TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS.

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I. Materials

All materials required for the works shall be procured and supplied by the contractor himself. The materials shall be of good quality and conforming to relevant BIS. The materials which are classified for ISI marking should be supplied with ISI marking only.

1.Cement and Steel

1.1 The entire quantity of cement and steel required for the work will be procured by the contractor. The contractor is responsible for all transport and storage of the materials and shall bear all related cost. The Employer shall be entitled at any reasonable time to examine the cement and steel supplied by the contractor.

1.2 The cement procured by the contractor shall comply with the requirements of IS 269/ 1976 with the latest revision thereof for ordinary Portland cement and IS 8112/ 1989 with the latest revision thereof for 43 grade ordinary Portland cement. It shall be of the best normal setting quality unless specially rapid hardening or quick setting quality if expressly instructed by the Engineer to be supplied. Each bag shall bear ISI Certification mark and as per specification no.10 of TNBP volume I.

1.3 The steel bars shall comply with the requirements set forth in the IS 432 Part I, IS 1139, IS 1786 as the case may be with the latest revision thereof and the test as described for ultimate tensile strength, bond test and elongation tests. Steel and steel product with relevant BIS certification with standard mark licenses should only be used particularly High Strength Deformed bars (TMT) for concrete reinforcement. All reinforcing steel shall be clean and free from oil, grease, loose scales or rust or other coatings of any character which would reduce or destroy the bed. Each band containing the bars shall bear the ISI Certification mark.

1.4 The cement/ steel shall be tested in nearby laboratories of Polytechnic or Engineering College by the Employer. Two samples should be taken by the Engineer in charge in the presence of the contractor or his authorised representatives or the technical personnel employed by the Contractor as in the agreement. The contractor shall without extra cost provide samples and co-operate in the testing of the cement/ steel. One sample shall be got tested and the other sample shall be retained by making clear identification in the sample by the Engineer in charge so as to identify at a later date. The cost of such test shall be borne by the contractor.

1.5 All cement shall be procured in bags and shall be stored in a dry place for which the contractor shall be responsible. Consignment of bagged cement shall be properly

stacked in a manner which will permit easy access for inspection and definite identification. Cement shall be used in approximately in the chronological order in which it is received, but cement that has been stored for a period longer than 4 months from the date of initial sampling shall not be used unless it has been re-tested at the expenses of the contractor and passed by the Engineer in charge as good quality on the retest. Cement aged more than 180 days from the date of initial sampling shall be rejected.

1.6 Cement which has become caked or perished shall on no account be used on the works and shall be rejected. Although the Engineer may have passed any consignment, he shall however have the power at the subsequent time to reject such consignment if he finds that any deterioration in the quality thereon has taken place.

1.7 A record of the quantity of cement/ steel procured with the name of dealer, bill number and date shall be maintained by the contractor. This should be produced for examination by the Engineer in charge at any time. The age of the cement shall be reckoned from the date of manufacture and it shall be verified by the Engineer in charge.

1.8 The rejected consignment of cement and steel should be removed from the site within two days.

2. Aggregates

2.1 Sand for use in masonry and plaster works shall confirm to relevant specification in TNBP (specification No. 7) and I.S.2116/ 1985, I.S. 1542/ 1977.

2.2 The coarse and fine aggregates for concrete shall confirm to I.S.383/ 1970 and as specified in the relevant clauses of I.S.456/ 1978. Other aggregates free from deleterious materials shall be used at the concurrence and approval of the Engineer after sufficient tests have been carried out at the contractor's cost.

2.3 The maximum quantities of deleterious materials in the aggregates, as determined in accordance with I.S. 2386 (Part II)/ 1963 shall not exceed the limits given in table I of I.S. 383. Unless otherwise specified all coarse aggregate in RCC shall be graded aggregate of 20mm nominal size. All aggregates shall be stored in hard impervious surface to ensure exclusion of all foreign materials and as per IS 4082/ 1977 and specification no.5 of TNBP volume I.

3. Water required for Construction

3.1 The water used in the construction shall be of potable quality and shall be tested at the contractor's cost. The contractor has to make his own arrangements at his cost for

water required for construction, testing, filling, etc., either from local bodies or from elsewhere, by paying the charges directly and arranging tanker etc., as per necessity. No claim for extra payment on account of non availability of water nearby or extra lead for bringing water shall be entertained. All required piping arrangements and pumping if required for water shall be made by the contractor at his cost. Water for mortar, mixing and curing of concrete shall be free from harmful matter or other substances that may be deleterious to concrete or steel and taken from a source approved by the Engineer. Ground water for mixing and curing shall confirm to the provisions in the class 4.3 of IS 456/ 1978.

4. Admixtures

Only where a beneficial effect is produced shall any admixture be used and that too after test has been carried out to convince the Engineer that no harmful effect will be produced by the use of such admixture and after approval by the Engineer. The admixture shall confirm to IS 9103/ 1972.

5. Form Work and Centring

5.1 Steel/ wooden form centring shall be used. If wooden form work is used, it shall consist of planks not less than 40mm thick and strong props. This shall be provided complying with clause 10 of IS 456/ 1978 and specification no. 30.8 of TNBP. The timber for form works shall be best hard wood and got approved by the Engineer in charge. This shall be deemed to be included in the items of contract even otherwise specified.

6. Separator (Cover Block)

6.1 For bottom cover of beams, slabs etc., separators of pre cast cement mortar blocks of suitable size with wire embedment as directed shall be used and tied to the reinforcement. Between layers of reinforcements, separators consisting of pieces of bars of suitable diameter shall be used. The required cover shall be provided as per clause 24-4 of IS 456/ 1978.

7. Pipes, Specials and Valves

7.1 General

7.1.1 All types of pipes required for the works should be of good quality confirming to relevant BIS and should be procured from reputed manufacturer or his authorised dealer. Each pipe should bear the trade mark of the manufacturer, the nominal diameter, class weight, batch number and the last two digits of the year of manufacture suitably and legibly marked on it. The Engineer shall have the right to conduct any test to ascertain the quality of the pipes supplied by the contractor. The contractor should make all necessary arrangements for testing the pipes. All the

charges and expenses towards the testing shall be borne by the contractor. The materials which are classified for ISI marking should be supplied with ISI marking only.

7.1.2 If on examination of any sample from any portion of the supply, the material is found to be sub standard and not fully in accordance with the relevant specification, the entire consignment shall be rejected. In case of doubt whether the materials conform to the specification or not, the decision of the Executive Engineer shall be final.

7.2 C.I. pipes

7.2.1 CI pipes shall be procured from the reputed manufacturer and the pipe shall conform to IS 1536/1976 or IS 1537/1976. The pipes shall bear ISI mark. The test certificate furnished by the manufacturer should be produced

7.3 AC pressure pipes

7.3.1 AC pressure pipes procured by the contractor shall strictly conform to IS 1592/1989 and as amended from time to time and the pipes should bear ISI marking. The CID joints should conform to ISS 8794/1988 and as amended from time to time. The AC couplers together with rubber rings for jointing the pipes should properly suit the AC pipes and withstand the same test pressure as the AC pipes. The test certificate issued by the manufacturer should be produced. The pipes shall be subjected to third party inspection also and the test certificate showing the inspection agency should also be produced.

7.3.2 The Engineer shall have the right to test pipes for the quality wherever felt necessary. All charges incurred in testing the pipes shall be borne by the contractor.

7.4 PVC Pipes

7.4.1 The unplasticized PVC rigid pipes shall strictly conform to IS 4985/1988 and as amended from time to time and shall carry ISI marking in every pipe.

7.4.2 The contractor should procure the PVC rigid pipes from a reputed manufacturer

7.4.3 The contractor should furnish the test certificate issued by the manufacturer

7.4.4 The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works

7.4.5 In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the PVC pipes for its quality such as specific gravity, impact strength at 0^0C, internal hydraulic pressure test, diameter, thickness etc. in TWAD Board laboratory.

7.4.6 The PVC pipe joints shall be with solvent cement of good quality, conforming to IS 14182/1994

7.4.7 The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness flexibility, colour etc.

7.4.8 All the PVC specials required for use in conjunction with PVC pipes, should be got approved by the Engineer-in –charge.

7.4.9 GI pipes

7.4.10 GI pipes should be procured by the contractor form reputed manufacturer or from their authorised dealer of reputed manufacturer and should conform to IS 1239/ part I, namely the inner and outer diameter, length and weight. The pipes which are found to be not conforming to relevant specification shall be rejected by the Engineer-in-charge.

7.5 CI D/F pipes

7.5.1 The CI/D/F pipes procured for use in the work should conform to the relevant BIS specification and suitable for use in the work.

