered to render it leak proof.

##### **4.1.2.13.3 RATES**

4.1.2.13.3.1 Ball float valve.

4.1.2.13.3.2 Making all damage good to original condition after completion of installation work.

4.1.2.13.3.3 Testing the entire system and rectification of defects if any.

4.1.2.13.3.4 All necessary materials, labor and use of tools.

##### **4.1.2.13.4 MODE OF MEASUREMENT**

4.1.2.13.4.1 The measurement shall be for each unit of Ball float valve fixed.

##### **4.1.2.13.5 MODE OF PAYMENT**

4.1.2.13.5.1 The contract rate shall be for each unit of Ball float valve fixed.

#### **4.1.2.14 WATER METER**

##### **4.1.2.14.1 SCOPE**

4.1.2.14.1.1 The item includes provision of Water meter with or without end flanges, non-return valve of specified diameter as mentioned in the schedule with strainer, sockets, flange, union, nuts etc. including fixing and testing.

##### **4.1.2.14.2 MATERIAL**

4.1.2.14.2.1 Water Meter shall conform to IS: 779 (Domestic type) or IS: 2373 (Bulk type) as specified in Schedule of Quantities and should have ISI certification mark. Non return valve and strainer shall be of the same diameter as that of water meter. Strainer, sockets, flange, union, union nuts, rubber packing etc. shall be as per the description of item. The water meter shall be electronic water meter with BMS compatibility.

##### **4.1.2.14.3 FIXING**

4.1.2.14.3.1 Water meter shall be fixed in position on the inlet pipe line and the joints shall be made either screwed or flanged with necessary sockets, flanges and union nuts as required or as directed by the Engineer-in-charge.

4.1.2.14.3.2 Screwed Joint

A few turns of Teflon tape shall be taken over the threaded ends to obtain complete water tight joint.

4.1.2.14.3.3 Flanged Joint

The flange joint shall be made for flange type water meter and the joint shall be as per the specification of flanged joint.

**4.1.2.14.4 TESTING**

4.1.2.14.4.1 The joints shall be tested to a hydraulic pressure of 1 Mpa (10 kg/cm<sup>2</sup>) along with testing of pipe line for a minimum duration of two hours.

**4.1.2.14.5 RATES**

4.1.2.14.5.1 Water meter with strainer non-return valve, sockets, union nut etc.

4.1.2.14.5.2 Making screwed or flanged joints with jointing material.

4.1.2.14.5.3 Making all damage good to original condition after completion of installation work.

4.1.2.14.5.4 Testing the entire system and rectification of defects if any.

4.1.2.14.5.5 All necessary materials, labor and use of tools.

**4.1.2.14.6 MODE OF MEASUREMENT**

4.1.2.14.6.1 The measurement shall be for each unit of water meter of specified diameter fixed.

**4.1.2.14.7 MODE OF PAYMENT**

4.1.2.14.7.1 The contract rate shall be for each unit Water Meter of specified diameter fixed. No extra payment shall be made towards making flanged and other joints and G.I. fittings used in fixing of the water meter.

**4.1.2.15 PRESSURE GAUGE**

**4.1.2.15.1 SCOPE**

4.1.2.15.1.1 The item includes provision of Pressure Gauge of specified range as mentioned in the schedule with siphon tubing & SS isolation cock.

**4.1.2.15.2 MATERIAL**

4.1.2.15.2.1 The pressure gauge shall be constructed of die cast aluminium and stove enameled.

4.1.2.15.2.2 It shall be weather proof with an IP 55 enclosure.

4.1.2.15.2.3 It shall be a stainless steel Bourdon tube type pressure gauge with a scale range from 0 to 16 Kg/cm<sup>2</sup> and shall be constructed as per IS: 3524.

4.1.2.15.2.4 Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by SS Ball Valve.

**4.1.2.15.3 FIXING**

4.1.2.15.3.1 It shall be fixed vertically in position on pipe line by means of screwed nipple, spool piece



or as required or as directed by the Engineer-in-charge.

#### **4.1.2.15.4 TEST**

4.1.2.15.4.1 Calibration certificate shall be obtained and submitted for each pressure gauge.

#### **4.1.2.15.5 RATES**

4.1.2.15.5.1 Pressure Gauge with isolation valve & siphon tubing.

4.1.2.15.5.2 Making connection with piping with all accessories.

4.1.2.15.5.3 Making all damage good to original condition after completion of installation work.

4.1.2.15.5.4 Testing the entire system and rectification of defects if any.

4.1.2.15.5.5 All necessary materials, labor and use of tools.

#### **4.1.2.15.6 MODE OF MEASUREMENT**

4.1.2.15.6.1 The measurement shall be for each unit of Pressure Gauge of specified range fixed.

#### **4.1.2.15.7 MODE OF PAYMENT**

4.1.2.15.7.1 The contract rate shall be for each unit Pressure Gauge of specified range fixed.

### **4.1.3 SYSTEM TESTING**

4.1.3.1 All pipes, fittings & valves shall be tested by hydrostatic pressure of 10 kg/cm<sup>2</sup> or 1.5 times working pressure whichever is higher. Pressure shall be maintained for at least 2 hrs. A test register shall be maintained & all entries shall be signed & dated by contractor & engineer in charge.