7.6 Valves

7.6.1 The contractor should procure reputed make of sluice valves, scour valves, reflux valves and air valves from the manufacturer or his authorised dealer and they should conform to the relevant BIS specification and suitable for use in the work. The valves shall bear ISI marks.

7.7 CI/PVC/GI/MS Specials and Fittings

7.7.1 The specials and fittings should be in conformity of the relevant BIS specification

7.8 Testing of Pipes

7.8.1 The manufacturer test certificate/third party inspection certificate should be produced by the contractor for the pipes used in the work. The engineer shall have the right to test the pipes, wherever felt necessary for its quality. All testing charges should be borne by the contractor.

7.8.2 Testing of materials to be used in works, for the quality of finished items shall generally be done by the contractor at his own cost in the laboratory approved by the Employer by providing requisite materials, transport of test specimen and other assistance required thereof.

7.9 M.S. pipes

7.9.1 MS pipes shall be procured from the reputed manufacturer and the pipe shall conform to IS 3589/2001 or IS 1537/1976. The pipes shall bear ISI mark. The test certificate furnished by the manufacturer should be produced

II. CIVIL WORKS

I. General

1.1 Tamilnadu Building practice (TNBP) shall be strictly followed for carrying out different items of the work for which no standard specifications are available and no alternate specification have been given under the description of works.

1.2 Where any provision of the TNBP is repugnant to or at variance with any provision under BIS or description of work, technical specification and conditions of contract, the provisions, of the latter shall be deemed to supersede the provision of the TNBP.

2. Earth work

2.1 Specification

Tamilnadu Detailed Building Practice (specification No.23 to the extent applicable) shall be followed for earthwork excavation.

2.2 Conveyance

The excavated earth, blasted rubble etc., shall be conveyed and deposited in the departmental lands within 150m of plant site and as directed by the Engineer in charge.

2.3 Stacking

Where the location of the work is such and does not permit the deposition of excavated earth while digging trenches for laying pipes, the excavated earth should be conveyed to a convenient place and deposited there temporarily, as directed by the Engineer-in charge. Such deposited soil shall be re-conveyed to the site of work for the purpose of refilling of trenches, if it is suitable for refilling. The unit rate for trench work of excavated and refilling shall include the cost of such operation.

2.4 Disposal of Surplus Earth

The excavated soil which is surplus to that required for refilling and after allowing for settlement will have to be removed, spread and sectioned at places shown on the site during execution for purpose of widening or levelling the road. Sectioning is to be done as detailed in TNBP. It is to be understood that no extra payment, will be made for this and the unit rate for trench work of excavation and refilling shall include the cost of removal of surplus earth to disposal site approved by the Engineer-in-charge, its spreading and sectioning at the bidder's expense.

2.5 Shoring, strutting and Bailing at water

The Rate for excavation of trench work shall include charge of shoring, strutting, bailingout water wherever necessary and no extra payment will be made for any of these

contingent works. While bailing, care should be taken to see that the bailed out water is properly channelised to floe away without stagnation or inundating the adjoining road surfaces and properties.

3. Concrete

3.1 Specification

Concrete for use in the works shall generally comply with TNBP (specification No.30) and the relevant BIS. The concrete mix shall be in specified proportions satisfying the maximum aggregate size, water cement ratio and required cube strength and workability as per IS 456-2000.

Such concrete must be adequately vibrated to form solid mass without voids. The entire concreting works should be done only with the prior approval and in the presence of Engineer in change.

For M30 design mix with graded aggregate the mix proportion with water cement ratio may be got approved from competent authority before the commencement of concrete work.

3.2 Mixing of Concrete

The concrete shall be proportioned as far as cement and aggregates are considered by volume. The amount of water required being measured either by weight or volume the adjustments must be made to frequent intervals at the discretion of the Engineer or his assistant to account for the moisture content of the aggregates. The mixing operation shall be performed only in a mechanical concrete mixer and shall continue until the whole batch of uniform consistency and colour. The mixing of concrete shall be done in accordance with clause 8 and 9 of IS 456-2000.

3.3 Transporting , Placing and Compacting Concrete

3.3.1 Transportation, placing and compaction of concrete mix by mechanical vibrators shall be done in accordance with clause 12 of IS 456-2000. It is imperative that all concreting operations be done rapidly and efficiently with minimum re-handling and adequate manpower shall there fore be employed to ensure this.

3.3.2 The forms shall be first cleaned and moistened before placing concrete.

3.3.3 The mix should not be dropped from such a height as it may cause segregation and air entertainment. When the mix is placed in position, no further water shall be added to provided easier workability.

3.3.4 No concrete mix shall be used for the work if it has been left for a period exceeding its initial setting time before being deposited and vibrated into its final position in the member.

3.3.5 While one concrete is being placed in position it shall be immediately spreaded and ramped sufficiently and suitable to attain dense and complete filling of all spaces between and around the reinforcement and in to the corners of form work for ensuring a solid mass entirely free from voids.

3.3.6 Construction joints required in any of the structural members shall be provided generally complying with clause 12.4 of IS 456-2000 and as directed by the Engineer in charge. The efficiency of tempering and consolidation will be judged by complete absence of air pockets, voids and honey combing after removal of form works.

3.4 Curing

3.4.1 Curing shall be done to avoid excess shrinkage or harmful effort to the members generally complying with clause 12.5 of IS 456-2000

3.4.2 The method adopted shall be effective and any special method used must be approved by the Engineer and be subject to complete supervision.

3.4.3 Any deficiency in concreting such as cracking, excessive honeycombing, exposure of reinforcement or other fault which entail replacement of the defective part by fresh concrete and whatsoever remedy reasonable required without hampering the structural safely and architectural concept, all at the cost of contractor.

3.5 Removal of Form Work

Removal of form work shall be done as per TNBP and BIS and as directed by the engineer in such a manner that no damage is caused to the structures. The striping time shall not be less than that indicated in clause 10.3 of IS 456-2000.

3.6 Testing of Concrete

3.6.1 During the course of construction works, preparation of test specimens, curing and casting of concrete shall be done in accordance with IS 1199 and IS 516 to ascertain the strength requirements and acceptance criteria indicated in IS 456-2000. The contractor shall provide all apparatus, labour and arrange to test the cubes at his own cost at the test laboratory decided by the Employer.

3.6.2 In addition to the above tests, any other test which may if desired by the Engineer in charge be carried out from time to time as per relevant specifications at the cost of contractor. In case the concrete does not meet the strength required, all corrective measures shall be taken at once at the contractor's cost.

3.6.3 The inspection and testing of structures shall be done in accordance with clause 16 of IS 456-2000.

4. Masonry

4.1 All masonry works such as Random Rubble / Coarse Rubble/ Brick work must be done as per TNBP specification and Bid schedule specification.

5. Plastering

5.1 Plastering would be 12 mm, 20mm and 25mm thick cement plaster either plain or water proof as may be specified.

5.2 The plastering items shall be executed in thickness and cement mortar of proportion as detailed in respective item in the BOQ. Similarly the plastering shall be either ordinary or water proof as specified in respective item in the BOQ.

5.3 In case of water proof plaster standard and approved water proofing compound shall be mixed in cement mortar in required percentage as directed and then the plaster is applied.

5.4 The finishing shall be either smooth or rough as may be directed by the Engineer unless otherwise specifically mentioned in the BOQ.

5.5 NEERU finish wherever directed by the Engineer shall be done at no extra cost.

5.6 Curing and watering shall be done as directed and plaster shall be in alignment and level. Any substandard work is liable to be rejected and shall have to be re-done at contractors cost. Sand to be used shall be of approved quality only. Cost of all scaffolding shall be included in the rates quoted in the BOQ.

6 Flooring

40mm thick cement concrete 1:2:4 shall be provided for flooring. The size of metal shall not be more than 12mm and it shall be properly graded. A thin coat of very fine plaster shall be provided on top to give a smooth finish. The marking of false grooves to surfaces as directed includes the cost of labour.

7. Doors and Windows

7.1 Sizes shown on drawings are clear openings in masonry and not the shutter's size. These sizes shown on drawings are, therefore, inclusive of required frame sizes and doors, windows, etc., and shall be manufactured, accordingly. If sizes bigger than shown in drawings are manufactured, as instructed specifically in writing they shall be measured and paid for accordingly.

7.2 The work shall be executed as per the size of frame thickness of shutter type viz. Plan planked, glazed, etc., and fixture, etc., as described in tender item. Iron bars for windows and ventilators are to be provided if specifically mentioned in the tender item at Contractor's cost. Specifications in TNBP shall be applicable.

7.3 The design of shutters and quality of wood shall be got approved form the Engineer-in-charge before manufacture. The CW/TW to be used for woodwork shall be uniform in substance straight, free from large deed knots, flows flanks. The work shall be done as per specification of TNBP latest edition. The joints shall be perfect.

7.4 Part of wood embedded in masonry shall be painted with the tar. The frames of doors, windows, ventilators, etc., shall have proper hold-fasts embedded in masonry

7.5 Whenever iron bar is to be provided as per tender item the rate thereof is included in tender item. The painting shall be done as prescribed in tender item. No painting, however, shall be permitted till the woodwork is approved by the Engineer-in-charge.

7.6 Any substandard work not confirming to the specifications are liable to be outright rejected and

7.7 Executive Engineer's decision in such cases shall be final and binding on the Contractor

7.8 The mode of measurement shall be on area units as mentioned in B0Q.

8. Painting

8.1 The work shall be carried out as per the description of the tender item and as directed by Engineer- in-charge. It shall be white washing, distempering and/or snowcem painting. Shade and make shall be as directed by the Engineer and for decorative purpose, Engineer may ask for different shades to be provided for different components or different parts of the same component which the Contractor shall have to do within his tendered rate only at no extra cost to the Employer. Cost of priming coat as directed, scaffolding, etc., shall be included in the tender rate. The work shall be executed as per the specifications of TNBP for painting. In general, all items of works must be done as per TNBP specifications and bid schedule specifications.

III. SOURCE CREATION

1. Borewells

1.1 Borewells are drilled for tapping the water from the deeper acquifer.

1.2 In hard rock areas, 150mm DTH Rigs shall be used for drilling of borewells for power pump schemes. The location of borewell and depth of borewell are to be decided based on the geophysical survey by the Employer.

1.3 In sedimentary areas, Rotary rigs shall be used for drilling tubewells. The pilot well has to be drilled to the depth recommended through geophysical survey by the Employer. For the location of screen pipe, electrical logging has to be done. After erection of the casing pipes in the tube well, proper packing has to be done as per IS 4097/1967.

1.4 For shallow depth tubewells, conventional calyx drills and hand bore sets may be deployed, if so directed by the Engineer in charge.

1.5 In certain parts of the State, where the depth of drilling extends to 60m and above and some areas where the boulder bed formation is encountered, ODEX drilling rigs (simultaneous casing and drilling) are to be deployed.

2. Open well

2.1 These types of wells may be proposed when the required quantity can be drawn from shallow depth and tapping deeper acquifer is not possible due to poor quantity and quality of water. The location of the open well has to be done with respect to geophysical survey. Subsequent to the geophysical survey, trial bores have to be drilled for confirming the data of survey. The diameter of the wells is to be decided based on the designed requirement.

2.2 The contractor must produce the spring details during the excavation of the open well. Wherever separate rate is provided in the B0Q for baling out water, necessary log books are to be maintained. Wherever necessary, weep holes or pipes are to be provided in the steining of the well.

2.3 Well rejuvenation technique may be adopted wherever necessary.

3. Infiltration Well

3.1 Infiltration wells must be constructed in the location shown by the Employer. Before starting the works confirmatory bores must be drilled in the periphery of the wells to ascertain the soil strata.

3.2 Clearance from bottom of curb to the hard strata should be D/2 subject to a minimum of 0.6m. ('D' refers to diameter of the well).

3.3 Clearance from top of porous concrete/perforated bricks to the bed level should not be less than 3.0m.

3.4 Pilasters should be provided from top of curb to the cover slab.

3.5 Holding down rods of size not less than 20mm dia should be placed at 1m interval.

3.6 Binding Rings of 15cm thick should be provided at 1.5m intervals.

3.7 Plastering the portions above porous concrete at 1.5m intervals.

3.8 Vent pipe of suitable size with anchoring arrangements shall be provided from cover slab upto 0.30m above M.W.L.

3.9 Two numbers of heavy type Inspection covers of size 75cm x 60cm shall be provided with locking arrangements.

3.10 Bottom curb should be taken below the scour depth.

3.11 Top cover slab should be minimum 1M above bed level.

3.12 Size of curb should be minimum of 0.60m including cutting edge.

3.13 Bottom portion of well should be filled with coarse sand for 0.60m depth (top of curb to bottom of curb).

General

In all above source creations, after completion of source, yield tests are to be conducted and safe yield has to be arrived at. Number of wells shall be decided depending upon the yield.

4. Collector well

4.1 General Specification

4.1.1 Confirmatory borings have to be put down along the proposed alignment of radial arms and at collector well point and detailed sieve analysis of the sample of soil is to be made at the proposed site before taking up the work by the contractor.

4.1.2 The location of collector well, radial arms should be suitably checked based on results of confirmatory borings and sieve analysis of soil samples of ensure the potentially of acquire by the contractor himself.

4.1.3 Detailed sieve analysis of the sample of soil is to be made before taking up the work. The contractor should submit a detailed report to the department and get the clearance from the Executive Engineer for proceeding with the work further.

4.1.4 Reduced levels of various components of collector well cum pump house should be maintained very carefully at every point.

4.1.5 True vertically of collector well and true horizontal position of radial arms should be ensured during execution. The tolerance limit of vertically of well sinking as per BIS is allowable.

4.1.6 "Design Mix" should be verified by the contractor at his own cost by conducting laboratory tests using the actual materials at site. The extra charges will not be paid by the Employer.

4.1.7 Cube test should be conducted for every work during execution in the nearby laboratory and the results shall be communicated to Engineer in charge then the there. The unit rates quoted in the price bid includes these types of tests also.

4.1.8 The results of tests conducted as above should be furnished to the Engineer concerned before carrying out the work and clearance to be obtained then and there before proceeding with the above items of work.

4.1.9 Plugging the bottom of collector well should be done effectively with special tools and plants to ensure water tightness.

4.1.10 The contractor should conduct necessary pumping tests to prove that the radial arms are driven on to correct alignment, levels and without any gap or damage to radial pipes and to prove that required quantity of water could be abstracted during summer. The required pumps, tools and plants etc. should be used by the contractor himself. No separate charges will be paid to the contractor on this account.

4.2 Radial Arms

4.2.1 Suitable length of radial arm of dia as per specifications to be driven in different directions so as to give the minimum guaranteed yield of ..... MLD of water throughout the year. The quantity furnished in the schedule is only approximate. If the well yields the required quantity of ..... MLD with radial arms of less than ..... metres, the payment should be restricted to the actual length driven at the rate per metre as quoted by the contractor. The slot in the radial arms should be of required size based on the sieve analysis of the soil samples obtained at site. The depth up to which the well should be sunk based on the confirmatory borings and the length for which the arms are to be provided so as to get the required yield shall be the sole responsibility of the contractor. The Employer has the option to instruct the contractor to drive any extra length of radial arms over and above the length provided in the Bid Document.

4.2.2 Each radial arms should be provided with bullet head for driving. No extra rate will be paid to the contractor for the bullet head as the rate to be quoted in the B0Q shall be inclusive of the above items. If due to site condition, the number of arms are to be increased than those provided in the agreement, it should be done at the agreement, it should be done at the agreement rate both for driving radial arms and providing bullet head. Further the contractor should supply, deliver and fix necessary extra number of .....mm dia tail piece and ..... mm dia sluice valve

as per BIS with operating gear head arrangements due to increase in number of radial arms at the agreement rate.

4.2.3 Fabricated MS slotted pipe should not be used for radial arms.

4.3 Baling out Water

4.3.1 The rates for well sinking and driving of radial arms will be inclusive of charges for baling and pumping out of water, scooping out of earth etc. complete and no extra payment for such contingencies will be made separately.

4.4 Tools and Plants

4.4.1 All the tools and plants required for the work including all pipes and timbers for shoring and strutting. Pumpsets for de-watering, compressor driving equipments for under water works etc. shall be provided by the contractor at his own cost. The rates quoted for the relevant items shall be inclusive of charges for such tools and plants and appurtenances required for the proper execution of the work.

4.5 Guarantee for Structural Stability

4.5.1 The water tightness of the collector well should be ensured when the collector well is empty.

4.5.2 The period of guarantee required by the contract shall be two years from the date of commissioning of the scheme. If any defects are noticed within the guarantee period, the defects should be rectified by the contractor at his own cost and the guarantee period will again be extended to two years from the date of completion of the rectification of defects by the contractor. During this period the structure shall neither develop any defect which shall endanger its stability nor shall show signs of leakage or seepage or infiltration through the sides or from the bottom of the collector well.

4.6 Guarantee for the Yield

4.6.1 The contractor should give a guarantee for the required yield of ..... MLD of water in all seasons of the year for a period of two years reckoned from the

date of commissioning of the collector well. The contractor has to indemnify the Employer towards guarantee for the yield of ..... MLD of water in all seasons through out the year.