4.1.3.2 In case of sectional testing carried out during construction, contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, & shall replace defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings to the building, furniture & fixtures shall be made good during defect liability period without any extra cost. All hot water supply & return piping shall be checked for proper insulation.

4.1.3.3 After completion the water supply system, contractor shall test each valve by closing & opening it a number of times to observe its working. Valves which do not effectively operate shall be replaced by new ones at no extra cost & same shall be tested as above.

### **4.1.4 FERRULE**

4.1.4.1 The ferrules for connection with main shall generally conform to IS 2692. It shall be of non-ferrous materials with a bell mouth cover & shall be of nominal bore as specified. The ferrule shall be fitted with a screw & plug or valve capable of completely shutting of the water supply to the communication pipe as & when required.

4.1.4.2 For fixing, the empty mains shall be drilled & tapped at 45 deg to the vertical & ferrule screwed in. The ferrule must be so fitted that no portion of the shank shall be left projecting within mains into which it is fitted.

### **4.1.5 STRAINER**

#### **4.1.5.1 SCOPE**

4.1.5.1.1 The item includes the 'Y' type or POT type strainers of size as specified in schedule of quantities including fixing, testing & commissioning.

#### **4.1.5.2 MATERIAL & FIXING**

- 4.1.5.2.1 Body material shall be cast iron, Gun metal or Stainless steel.
- 4.1.5.2.2 Screen material shall be either bronze or stainless steel. Screen shall be removable type. Size of the perforations shall be 1/8" if not specified.
- 4.1.5.2.3 Strainers shall have either screwed or flanged ends.
- 4.1.5.2.4 Strainers shall be provided with equal size of butterfly valve for ease of cleaning.
- 4.1.5.2.5 It shall be such designed that, removal/ replacement of screen can be possible without disconnection of main pipe.

#### **4.1.5.3 TESTING**

4.1.5.3.1 It shall be hydraulically tested at least for 1.5 times working pressure.

#### **4.1.5.4 RATES**

- 4.1.5.4.1 Strainer.
- 4.1.5.4.2 Fixing material, specials & hardware.
- 4.1.5.4.3 Fixing, testing & commissioning.
- 4.1.5.4.4 Painting.
- 4.1.5.4.5 Making all damage good to original condition after completion of installation work.
- 4.1.5.4.6 All necessary labor, material and use of tools.

#### **4.1.5.5 MODE OF MEASUREMENT**

4.1.5.5.1 The measurement shall be for one strainer

#### **4.1.5.6 MODE OF PAYMENT**

4.1.5.6.1 The contract rate shall be for one strainer.

### **4.1.6 WATER HAMMER ARRESTER**

#### **4.1.6.1 SCOPE**

4.1.6.1.1 The item includes the Water hammer arrester as per requirement including fixing, testing & commissioning.

#### **4.1.6.2 MATERIAL**

- 4.1.6.2.1 Water hammer arrester shall be capable of withstanding pressure up to 500 PSI.
- 4.1.6.2.2 It shall be maintenance free with a companion flange to suit in pipeline.
- 4.1.6.2.3 It shall have copper barrel with brass piston.

#### **4.1.6.3 RATES**

4.1.6.3.1 Water hammer arrester.

- 4.1.6.3.2 Fixing material, specials & hardware.
- 4.1.6.3.3 Fixing, testing & commissioning.
- 4.1.6.3.4 Painting.
- 4.1.6.3.5 Making all damage good to original condition after completion of installation work.
- 4.1.6.3.6 All necessary labor, material and use of tools.

#### **4.1.6.4 MODE OF MEASUREMENT**

- 4.1.6.4.1 The measurement shall be for one unit

#### **4.1.6.5 MODE OF PAYMENT**

- 4.1.6.5.1 The contract rate shall be for one unit.