Yield Tests

4.6.2 The contractor is responsible for the required yield of ..... MLD. The yield test will be conducted by him in the presence of the Engineer not below the rank of

an Assistant Executive Engineer during summer and the results of the same shall be furnished to the Engineer in charge. The yield test will be conducted as many times required by the Engineer in charge even for part length of radial arms by operation of valves. The required pumpsets, tools and plants etc. should be made available by the contractor at his cost for conducting yield tests and no extra charges will be paid to the contractor.

4.7 Diversion of surface flow and isolating the site of work

4.7.1 The contractor himself has to arrange for necessary diversion of surface flow for isolating the site of work for construction of collector well cum pumphouse and other allied works. The bund for diversion should be well formed in such a manner that there may not be any breach during the progress of work and the same should also be maintained in good condition till the work is completed.

4.7.2 The contractor will be personally responsible for any damages caused to the work due to any breach in the diversion formed during the progress of work.

4.7.3 The employer will not take any cognizance of any damage to the materials or the equipment required for the work and kept in the river bed or in the bank due to any cause whatsoever it may be. The contractor should take necessary precaution against floods, theft or any loss or damage occasioned by or arising out of act of God and in particular unprecedented floods etc. The contractor shall arrange for risk insurance at his cost for the above cause.

4.9 Earthwork Excavation

4.9.1 The levels in the drawings are only approximate for the guidance of the contractor in general. From the date of execution, the bed level and the sub soil water level as noted will be reckoned. Thus the payment will be regulated according to the sub soil water level observed.

4.9.2 In regard to the width of the excavation of work above or below water level, sketch will be furnished to the contractor and payment will be restricted as per section shown in plans irrespective of the facts that the contractor excavates the same with more side slopes for his own convenience.

4.9.3 The contractor has to fix up and maintain necessary sight rails and ranging rods etc. as required by departmental officers for checking the various levels.

4. 10. Excavation for Foundation

4.10.1 Unless otherwise specified open well excavation shall be resorted upto water levels as directed by the Engineer.

4.10.2 All precautionary measures for the safety of labourers while excavation shall be made as per the relevant BIS for safety code for earth work.

4.10.3 The quantities furnished in the BOQ are only approximate. Any omission or excess in quantities may arise during execution according to the site condition. Any alteration of work or any additional work during execution has to be done by the contractor. If no rate in the BOQ is applicable or derivable for the additional works, the rate will be arrived at as per rules and regulations governing for the working out of rates for supplemental item of work and will be paid to the contractor.

4.11 Well Sinking

4.11.1 Unless otherwise specified open well excavation shall be carried upto water level before the well curb is laid.

4.11.2 Sinking of well shall be carried out as per the relevant specification of TNBP and as directed by Employer.

4.11.3 The contractor shall arrange his own method sinking unless otherwise specified or ordered by Engineer i.e. by manual labourer drivers or by dredgers and loading the top of the staining to assist sinking, adopting, suitable combination to sink the well to the required depth.

4.11.4 No de-watering of the wells must be done during sinking without obtaining prior permission of the Engineer and any damages which may result to the well by such de-watering shall be made good at the contractor's expenses.

4.11.5 The well must be sunk perfectly vertical and in the exact position of the site selected. If it is necessary to sink a well deeper than the specified depth in order to set right any tilt or error of position such sinking must be done at the contractor's expenses.

4.11.6 Well shall not be left partially sunk during the periods of release of water. The rectification of damages to the partially sunk wells due to any cause shall be done by the contractor to the satisfaction of the Engineer in charge of the works at the contractors cost.

4.12 R.C.C. Well Curb

4.12.1 The well curb must be cast as per drawings and as per departmental specification.

4.13 R.C.C. Well Staining

4.13.1 Well staining should be of required thickness and with required reinforcements. No patent water proof materials shall be mixed in the concrete or mortar and applied to the work as a matter of course by the contractor as they are liable to give deceptive results on the water tightness of the structure. The structure should be stable, sound and water tight to facilitate construction work. Under full working head of

water it shall not develop any defects which shall endanger its stability. The contractor shall make his own arrangements at his costs for the testing of works and carrying out such rectification as may be ordered to be done if necessary.

IV. PIPE LAYING WORKS

1. General

1.1 The earthwork for the pipe laying work shall generally confirm to the details given below.

Sl.No.	Dia of Pipe in millimetre	Depth of Bottom of pipe below ground level in centimetre	Width of trench at bottom in centimetre
1	PVC pipe Upto 140	105	60
2	For other Pipe Upto 150	105	75
3	200	110	80
4	250	120	80
5	300	135	80
6	350	145	90
7	400	155	90
8	450	170	100
9	500	185	100
10	600	205	110
11	700	230	120
12	750	245	125

1.2 Wherever necessary, sand cushioning for the bed shall be given as per IS Standards and as directed by the Engineer in charge. The pipe should be laid true to the alignment line and grade wherever necessary, appropriate bends should be used. The pipes laid must be jointed properly and carefully by using approved type of jointing materials.

1.3 After the pipes are laid and jointed, the pipelines are to be subjected to hydraulic pressure test as detailed in the relevant BIS specification for various types as indicated below.

A.C. pressure pipes	..	Clause 2 of IS 6530/ 1972
Cast in iron pipes	..	Clause 6 of IS 3114/ 1985
PSC. pipes	..	Clause 2 of IS 783/ 1985
PVC pipes	..	Clause 2 of IS 7634/ 1975
DI Pipes	..	IS 8329/2000
GI pipes	..	IS1239/ Part I -1990
MS pipes	..	IS 3589/2001
MS specials	..	IS 7323

In portion of pipe line, where the pipes have developed cracks or sweating, such pipes with jointing materials shall be removed and re-laid with new pipes at the contractor's cost and the pipe line shall be re-tested to the entire satisfaction of the Engineer in charge. No extra payment will be made on this account. The bidder has to make his own arrangements for the procurement of the required equipments for testing pipes which shall be subjected to such test as the Engineer-in-charge deems fit to the ensure the accuracy of the gauge.

1.4 Refilling shall be done with proper compaction with excavated earth. In no case the contractor shall be allowed to refill the trenches in hard excavated portion to be refilled by the boulders or excavated stuffs. This portion of trench shall be refilled by the soft strata from excavated stuff from distance place at no extra cost. The refilling shall be done in 15cm thick layers duly watering and compacting each layer. The refilling may be done upto a height of 20 to 30cm than the natural ground level to allow that sinking afterwards. If the refilling gets sunk below the natural ground level at anytime till the completion of the work, the contractor at his cost should make good the refilling to the required level as may be directed by the Engineer in charge.

1.5 In case of pipe trenches, the Engineer may reduce the width of trench wherever a hard strata is met with, if he feels adequate and just sufficient to lay the pipe line in order to reduce the hard rock quantity. In such case the contractor will be paid as per the actual measurement.

1.6 If the work is in a residential area, the contractor should carry out the excavation carefully to avoid collapse of any structure.

1.7 Valves shall be provided with valve pits with proper cover to bear the loads coming on it as per bid documents and departmental drawings and specification. Public fountains, Fire hydrants shall be provided as per type design and specification.

1.8 Adequate protective measures should be taken against surge pressure. Zero velocity valves and air cushion valves should be provided at the appropriate places. Thrust blocks and anchor blocks should be provided at all the bends and appropriate places.

1.9 Water required for testing the pipeline shall be arranged by the contractor at his cost.

2. Laying Cast Iron pipes

2.1 The laying and jointing of case iron pipes shall be carried out as follows :

Before laying the pipes, the contractor shall carefully brush them to remove any soil, stones or other materials which may be therein. An even and regular bed having been prepared and joint pit excavated to form a process under the socket of each pipe of no greater depth and width than to enable the pipe jointing to be properly done. Each pipe shall then be

carefully lowered and placed singly in the trench and shall rest in the solid ground for a distance of not less than two thirds of its entire length. In places where the soil is not hard, cement concrete bed blocks or timber piles have to be provided under the pipes if directed by the Engineer in charge.

2.2 Pipes not Truly Laid

Any pipe or pipes laid, which on inspection are found to diverge from the true lines and levels shall be removed and re-laid to the true lines and levels and the old jointing properly cleared off the pipes and fresh joints made by the contractor at his expense. Any pipes damaged in removal shall be replaced by the contractor at his cost.

2.3 Cutting of C.I. Pipes

Where necessary and as ordered by the Engineer in charge, the Contractor shall cut the pipes and fix and joint common collars for jointing spigot ends. The cut ends of the pipe shall be made truly at right angles with the axis of the pipe.