### **4.1.7 PUDDLE SLEEVES (INSERTS)**

#### **4.1.7.1 SCOPE**

- 4.1.7.1.1 Work under this section consists of furnishing all labour, material, equipment & appliances necessary & required to completely install the Puddle Sleeves/ inserts such as inlet, outlet, overflow, drain, ladder, manhole frame & cover including all other material materials required to complete the work for connection to the RCC tanks & Equipments as indicated on the drawings & specifications.

#### **4.1.7.2 CODES & STANDARDS**

- 4.1.7.2.1 Unless specifically mentioned otherwise, all the applicable codes & standards published by the Bureau of Indian Standards & their subsequent revision shall govern in respect of design, workmanship, quality & properties of materials & method of testing.
- 4.1.7.2.2 Nothing in this specification shall relieve the contractor of his responsibility. The material supplied shall comply with the latest applicable Indian standards as applicable & or of best practices.
- 4.1.7.2.3 Following are the standards & codes to be followed as a part of these specifications.

IS: 2062– 1992	:	Structural Steel for general purpose
IS: 226	:	Galvanization of structural steel
IS: 816 & IS: 823	:	Welding of Structural Steel

### **4.1.8 CONNECTION TO EQUIPMENT**

- 4.1.8.1 All inlets, outlets, valves, piping & other incidental work connected with installation of mechanical equipment supplied by other agencies shall be carried out by the contractor in accordance with the drawings, requirement for proper performance of equipment, manufacturer's instructions & direction of the Engineer in charge. The equipments to be supplied by other agencies may generally for Kitchen, Laundry, Irrigation system, Pumps, hot water generators, etc. The work of connections to the various equipments shall be through proper unions & isolating valves in consultation with equipment supplier, engineer in charge.

### **4.1.9 CONNECTION TO RCC TANKS/ RESERVOIRS**

- 4.1.9.1 Inlets, outlets, interconnection sleeves & drain outlets for the reservoir shall be made through

mild steel bath galvanized puddle sleeves obtained from reputed manufacturers & to be inserted at suitable levels as indicated on the drawings. The contractor shall be responsible for placing the inserts at required level well in advance & before making the final shuttering layout for casting the walls. All puddle sleeves must be fixed in true alignment & level to ensure further connection in proper order all the overhead water tank terraces shall be provided with efficient rain water disposal system. The necessary sleeve in the tank wall shall be provided for running the level controller wires/ probes.

- 4.1.9.2 The plate used for fabricating the puddle flange shall be MS 6 mm thick with fillet welding. The length of the puddle sleeve shall be 600 mm minimum unless otherwise specified. Puddle sleeve shall have flanged ends for all sizes. Puddle sleeves shall be hot dip galvanized after fabrication.
- 4.1.9.3 The tanks shall be provided with vent pipes of minimum 100 mm diameter with mosquito proof mesh.
- 4.1.9.4 The overflow pipe shall be so placed to allow the discharge of water being readily seen. A stop valve shall be provided in the inlet water connection to tank. The outlet pipes shall be fixed approximately 75 mm above the bottom of tank towards which the floor of tank is slopping to enable tank to be emptied for cleaning.
- 4.1.9.5 Full way gate valves shall be provided as near the tank as practicable on every outlet pipe from storage tank except overflow pipe.
- 4.1.9.6 The floor & walls of the tank shall be tiled with glazed tiles (by other agency) up to overflow level. Alternatively, food grade epoxy paint to be applied.

#### **4.1.10 MANHOLE COVERS**

- 4.1.10.1 Manhole cover shall be medium/ light duty type (cast iron) with double seal, locking arrangement & lifting hooks manufactures as per IS: 1726. The shape of the cover shall be as shown in the drawing.

#### **4.1.11 ALUMINIUM LADDER**

- 4.1.11.1 For effective maintenance of the tank, portable aluminium step ladder to suit the depth of the tank shall be provided with necessary hooks & fixing accessories.

#### **4.1.12 DISINFECTION/ STERILISATION OF PIPING & TANK**

- 4.1.12.1 Before commissioning of water supply system, the contractor shall arrange to disinfect the entire system.
- 4.1.12.2 Water storage tanks & pipes shall first be filled with water & thoroughly flushed out. The storage tanks shall then be filled with water again & disinfecting chemical containing chlorine shall be added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.
- 4.1.12.3 If ordinary bleaching powder is to be used, the proportion shall be 150 gm of powder in 1000 liter Of water. The powder shall be mixed with water in storage tank. For any other chemical, the proportion shall be as recommended by the manufacturer. When the storage tank is full, the supply shall be stopped; all tapes on distributing lines shall be opened successively. Each tap shall be closed when water discharged shall begin to smell chlorine. The storage tank shall then be filled with supply pipe with more disinfecting chemicals in recommended proportion. The storage tank & pipe shall remain charged for at least 3 hours. Finally, tank & piping shall be thoroughly flushed out before water is to be used for domestic application.

#### **4.1.13 PRE COMMISSIONING**

- 4.1.13.1 Ensure that all pipes are free from debris & obstructions.
- 4.1.13.2 Check all valves for effective on-off operation.
- 4.1.13.3 Ensure than all connections to branches are made.
- 4.1.13.4 Ensure connection of mains to UG tank, Pumps & OH tank as per requirement.
- 4.1.13.5 Water supply shall be available at underground tank.
- 4.1.13.6 Ensure that all line valves shall be closed.

#### **4.1.14 COMMISSIONING**

- 4.1.14.1 Disinfect Storage tanks & piping.
- 4.1.14.2 In case of bore well supply, start pump & fill underground water tank. Water shall first enter into fire compartment & then fill domestic compartment.
- 4.1.14.3 Start domestic pump to fill OH tank. After filling the OH tank, drain the tank to its ¼ the capacity by opening the drain valve. This is to ensure removal of silt, mud, debris, etc. Again fill OH tank to full.
- 4.1.14.4 Release water in each line by opening the line valves, flush out whole piping system & ensure clear water is now coming out of the system.
- 4.1.14.5 Observe valves for any leakage. Check the pressure at pump & at farthest utility points.

### **PUMP & EQUIPMENT**

#### **HORIZONTAL CENTRIFUGAL SUBMERSIBLE PUMP- HYDROPNEUMATIC SYSTEM**

##### **SCOPE**

This specification covers the supply, installation; testing & commissioning of Horizontal Centrifugal type (Monoset)/ Open well monoset submersible pumps. The scope also includes motor, delivery piping up to Discharge Header with necessary pipe, fittings, electric panel, pressure gauges, etc. Each pump shall have isolation gate/ ball valve & NRV at delivery side & on header.

##### **CODES AND STANDARDS**

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

##### **DESIGN FEATURES:**

The pump shall be capable of developing required total head at rated capacity.

Impeller shall be enclosed type and shall be dynamically balanced.

The pump shall have non overloading characteristics.

The pump shall be submerged in tank/ reservoir.

##### **CONSTRUCTIONAL FEATURES**

The casing shall be of rigid construction and shall have central delivery pipe.

The casing shall be of Cast Iron.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss in case of moonset pumps.

Impeller shall be of one piece and shall be of BRONZE/ SS CF 8 M.

The shaft shall be of S.S. and its surface shall be properly finished.

Shaft sleeves shall be provided to protect shaft from any damage.

Bearing shall be ball or roller type.

Mechanical seal shall be provided to avoid any leakage.

Each pump shall be driven by directly coupled squirrel cage induction motor having 1500/ 2900 RPM, TEFC enclosure & IP 58 protection.

#### **INSPECTION AND TESTING**

The pump shall be offered for visual inspection before dispatch.

Material test certificates for the various pump components shall be furnished for purchaser's approval.

Hydrostatic test shall be carried out at 1.5 times the maximum discharge pressure.

For electrical accessories, necessary tests shall be performed or factory test certificate shall be furnished.

#### **SYSTEM DESCRIPTION**

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. When the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, if the system pressure be still below the pre-set value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/ standards.

The system shall be under the control of a microprocessor based control panel.

A pressure transducer shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.



The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transducer shall register the actual pressure on the discharge side.

The variable frequency drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Frequency Drive (VFD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VFD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply. Alternatively pumping system shall be with fixed speed drive motor. By getting the signal from microprocessor based control panel through pressure transmitter, pumps will operate in sequence & vice a versa.

The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the pre-set value.

#### **CONTROL PANEL**

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions.

Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps.

When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/ day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s).

In event of control failure, the pumps shall be able to be start/ stopped manually at the local panel by means of pressure switches.

The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

Automatically starting the pumps when the water level is back to normal.

In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

Functions to limit the no. of start/ stop of pumps per hour.

The system control panel shall incorporate LCD Display.

### **OPERATION OF CONTROL PANEL**

#### **Auto mode**

The desired delivery pressure within the range specified, shall be set at the control panel. The pressure transmitter shall detect the delivery pressure continuously and give feedback to the microprocessor which will control the variable speed drive frequency converter for speed control of the duty pump. When demand increases, the subsequent pumps in the system will be activated to boost up the pressure. Ultimately the duty pump set shall be operated fully automatically to maintain the delivery pressure constantly at the desired set value.

#### **Manual Mode**

The on/ off function of the pumps shall be manually adjusted at the microprocessor located at the local control panel.