2.4 Covering up Open Ends

The contractor shall take particular care to ensure that the apertures and open ends of pipes are carefully covered whenever the workmen are not actually employed therein.

2.5 Jointing of C.I. Pipes

The trench must be kept quite dry during jointing unless in any particular case the Engineer permits laying of the pipe in wet conditions. Plain spigot and socket pipes shall be joined as follows.

a) Lead Joints

Generally lead joints shall be used for all sizes. In the case of 100mm pipes, cement joints may be used if specified in which case for every ten cement joints, one lead joint shall be used. Provision of lead joints shall also be made at street crossings, at closing joints and for all specials and as determined by the Engineer depending upon the site condition.

The spigot of the pipe must be forced well home into its socket and must be centred, so that the joint may be of even thickness all round. As many laps of white hemp spun yarn as may be needed to leave the space required for the lead shall be driven to the bottom of the socket without being forced through the joint into the pipe but carefully driven home with a caulking tool. The proper depth of each joint shall be tested before running the lead by passing completely round it a wooden gauge, notched out to the correct depth of lead, the notch being held close against the face of the socket. The joints shall then be run with molten lead in sufficient quantity so that after being caulked solid, the lead may project

3mm beyond the face of the socket against the outside of the spigot but must be flush with the outside edge of the socket.

For pouring lead in the joints, a ring of hemp rope covered with clay shall be wrapped around the pipe at the end of the socket leaving an opening at the top of the socket into which the lead can be poured. The hemp rope shall be supported by clay packing so as to withstand the operation of lead pouring.

The lead used shall be carefully skimmed of all scale, when melted in a cast iron pot or patent melting machine. Sufficient lead shall then be taken by a ladle and run hot into the joint, and the joint filled at one running. The joint shall then be caulked when cool by a suitable caulking tool and a 2kg hammer and the joint left neat and smooth.

The weight of lead and hemp which shall be used in each joint shall be in conformity with the table given below or as specified by the Engineer.

Quantity of lead and spun yarn for different sizes of pipes

Nominal size of pipe in mm	Lead/ joint In Kg	Depth of Lead joint in mm	Spun Yarn per Joint in Kg
80	1.8	45	0.10
100	2.2	45	0.18
125	2.6	45	0.20
150	3.4	50	0.20
200	5.0	50	0.30
250	6.1	50	0.35
300	7.2	55	0.48
350	8.4	55	0.60
400	9.5	55	0.75
450	14.0	55	0.95
500	15.0	60	1.00
600	19.0	60	1.20
700	22.0	60	1.35
750	25.0	60	1.45
800	31.5	65	1.53
900	35.0	65	1.88
1000	41.0	65	2.05
1100	46.0	65	2.40
1200	50.0	70	2.60
1500	66.5	75	2.80

Nominal size of pipe in mm	Lead/ joint In Kg	Depth of Lead joint in mm	Spun Yarn per Joint in Kg
8 Inches	4.54	2.00 Inches	0.29
9 "	5.10	2.00"	0.31
10 "	5.67	2.00 "	0.34
12 "	6.58	2.00 "	0.48
14 "	9.30	2.50 "	0.63
15 "	9.98	2.50 "	0.68
16 "	10.66	2.50 "	0.74
18 "	14.06	2.50 "	0.95
20 "	16.33	2.50 "	1.04
21 "	17.92	2.50 "	1.08
24 "	20.41	2.50 "	1.21
27 "	23.13	2.50 "	1.33
30 "	25.86	2.50 "	1.46
33 "	28.35	2.50 "	1.65
36 "	31.58	2.50 "	2.40

Note

The quantities of lead and spun yarn given in the table are provisional and variation of 20 percent is permissible.

b) Flanged Joints

Flanged joint should be made by painting the facing of the flange with white lead freely and bolting up evenly on all sides. A thin fibre of lead wool may be very useful in making the joints water tight where facing of the pipes is not true.

When packing must be used, it should be of rubber insertion of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt holes cut out evenly on both the inner and outer edges. Where the flange is not fully faced, the packing may be of the diameter of the packing strip only. Proper placing of the packing should be checked before another pipe is joined on.

c) Cement Joints

The cement for the joints shall confirm to IS 269/ 1996 specification for ordinary, rapid hardening and low heat portland cement.

Cement and water taken in proportion 8 : 1 by weight shall be thoroughly mixed. The mixture shall be such that when it is tightly compressed by hand into a ball and the ball is broken into two pieces the break shall be clean. If the hand becomes water stained, it has to be considered that the water is excessive. If there is evidence of crumbling in the break, water added is less than required. The cement mixture shall ring with metallic sound while caulked.

Cement which has been wet for more than one hour or which had undergone initial set shall not be used for jointing.

Making the joints

When new pipes are laid close ahead of a newly made cement joint, the disturbance caused during the forcing home of the pipe ends into the sockets during the adjustment of the pipe to proper alignment may damage the new joint. To avoid this damage, jointing shall be done only when there are atleast six pipes laid to the final grade and alignment ahead of the joint to be made. Starting at the bottom of the joint the joint space shall be filled with wetted cement and caulked. The remaining joint space shall than be refilled with cement and caulked until the joint is practically flush with the face of the socket. The mixture shall be thoroughly compacted to make a water tight joint.

No water shall be allowed to touch the joint until the initial set had taken place. Immediately after initial set has taken place, the joint shall be covered with wet burlap, or other approved wet materials to ensure complete hydration of the cement. No water shall be allowed into the pipe until the elapse of 12 hours after the last joint in the line is made. Filling the pipe with water without pressure after this interval will be beneficial to curing of the joint.

d) Rubber Ring Joints

In the case of rubber ring joints or push on joints, the groove and the socket shall be thoroughly cleaned before inserting the rubber gasket. While inserting the gasket it shall be made sure that it faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, lubricant shall be applied in accordance with the pipe manufacturer's recommendations.

The contractor shall make sure that the plain end is beveled as square as sharp edges may damage or dislodge the gasket and cause a leak. When the pipe is cut at site, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.

The plain end of the pipe shall be pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflections are to be made in the alignment, it may be made after the joint is assembled. A timber header shall be used between the pipe and crow bar or jack to avoid damage to the pipe while the plain end of the pipe is pushed into the socket either with a crow bar or jack, or level pullet.

2.6 Fixing Sluice Valve

The sluice valves to be fixed on the pipelines shall be examined, cleaned and placed in the positions as shown in the drawings. The valves shall be placed on the pipe line and valve chambers constructed according to drawings. The depth at which the valve is to be laid and the dimensions of concrete and masonry shall be varied when necessary under the orders of the Engineer.

As the pipes in some instances may be required to be fixed at a less depth than will permit the top of the valve spindle being below the level of the road (but this may only be in cases where the position of the valve is to one side of the metalloid road) the walls of the valve chamber shall in such cases be carried upto such height at may be ordered, and the chamber shall have such covering as the Engineer may direct.

The valve shall be supported in the valve chamber so that no stress or strain occurs in the flange or other joints of the valve.

The valve shall be carefully protected from slime or dust by a suitable mat or gunny covering and the pit itself shall be cleared of all unwanted material.

2.7 Fixing Scour Valve

Scour valves shall be fixed at places shown in the drawings or as directed by the Engineer, and the scour connections from the main shall be carried out completely as per drawings.

2.8 Fixing Air Valve

Air valves shall be fixed at the summits of pipe lines or at places may be directed by the Engineer. The air valve connections etc, shall be carried out as per drawing.

2.9 Interconnection Work

The interconnection work between the existing main and proposed main to be laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the contractor shall make ready necessary tools and plants required for the work at site, such as pumpsets, shoring materials etc., He shall also keep ready at site necessary pipes, specials, valves if any required for the work. The

contractor shall keep necessary skilled workmen of sufficient strength at site and once the work is commenced, the entire interconnection work shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of Specials, valves (except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site stacking, excavation, timbering, pumping out water from the trenches, lowering, aligning, jointing specials and valves cutting the existing mains, baling out water, inserting the necessary branches, jointing, testing, refilling etc., shall comprise as one unit of work and will be paid at the lump-sum rate quoted in the schedule for interconnections.

2.10 Works to be left water tight

The contractor shall construct the pipes chambers and all other works so that they shall be water tight. Should any leakage appear, it shall be made good by him at his expense by removing and reconstructing the portions of the work so affected or by other method which will render the work thoroughly water tight to the satisfaction of the Engineer.

2.11 Cleaning of Mains

During the execution of the work the contractor shall keep the interior surface of the mains free from cement, brick, soil or other superfluous matter and shall hand over the mains perfectly clean and free from deposit on completion.

2.12 Masonry Chambers

Chambers for sluice vales, inspection, scour valves, air valves shall be constructed on the pipes in the positions as shown in the drawings or in such positions as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings or as ordered by the Engineer. The excavation shall be made lower than necessary to admit of the earth being properly timbered. The bottom of the excavation shall be properly levelled, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the building of the brick walls shall then be proceeded with and all iron work fixed in as the building proceeds. The inside of all chambers shall be plastered with cement mortar 20mm thick and the outside with cement mortar 12mm thick. The chamber shall be topped with pre-cast R.C.C. Slabs 1:2:4 or cast iron surface box of valve cover as ordered by the Engineer. The surface box or valve cover shall be fixed on the top of the R.C.C. slab by a layer of cement mortar and sides of the surface box or valve cover covered over with

cement concrete. Where pipes pass through walls of chambers relieving arches shall be turned neatly over the upper half of the pipes or R.C.C. lintels shall be provided to avoid load of the walls transmitted to the pipes. Cast Iron steps shall be built in each chamber as the work proceeds one being inserted to every 4 courses of brick work, horizontal distance centre to centre of each row being 30 cms. The contractor shall include in his rate for brick work cost for fixing steps, frame, cover etc., for completing all chambers in accordance with the drawings and with the above specifications.

2.13 Testing of Main –Hydrostatic Test

After laying and jointing the pipes and specials, the pipe lines shall be tested for hydrostatic pressure in such length as may be specified by the engineer. The test pressure shall be equal to 50% or such other higher percent as may be specified in excess of the pressure the pipe will have to withstand subsequently subject to a minimum test pressure of 7 kg/sq.cm in the case of lead joints. However in the case of cement joints, the joints may be tested to a minimum test pressure 3.5 kg/sq.cm.

If cement joints show seepage or slight leakage, such joints shall be cut out and replaced as directed by the Engineer and the test repeated. The Contractor shall make his own arrangements to procure, necessary equipments, apparatus etc,. required for testing and shall provide necessary labour for filling with water the length of pipes to be tested, fixing all apparatus and for carrying on the testing operations until the length of pipes, specials and connections are finally passed by the Engineer. The length to be tested shall be provided with two blank flanges fastened on in the usual manner by collar bands and bolts to the end pipes or if the length to be tested shall have a sluice value at each end, such blank flanges may dispensed with. The length of pipes to be tested shall first be filled in with water from a higher section of pipes already laid or with clean water shall be arranged at the contractor's expense with the approval of the Engineer. Before the actual testing pressure is applied any air which has lodged in the length of pipes to be tested shall be got rid of, by screwing on at the highest part of the length of pipes or temporary air valve, or, by opening a temporary stop-cock or by other mean as the Engineer may direct.

The test pressure shall then be applied to the length of pipes under test by a hand or powered hydraulic test pump. The connection of the test pump to the length of pipes shall either be at the union connection provided at a blank flange or shall be at a temporary stop sock or fountain connections as the Engineer may in the circumstances direct. The actual

test shall be made by pumping water into the length of pipes under test, until the test pressure as specified above has been reached on the pressure gauge.

The test pressure shall be maintained for one hour or for such other period of time as may set by the Engineer and each joint will be inspected. While the pressure is on, the pipes should be struck smartly with a 2 kg hammer. When a flange joint is found to be leaking, care shall be taken that while tightening up the flanges, the neighbouring joints are not affected .If the length of pipe line under test is found to be satisfactory and no leaks or sweatness are found at the pipe joints or at the joints of specials and connections then this length of pipe line will be passed by the Engineer.

But should any pipe, joint, special or connection be found to sweat or leak, the contractor shall make good at his cost such defective joint and the length of pipe line shall be re-tested by the Engineer until all pipes, joints, specials and connection are found to be satisfactory.

If any pipe or special leaks or bursts, the damaged portion shall be removed and new pipes or specials shall be laid and jointed at the contractor's cost.

2.14 Restoring Road Surface

The surface of the road or ground shall be finished off to the proper level with the same kind of material as the surface consisted of before the excavation commenced except in the case of superior roads and tarred roads in which case the surfaces should be finished off with water bound macadam surface. Should any settlement occur after refilling is completed and upto the end of the period of maintenance, it shall be made good at once and the surface restored to the satisfaction of the authority under whose jurisdiction such road or ground may be, all at the cost of the contractor.

2.15 Collection of Rubbish

The contractor shall, at his cost, on the completion of the work remove all water and all materials or rubbish of every description which may have been collected in the works and find a deposit thereof and anything which my have collected within the works, during the period maintenance shall also removed before the works are finally accepted by the Employer.

3.1. Laying and Jointing of PVC Pipes

a) PVC Pipes

The PVC pressures pipes for water supply and distribution shall conform to IS 4985/ 1988.

b) Laying of PVC Pipes (IS 7634/ 1975)

The trench bottom should be carefully examined and should be free from hard objects, such as flints, rock projections or tree roots etc. The bedding for the pipes should be

brought to an even finish providing uniform support for the pipes over their length and pipes laid directly on the trench bottom. In other case the trench should be cut correspondingly deeper and the pipes laid on a prepared under bedding which may be drawn from the excavated material if suitable. As a rule trenching should not be carried out too far ahead of pipe laying. The trench should be kept as narrow as practicable but must allow adequate room for jointing pipes and placing and compacting the back fill. Mains should be laid with a cover of not less than 1m measured from the top of the pipes to the surface of the ground. Mains which might be brought under roadways by future widening schemes should be so laid that the eventual cover will not be less than 1m.

c) Jointing of PVC Pipes

The jointing of PVC pipes are done either by using Solvent Cement Joint or rubber ring joint. The solvent cement used for jointing should be of the quality as specified in IS 14182/ 1994. The spigot and socket ends of the pipes should be cleaned and roughened with emery paper. If the ends are grossly contaminated, they should be cleaned with Acetone or Methyl Alcohol. The solvent cement should be thickly applied on the spigot end and thinly in the socket. For larger sizes the first coat should be allowed to dry and a second coat applied. The spigot is then pushed into the socket and the excess cement wiped off at once with piece of cloth or rag. The joint should not be disturbed for atleast 5 minutes. The pipe should not be subjected to working pressure for 24 hours after jointing.

i) Rubber Ring Joint

The pipes for rubber ring joints are supplied with both ends chamfered. A mark should be made at a distance from the pipe end equal to half the length of the coupler. The inner side of the coupler ring and the chamfered end of the pipe should be clean and dry. The 'O' ring is then slipped into the coupler. The ring and the chamfered end of the pipe are lubricated with a lubricant. The coupler and the pipe should be carefully aligned and should be truly coaxial. The coupler is then pushed home into the pipe or the pipe is pushed into the coupler to make the joint.

4. Disinfection of Mains

Upon completion of a newly laid main or when repairs to an existing pipe are made, the main shall be disinfected as directed by the Engineer.

The mains shall be flushed prior to dis-infection except when the tablet method is used. After initial flushing, the hypo chlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solution may be fed with a hand pump .In the case of mains of a large diameter, water from the existing distribution system or other approved

source of supply shall be made to flow at a constant measured rate into the newly laid pipe line. The water shall receive a dose of chlorine also fed at a constant measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at not less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'Slug' of chlorinated water that will as it passes along the line expose all interior surfaces to a concentration of at least 300 mg/l. for atleast 3 hours. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect the appurtenances.

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

After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, dis-infection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main shall be placed in service.

5) Laying and jointing of Ductile iron pipes.

a) Ductile iron pipes

The Ductile Iron pressure pipes shall conform to the I.S. 8329 /2000 & specials as per IS 9523/2000.

b) Laying Ductile Iron Pipes as per IS 12288/1987

The pipe should be lowered into the trench with tackle suitable for the weight of pipes. For smaller sizes up to 250mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes either a well designed set of shear legs or mobile crane should be used. When lifting gear is used the positioning of the slink to ensure a proper balance, should be checked when the pipe is just clear of the ground. If sheathed pipes are being laid, suitable wide slings are scissor dogs should be used.

All construction debris should be cleared from the inside of the pipe either before or just after a joint is made. This is done by passing a pull through in the pipe, or by hand, depending on the size of the pipe. When laying is not in progress a temporary end closer should be securely fitted to the open end of the pipe line. This may make the pipe buoyant in the event of the trench becoming flooded, in which case the pipe should be held down either by partial refilling of the trench or by temporary strutting. All persons should vacate any section of trench into which the pipe is being lowered.

b.1 On gradient of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe should be held firmly in position while the trench is back filled over the barrel of the pipe. The back fill should be

well compacted.

c) Jointing of Ductile Iron Pipes:
Two main types of joints are used with Ductile Iron pipes and fittings.
i)Socket and spigot flexible joints.