#### **Frequency Control By-pass Mode**

All the pump sets shall be started/ stopped automatically with the pump output at fixed maximum rotational speed. All the control and protection functions shall remain active. The cut in/ cut out pressure shall be internally calculated by the microprocessor for each pump.

### **ELECTRICAL COMPONENT**

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker.

### **METHOD OF STARTING**

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/ Delta, or using Soft Starters.

### **PUMP PRESSURE VESSEL**

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

## ACCESSORIES

The system shall be provided with all accessories such as base plate, mounting pads, foundation bolts, foot valves, pressure gauge, pressure switches, pressure transmitter, level indicator, isolation valve for pressure vessel, etc. all accessories required for proper and safe operation shall be furnished with the pumps.

## SUCTION AND DELIVERY PIPE, FITTINGS, FLANGES & VALVES

All suction, delivery and header pipe shall be GI & shall conform to IS: 1239, medium/ heavy duty. Fittings shall be as per the pipe thickness. All pipes shall have flanges connection & pipe shall conform to BS 10, Table - D. All hardware shall be zinc plated. The system shall be equipped with suction & delivery valves flanged valves. On suction side ball/gate valve shall be provided while on delivery side ball/ butterfly valves shall be provided. Also, spring operated check valves shall be provided on delivery side of each pump & on delivery header. In case of negative suction foot valve shall be provided for each pump suction or suction header as specified in data sheet. Flexible bellows shall be provided on suction & delivery side of each pump.

## TESTING

Hydrostatic test shall be carried out at 1.5 times the maximum discharge pressure.

For electrical accessories, necessary tests shall be performed or factory test certificate shall be furnished.

## DRAWINGS

Following drawings shall be furnished by the vendor:

- Overall dimensional drawing.
- Pump performance curves..
- Cross-sectional drawings.
- Panel GA drawing.
- Bill of Material and Material of Construction.

## TECHNICAL SPECIFICATIONS FOR CENTRIFUGAL MONOSET SUBMERSIBLE PUMPS

SR.	PARTICULAR	SPECIFICATIONS
1.0	Application	
2.0	Number of Units/pumps	As per BOQ
3.0	Design capacity of each pump	As per BOQ
4.0	Total head at design capacity	As per BOQ
5.0	Total duration of operation	As per BOQ
6.0	Speed	1500/2900 RPM
7.0	Location	Inside the tank
8.0	<b>FEATURE OF CONSTRUCTION</b>	
8.1	Impeller	Enclosed
8.2	Shaft	Coupled
8.3	Drive Transmission	Direct
8.4	Seal	Mechanical

8.5	Mounting	Base plate
8.6	No. of stage	Single
8.7	Nozzle orientation A. Suction B. Discharge	Side suction Top discharge
8.8	Starter	DOL for upto 5 KW & Star / Delta for more than 5 KW rating
8.9	Flange drilling	As per BS 10, Table F, raised face with off center bolt holes
<b>9.0</b>	<b>LIQUID DATA</b>	
9.1	Liquid handled	Water
9.2	Specific gravity	1.0
9.3	Temperature	Ambient temp.
<b>10.0</b>	<b>MATERIAL OF CONSTRUCTION</b>	
10.1	Base plate	M.S. IS 226
10.2	Pump Casing	Cast Iron
10.3	Impeller	Bronze IS 318 Gr LTB2 / SS CF8 M as specified
10.4	Shaft	S.S AISI 410
10.5	Wearing Ring	S.S AISI 410
10.6	Painting	Epoxy
10.7	Hardware in contact with water	Hot dipped galvanized
10.8	Companion flanges	M.S., BS 10, Table F
<b>11.0</b>	<b>ACCESSORIES &amp; SERVICES REQUIRED</b>	
11.1	Base Plate	YES
11.2	Foundation bolts	YES
11.3	Companion flanges	YES
11.4	Spare parts required	YES
11.5	Maintenance tools required	YES
11.6	Foot valves	Required in case of negative suction
<b>12.0</b>	<b>MOTOR :</b>	
12.1	Power Supply	230 / 415 Volts, 3 phase, 50 Hz. AC
12.2	Class of Insulation	Class B
12.3	Degree of Protection	IP 58
13.0	Delivery piping	UPVC SCH 80
14.0	Delivery valves & header valves	flanged valves Flanged Ball / gate valve on delivery side of each pump & Flanged Non Return Valve on delivery side of each pump & on header Flexible bellows on delivery of each pump
15.0	Starter Panel	Required with pump interlocking with respect to tank levels. Power / control cable from starter to pump to be provided
16.0	Level Indicator	Required for 0-5mtr. Range and shall be panel mounted and interlocking with pump.
17.0	Pressure Gauge	Required at delivery of each pump & on header.