1. Push on joints
2. Mechanical joints

ii)Rigid flanged joints.

iii)Flexible joints:

The spigot and socket flexible joint should be designed to permit angular deflection in direction and axial movement to compensate for ground movement and thermal expansion and contraction. They incorporate gasket of electrometric materials and the joints may be of the simple push-on-type or the type where the seal is effected by the compression of a rubber gasket between a seating on the inside of the socket and the external surface of spigot. Joints of the latter type are referred to as mechanical joints. Both push-in and mechanical joints are flexible joints. Flexible joints require to be externally anchored at all changes in direction such as at bends, etc., and at blank end to resist the thrust created by internal pressure and to prevent the withdrawal of spigots.

Flanged joints:
Flanged joints are made on pipes having machined flange at each end of pipe. The seal is usually effected by means of a flat rubber gasket compressed between two flanges by means of bolts which also serve to connect the pipe rigidly. Gaskets of other materials, both metallic and non metallic are used for special applications.

Jointing procedure:
Procedure for jointing will vary according to the type of joint being used. Basic requirements for all types are:
a) Cleanliness of all parts
b) Correct location of components
c) Centralization of spigot within socket and
d) Strict compliance with manufacturer"s jointing instructions.

The inside of sockets and the outside of spigots should be cleaned and wire brushed for a distance of 150 to 225 mm. Glands and gaskets should be wiped clean and inspected for damage. When lifting gear is used to place the pipe in the trench, it should also be used to assist in centralizing the spigot in the socket.

Where the pipeline is likely to be subjected to movement due to subsidence or temperature variations, the use of flexible joints is recommended. A gap should be left between the end of the spigot andthe back of the socket to accommodate such movement.

V. WATER RETAINING STRUCTURES

(Elevated Service Reservoir/ Ground Level Service Reservoir/ Sump etc.)

1. Each service reservoir shall be executed as per the drawings and specifications and as directed by the Engineer in charge.
2. The service reservoirs shall be provided with suitable size C.I. D./ F. Pipes for inlet, delivery, overflow and scour connections and painted with two coats of anticorrosive paint as per BOQ/ Drawing.
3. Suitable size sluice valves with gear arrangements wherever necessary shall be provided for all inlet and outlet connections with valve pits.
4. Water level indicators enamel painted with float and painted with graduations in metric units shall be provided to indicate water level inside the reservoir.
5. Suitable size and required number of ventilators, manhole covers shall be provided as directed by the Employer.
6. RCC spiral staircases shall be provided for outside and access ladder inside the service reservoirs as per Specifications.
7. The finishing colour of the service reservoirs shall be aesthetically selected after its approval by Employer and double coating shall be applied after water tightness certificates is given by the Engineer.
8. Lettering to indicate the capacity and other details as directed by the Employer shall be written on the side wall of the service reservoirs.
9. Valves shall be provided with valve pits and cover to bear the loads coming on it as per departmental type design and plans.
10. Testing for water tightness

10.1 For water retaining structures above ground level, the requirement of the test shall be deemed to be satisfied if the external face shows no sign of leakage and remain apparently dry over a period of observation of seven days after filling upto maximum water level and allowing seven days period for absorption.

10.2 In case of underground structures with top covered, the tanks shall be deemed to be water tight if the total drop in water level over a period of seven days does not exceed 40mm.

10.3 If the structure does not satisfy the condition of the test period, the test may be extended for a further period of seven days and if the specified conditions of the test are satisfied the structures shall be considered to be water tight.

10.4 In case of unsatisfactory test results, the contractor shall ascertain the cause, make all necessary repairs and repeat the procedure in the preceding clauses until the test has been passed satisfactory at no extra cost to the employer.

10.5 In addition to the withheld amount, 40% of the amount of each bill of the contract shall be deducted and will be retained till the date of receipt of certificate of water tightness from the Executive Engineer, TWAD Board. The whole of the above sum

together with any recovery from the payments already made to the contractor as may be assessed by the Executive shall be forfeited to the TWAD Board if the RCC reservoir develops structural defects or leaks. The above recovery shall be exclusive of the amount deposited towards security deposit. The fact of carrying out water tightness test should be recorded in M.Book. The last part bill should be passed only after above certificate is issued. However the contractor shall be permitted to execute an indemnity bond in lieu of the recovery of 40% in each bill in prescribed form in stamp paper for a value of Rs.100.00 towards water tightness and structural stability of the reservoir/ water retaining structure. The period of guarantee required by the contract shall be two years from the date of completion and commissioning (with filling of water upto maximum water level in the case of service reservoir/ over head tank/ water retaining structure). If defects are noticed within the stipulated period of 24 months of satisfactory performance, the defects should be rectified by the contractor at his own cost and the performance period again shall be reckoned from the date of completion of the rectification of defects by the contractor. In the case of service reservoir/ over head tanks and other water retaining structures during this period, structure under full working head of water should show no sign of leakage. The test for water tightness should be arranged to be carried out and completed within 30 days from the date of intimation, by the Engineer. The testing of the service reservoir/ OHT and other water retaining structures should be done by the contractor at his own cost inclusive of all necessary equipment, water etc., complete. The test for water tightness of the structure as well as materials of construction used shall be conducted in confirmity with the standard specification as per IS 3370 (Part-I) 1965 as amended from time to time and the other specifications as mentioned in the bid document.

11. C.I. Pipe Connections

11.1 The vertical pipe connections shall be hoisted and fixed true to plumb without any deviation from the vertically as directed by the Engineer-in-charge.

11.2 The jointing of pipes shall conform to the requirement and all required jointing materials shall be arranged by the contractor at his cost.

12. Scour

12.1 Scour and overflow arrangements should be connected and let to a common pit from where it will lead to the nearest open drain.

13. Maintenance

13.1 During the maintenance period, the contractor should clean the elevated service reservoir and sump at the intervals as directed by the Engineer.

VI. LAYING AND JOINTING OF PIPES

5.1 General

The specification for laying and jointing shall generally conform with IS : 783 – 1985.

5.2.Earth work excavation

5.2.1 General

Before commencing the work and also during the progress of the work, the contract shall give notice to the concerned authorities viz., the Panchayats, the Municipalities, the Railways, the Electricity Board, the Telegraph Department, the Traffic Department attached to the Police and other Departments or Companies, as may be required to the effect that the work is being taken up in a particular locality and that necessary diversion of traffic may be arranged for. The contractor shall co-operate with the department concerned and provide for necessary barricading of roads, protection to existing underground cables, etc. met with during the excavation of trenches. The contractor shall also provide at his own expense watch and light during the day and the night and put required notice towards such as "Caution" "Road Closed for Traffic" etc. He should also provide and maintain at his own expense the necessary supports for underground cables, etc. to afford the best protection to them in consultation with the authorities in charge of the properties and to their best satisfaction.

5.2.2 Trench excavation

The width and depth of excavation of trench shall be as per relevant BIS. The rate for excavation shall include charges for shoring, strutting, bailing and pumping water whenever necessary and no extra payment shall be made for any of these contingent works.

Excavation and refilling for the socket hollows shall be paid for as excavation and refilling for trenches in soil of appropriate classification. The supply of river sand required for refilling should be paid for separately if provided in BOQ as separate item.

The contractor shall deposit the surplus earth if any from trench work at proper place as may be directed by the Engineer and no extra rates shall be paid.

Wherever earthern road or gravel road is cut for the laying of pipes, the contractor shall restore the surface after the pipes and specials are laid and

jointed with available materials to the satisfaction of the Engineer without extra cost either for cutting or relaying. The clause shall not apply to the cutting of concrete or

macadam or brick surfacing or black top roads. The pipes shall be laid to correct levels and gradients, as may be directed by the Engineer, after fixing the sight rails as in Clause No. 106 of TNBP without extra cost.

If the floor of the trench is other than rock, hard clay or boulders, the floor shall be rounded to fit the curve of the pipe to form an even bedding for the pipe for a width equal to half the outer diameter of the pipe.

If the floor of the trench is in rock, hard or clay which will otherwise not provide uniform support for the pipe, the floor shall be excavated below the proposed bottom level of the pipe to a depth of 20cm and the trench

shall be refilled with approved soil or river sand as may be directed by the Engineer and properly compacted to a level of 10cm above bottom of the pipe. If river sand is used for refilling, the sand shall be paid for separately if provided in BOQ as a separate item.