		0 –7 kg/sq.cm
<b>18.0</b>	<b>PRESSURE VESSEL</b>	
18.1	Capacity	As per BOQ
18.2	No. of Unit	As per BOQ
18.3	Material of Construction	M.S. conforming to IS 2062 / FRP
18.4	Shell thickness	8 mm / Suitable for 8 Kg/cm2 pressure rating.
18.5	Dished end thickness	10 mm/ Suitable for 10 Kg/cm2 pressure rating.
18.6	Test Pressure	10 kg / cm2 minimum
18.7	Painting	Epoxy
18.8	Type of Air Compressor	Oil free, Teflon coated / Inbuilt Air cell
18.9	Tank outlet size	As per Manufacture's configuration

**RATES**

Pump-Motor sets.  
 Base plate, foundation bolts, anti vibration pads.  
 Pump delivery pipe & delivery manifolds.  
 Foot valves in case of negative suction.  
 Pump delivery & delivery manifold isolation valve & NRV , flow meter and pressure gauge.  
 Pressure gauges& level indicator to be interlocked with pump operation.  
 Pressure vessel with isolation valve and pressure gauge.  
 Starter panel with all electrical components, protections, interlocks, cable from starter to pump.  
 All material like flanges, hardware, gaskets, etc. required for installation.  
 Installation, testing & commissioning.  
 Making all damage good to original condition after completion of work.  
 All necessary labor, material and use of tools.

**MODE OF MEASUREMENT**

The measurement shall be for one set including working & stand by units

**MODE OF PAYMENT**

The contract rate shall be for one set including working & stand by units

**Design Basis for Pump:**

As it can be observed from the above details, the pump system would have to be of:

Discharge Pressure: 3.5 ~ 4.3 kg/cm<sup>2</sup>

Discharge Flow Rate: 1500 LPM (Peak)

Suction Head: 05 Mtrs.

Discharge Head: 35 – 43 Mtrs.

Line Pressure to be maintained at an average at 3.0 kg/cm<sup>2</sup> (3.0Bar).

**Pumping System:**

For the above water distribution, we propose to have 5 submersible pumps at the Main Tank with V.F.D. Starter Panel, and operated by a Programmable Logic Controller (PLC) Panel.

**PUMPS:**

The submersible pumps would be equipped with the following:

1. Motor: Each pump shall have 2900 RPM; 415V / 3 phase / 2 pole / 50~60 Hz; submersible electric motor, with dry run protection.
2. Pump: The pump shall have Cast Iron Body, Cast Iron head, Cast Iron Impeller, SS Shaft, and mechanical seal.
3. The pump shall be suitable for auto / manual operation common electrical panel with individual VFD, switch panels having all necessary accessories & safety devices of standard specifications.
4. Pipe for delivery: 65 mm x 20 ft. delivery pipe, relevant isolation valves, bends, flanges up to common header line.

**Ancillary Water Supply Pump Installations:**

Each pump would be provided with the flowing sensors:

- a. Ampere Reader
- b. Voltage Reader
- c. kW/h Reader
- d. Dry Run Sensor
- e. Health Check Sensor.

Additionally, the system would have the following:

- i. CPVC Pipe (Sch-80) of 65mm Ø from pump discharge up to the main header;



- ii. CPVC (Sch-80) fittings – Brass threaded Male Unions, Brass threaded female couplers, Brass threaded Reducer Tees, etc.
- iii. CPVC (Sch-80) body with EPDM Vales – butterfly valves, ball valves, gate valves, globe valves, non-return valves, etc.
- iv. Electronic flow sensors;
- v. Electronic pressure gauges;
- vi. Filter at suction side;
- vii. Bellows (if required).

**Control & Starter Panels:**

**Starters:**

Variable Frequency Drive based Star Delta Starters as per applicable IS Codes & IEC Codes, and standard specifications.

**Load Manager:**

Multi-function meter having display of Kilo-watt per hour, Voltage, Ampere, etc consumption as per IS Codes & IEC Codes, and standard specifications.

**NO-NC Contactor:**

The pumps shall be operated based on the pre-set programs through a PLC.

**Surge Protectors:**

The panel shall have an in-built Surge Protector Device to maintain the overall health of the system.

**Pressure Vessel:**

The entire assembly of the pumps would be supported by a 800 litres Pneumatically pre-set Vessel having diaphragm set to maintain the maximum of 4.3 Bar (62.37 Psi) (0.43 MPa).

**Valves, Guages, etc:**

**Valves:**

Isolation Valves: The discharge header from the pump would have 2 isolation valves and one Non-return valve.

**Sensors:**

In line electronic flow sensors & pressure sensors would be installed in the discharge header of each pump.

In line electronic flow sensors would be installed in the main discharge header of the total water supply installation. These sensors would direct the number pumps to be operated via the PLC panel.

**Guages:**

There would be electronic pressure gauge in the discharge header of the total water supply installation. These sensors would direct the number of pumps to be operated via the PLC panel.

**Accessories:**

There would be brass threaded unions, couplers, tees, bends; etc in the pipe line and the jointing would be using Teflon tape as precautionary and additional insulation of the joints.

The normal side of the joints would be made using the best class of Solvent Cement adhesives, as prescribed by the pipe manufacturer and applicable IS Codes and Standards.

**Overall piping works:**

The discharge header would be of CPVC (Sch-80) pipes with National Sanitation Foundation (NSF) certification for potable water distribution. All pipes and fittings would be as per applicable IS Codes and Standards.

The pipe material would be as under:

The pipes and fittings chemically known as Chlorinated Poly Vinyl Chloride [CPVC] shall be produced in Copper Tube Size [CTS] from 2½” to 8” with two different standard dimensional ratios – Sch-40 and Sch-80.

The fittings shall be produced as per Sch-80.

All the CPVC pipes and fittings shall be made from the identical CPVC compound having the same physical properties.

Pipes and fitting shall be produced as per IS: & shall meet the requirement of ASTM D 2846 where as the pipes produced with SDR 13.5 shall meet the requirement derived from ASTM F 442, specific to CPVC in Iron Pipe Size[IPS] dimension, which also shall be applied to CPVC pipes in Copper Tube Size[CTS] dimension.

Material for pipe & fittings shall conform to the following:

ASTM D 1785	Specification for Poly Vinyl Chloride (PVC) Plastic Pipes, SCH 40 & SCH 80.
ASTM D 2466	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 40
ASTM D 2467	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 80
ASTM D 2564	Solvent Cement for Plastic Pipes & Fittings
ASTM D 2774	Underground installation of Thermo plastic Pipes

**CUTTING AND JOINTING AND LAYING**

CUTTING:

In order to make a proper and neat joint, the pipe length shall be measured accurately and make a small mark. Ensure that the pipe and fittings are size compatible. It shall be easily cut with a wheel type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible shall provide optimal bonding area within a joint.

#### DEBURRING/ BEVELING:

Burrs and filings shall prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. A pocket knife or file shall be used for this purpose. A slight bevel on the end of the tubing shall ease the entry of the tubing into the fitting socket.

#### FITTING PREPARATION:

Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

#### SOLVENT CEMENTS APPLICATION:

Use only CPVC cement or an all – purpose cement conforming to ASTM -493 or joint failure may result. When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged water ways.

#### ASSEMBLY:

Immediately insert the tubing into the fitting socket, rotate the tube  $\frac{1}{4}$  to  $\frac{1}{2}$  turn while inserting. This motion will ensure and even distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

#### SET AND CURE TIMES:

Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments, smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

The pipe joint setting & curing time shall be recommended as :

#### SET TIME:

TEMPERATURE	PIPE SIZE	PIPE SIZE	PIPE SIZE
RANGE	15 MM TO 32 MM	40 MM TO 75 MM	100 & 150 MM
15.5-37.7 DEG C	15 MINUTE	30 MINUTE	60 MINUTE
4.4-15.5 DEG C	60 MINUTE	120 MINUTE	240 MINUTE

CURE TIME:

TEMPERATURE	PIPE SIZE	PIPE SIZE	PIPE SIZE
RANGE	15 MM TO 32 MM	40 MM TO 75 MM	100 & 150 MM
15.5-37.7 DEG C	6 HRS.	12 HRS.	24 HRS.
4.4-15.5 DEG C	12 HRS.	24 HRS.	48 HRS.

To compensate the expansion & contraction, suitable means shall be provided by expansion loops with 90 deg elbows/ bellows subject to the application for the above ground installation.

For underground application, the compensation for expansion & contraction shall be done by snaking the pipe in trench.

**CEMENTING:**

Verify the cement is the same as the pipes and fittings being used.

Check the temperature where the cementing will take place.

Cement takes longer time to set up in cold weather. Be sure to allow extra time for curing. Do not try to speed up the cure by artificial means – this could cause porosity and blisters in the cement film.

Solvents evaporate faster in warm weather. Work quickly to avoid the cement setting up before the joint is assembled. Keep the cement as cool as possible. Try to stay out of direct sunlight.

Keep the lid on cements, cleaner and primers when not in use. Evaporation of the solvent will affect the cement.

Stir or shake cement before using.

Use ¾" dauber on small diameter pipes, 1 ½" dauber up through 3" pipe, and a natural bristle brush, swab or roller ½ the pipe diameter on pipes 4" and up.

Do not mix cleaner or primer with cement.

Do not use thickened or lumpy cement. It should be like the consistency of syrup or honey.

Do not handle joints immediately after assembly.

Do not allow dauber to dry out.

Maximum temperature allowable for CPVC pipe is 180o F.

All colored cements, primers and cleaners will have a permanent stain. There is no known cleaning agent.

Use according to the steps outlined in ASTM D – 2846, joining of pipe and fittings.

### TESTING

- a) After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow.
- b) Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost.
- c) Use of any compound for stoppage of leaks shall not be permitted.
- d) The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more.
- e) The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer.
- f) The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually.
- g) Pressure gauge must be accurate and preferably should have been recalibrated before the test.
- h) The test pump having been stopped, the test pressure should be maintained without loss for at least two hours.
- i) The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

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## 7. MAINTENANCE

The section covers the maintenance schedule during warranty period and 5 years subsequent to the warranty period.

The maintenance provided during the warranty period shall be fully comprehensive and shall include but not limited to all equipments, labour part and emergency calls providing and site response within 24 hours. During the maintenance period after the warranty is over, the maintenance shall be fully comprehensive as stated above.

The maintenance shall also include a minimum of 12 monthly preventive maintenance visits by qualified personnel who are thoroughly familiar with the type of equipment and system provided for this project.

The maintenance of high side of central air-conditioning plant shall be got carried out from the Manufacturer/ authorized agencies only.

Water pump	Monthly inspection	<ol style="list-style-type: none"> <li>1. Inspect all water pumps</li> <li>2. Check all seals, glands and pipelines for leaks and rectify as necessary.</li> <li>3. Re-pack and adjust pump glands as necessary.</li> <li>4. Check all pump bearings and lubricate with oil or grease as necessary.</li> <li>5. Check the alignment and condition of all rubber couplings between pumps and drive motors and rectify as necessary.</li> <li>6. Check all bolts and nuts for tightness and tighten as necessary.</li> <li>7. Inspect all valves, meters, flow guages, pressure guages etc for their proper functioning.</li> <li>8. Check and repair valve packings etc for leakage and rectify problems if any.</li> </ol>
Water pumps	Annual Inspection prior to expiry of warranty period.	<ol style="list-style-type: none"> <li>1. Perform all function for monthly checks.</li> <li>2. Check motor earthing, meggar motor and connection wiring on each leg.</li> <li>3. Tighten motor terminals</li> <li>4. Check starter contacts</li> <li>5. Test and calibrate overload setting.</li> </ol>



<p>ALL AREAS.</p>	<p>Six monthly and annual inspection prior to the expiry of the warranty period.</p>	<ol style="list-style-type: none"> <li>1. Clean and adjust all switch gear, contactors, relays and associated electrical equipment at intervals not exceeding six months.</li> <li>2. Check and prove operation of thermal over load and protection devices.</li> <li>3. Check and ensure tightness of all equipment fastenings and cable terminations within switch boards.</li> <li>4. Vacuum clean all switch board cubicles.</li> <li>5. Check all piping system for leaks and repair these where they have occurred.</li> <li>6. Check for damage and deterioration of insulation of sheathings. Rectify as necessary.</li> </ol> <p>The contractor shall arrange the following consumable materials as and when required.</p> <ol style="list-style-type: none"> <li>7. All oils and greases required for lubrication of compressors, fan bearings, motors bearings, pivots and other moving parts.</li> <li>8. All refrigerant required for topping up. Refrigerant loss if due to manufacturing defect or due to negligence shall be made good by the contractor.</li> <li>9. All consumable filter elements/rolls.</li> <li>10. All chemicals for the correct chemical treatment of the cooling tower and chilled water systems.</li> <li>11. All carbon brushes required to replace worm brushes in electric motors.</li> <li>12. All electric contact points required to replace worm electric contact points in switchgears, motor starter gears, electronic control gears and electric relays.</li> <li>13. All electric fuses required to replace blown fuses.</li> </ol> <p>Just before the expiry of the warranty of the contract, the contractor shall carry out a complete system operability test on all the systems of sub systems as called for in the contract.</p> <p>The purpose of the test is to verify that the performance of all the systems of sub-systems in the contract is in accordance to the specifications.</p> <p>All test shall be carried out in the presence of the Engineer- In-Charge or his representative.</p> <p>The warranty period is deemed to be over if the department or his representative is completely satisfied with the system performance during the test.</p>
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