5.3 HARD ROCK

"Rock requiring blasting" shall exclude all rock such as soft rock, disintegrated rock, small boulders, all of which can be removed either with pick axe or craw bards and shall apply to rocks of different kinds when cannot be removed by any of these means. In case of difference of opinion, the Engineer's decision as to which rock shall be considered as "rock requiring blasting" shall be final.

Refilling of the trench in reaches where the excavation is in rocky soil shall be with approved soil which is surplus from trench work operations elsewhere along the alignment or which shall be obtained from new borrow pits.

It is to be distinctly understood that if surplus soil from trench work elsewhere along the alignment is used no extra payment shall be paid for conveyance of the soil to the refilling site; no payment will be made for any excess earth brought to site and it shall be disposed off by the contractor at his own cost. Hard rock which is blasted and removed will be measured and paid for on stack measurements with a percentage deduction of 40% for voids. The stacking shall be as directed by the Engineer.

5.4 Lowering pipes and jointing of pipes and specials

5.4.1 Laying and jointing shall be in accordance with Clause 9.1, IS:783-1985 for laying of concrete pipes. All pipes and fittings shall be carefully handled and lowered into the trench by means of mobile cranes. Any other method of handling shall be got approved by the Executive Engineer concerned. The pipes and specials should be handled by flat rubber bolts. Iron chain or iron crow bards should not be used under any circumstances for handling the pipes and specials at any state. The sockets shall

face opposite to the direction of flow of water in the pipe. Pipes shall be normally laid so that the spigot end enters the socket of the last pipe that is, socket faces and direction of laying. The socket and spigot ends of pipe shall be cleaned of all extraneous matter especially clay or grease. Rubber ring shall be clean and dry.

5.4.2 Pipes shall be laid true to the lines and grades given on the plans. The rubber rings shall be kept evenly positioned on the spigot groove, and when satisfied that pipe and ring are correctly positioned, the pipe shall be forced right home to the full depth of the joint. Inside the joint, the two pipe ends shall be in close proximity.

5.4.3 Baling or pumping out of water from trench including shoring, strutting and removing slush while laying, jointing and testing shall be done by the contractor at his expense.

5.5 Special Fittings

5.5.1 Special fittings have to be located at the exact chainage as shown on plans. It might entail in the necessity of laying short pipes in specified length. The number of gaps should be got approved by the Executive Engineer concerned.

5.5.2 Jointing between the special and pipe shall be done with rubber rings.

5.5.3 The construction of all anchor blocks at bends, 'Y's and Tees shall be done by the contractor. It shall be his responsibility to check for the adequacy of the anchor block.

5.6 Testing pipes on position

5.6.1 The finished pipe line shall be tested in convenient sections between stop valves. The test gap and short reaches which could not be tested simultaneously as a continuous reach due to circumstances prevailing during execution may be subjected to the pipe line static pressure or maximum working pressure plus surge pressure which may be created during testing the short reaches and test gap whichever is higher as the case may be. The Executive Engineer's decision regarding the test pressure at field for the above test gap and short reaches will be final. When testing the pipe line hydraulically, the line shall be filled completely with water and kept filled for a week. The pressure shall then be increased gradually to full test pressure and maintained at this pressure for one hour. In testing pipe lines, a seepage allowance of 2.5 litres per kilo metre per hour per centimetre diameter of the pipe shall be permissible.

5.6.2 Joint Testing

When testing the finished pipe line hydraulically after filling the pipe line section under test with water it shall be left under operating pressure for a certain length of

period which will depend upon initial permeability, absorption movement of the pipe line under pressure and the quantity of air trapped. More water shall be pumped from a calibrated container until the required test pressure is reached, the test pressure shall be maintained throughout the test by means of continued pumping using a pressure relief valve. The excess water coming from the relief valve shall be returned to the calibrated container. The rate of loss of water from the container shall be determined at regular intervals The pipe line is satisfactory provided the successive measurements show a diminishing quantity.

An allowance of 3.00 litres per millimetre diameter of pipe per kilometre of pipe line per day per each 30 metre head of pressure applied shall be allowed.

The field test pressure to be imposed should be not less than the greatest of the following.

a) 1 ½ times the maximum sustained operating pressure;
b) 1 ½ times the maximum pipe line static head; and
c) Sum of the maximum sustained operating pressure or the maximum pipeline static pressure and the maximum calculated surge pressure.

Subject to a maximum equal to the works test pressure for any pipes and fittings incorporated in the pipeline. However, the line test pressure, in no case, shall exceed the hydrostatic proof test pressure. Pressure gauges shall be inserted at both ends of the line and test so that leakage can be precisely calculated.

5.7 Back Filling Trenches

5.7.1 The initial back fill shall be of selected materials suitable for tamping under the pipes and down at the sides. Earth shall be placed by hand in 7.5cm layers and rammed well until the backfill materials reaches 15cm above the crown line of the pipe. Mechanical rammers may also be used.

5.7.2 The remainder of the trench shall be filled carefully with ordinary excavated material without rock and rammed property.

5.7.3 Refilling can be done leaving the joints portion exposed, after laying.

5.8 River crossings

5.8.1 All the supporting structure for pipeline to be taken above M.F.L. (Maximum Flood Level) in river. The contractor shall furnish detailed drawings showing the type of bedding needed to support the pipe.

Railway Crossings

Required permission for laying, jointing and testing the pipeline across the railway lines will be obtained by the Employer. The contractor will carry out the work according to the specifications and stipulations made by the Railway authorities.

5.9 Road Crossings

Wherever pipeline has to cross roads or cart tracks, it shall be done through a culvert or bridge, wherever necessary.

5.10 Distance Indicators

The employer shall supply and fix indicators at all points of change of direction, at all valves and at every one kilometre intervals along the pipeline. Indicators shall consist of 10cm x 10cm pre-cast concrete posts 1.25 metre length set 0.75metre into the ground and painted white above ground level. The description shall be written in blue at one face of the pre-cast post.

5.11 Drawings

The drawings are only indicative. The site conditions will only be the governing factor for manufacture, laying and payment.

VII. Pumpsets and Accessories

I General

1. All the materials used shall conform to the relevant BIS and should be delivered at site of work. The contractor is responsible for safe custody of machinery and other equipments under this contract till handing over to the employer.
2. The rates should include all the minor items of civil works, if any required for installation complete
3. All necessary civil works for creation of all equipments and accessories offered by the contractor under this contract should be done by the contractor.
4. Test certificates for machinery and equipments should produced along with supply
5. The bidder should enclose the performance curve duly indicating the duty point for the size of the impeller selected (family curve should not be furnished) the performance curve should furnish complete range of operation and the curve should be authenticated by the manufacturer or his authorised dealer. In the event of non compliance the offer shall be summarily rejected
6. The contractor shall make necessary arrangements to get supply of electricity from TNEB for operating the machinery and equipments. Necessary vouchers in original for the payment made to the EB shall be produced to the employer by the contractor which shall be reimbursed by the employer.
7. Before supply of machinery, equipments and other accessories prior approval of the Engineer should be obtained giving the name of makes and other details required.
8. Obtaining approval or electrical layout diagram for the installation of all the equipments (transformers, generators, pumpsets and other accessorice) and obtaining safety certificate on completion of work from Chief Electrical Inspector to Government of Tamil Nadu should be arranged and got approved by the contractor at his cost.
9. The contractor should get the layout approval in time before execution and for the size and capacity of the equipments before the supply of the same. After execution of the Safety Certificate if any modification or alteration suggested by the Chief Electrical Inspector on the installation work done by the contractor should be carried out by the contractor at his cost.
10. All the materials should be supplied as per BOQ and should be of standard makes mentioned below:-

Sl.No.	Description	Make
1	Centrifugal pump	Kirloskar, Jyothi, Best and Crompton Mather and Platt, Inorthington, Flow More or Equivalent.
2	Turbine pump	Kirloskar, Jyothi Best and Crompton Mather and Platt, Inorthington, Flow more Fair Banks Morse or equivalent.
3	Submersible pump and motor	KSB, Calama, Waterman, Atlanta or equivalent.
4	Make of motor	Jyothi NGEF, GEC, Crompton and Greeves, Siemens or equivalent.
5	Make of transformer	Kirloskar, GEC Indo TECH, Hindustan or equivalent
6	Diesel Generator	Kirloskar, GEC of equivalent
7	Starter	L&T, Cutler Hammer, Siemens, MEI or equivalent.
8	Switch fuse and circuit breakers	L&T, Cutler Hammer, Siemens, MEI or equivalent.
9	Cables	Finolex, Unista, Uniflex or equivalent.
10	Valves	Kirloskar, Venus, Upadaya CALSONS or equivalent.

11. The right of choosing the make among the makes offered by the contractors rest with the employer only.
12. The submersible pumps centrifugal pumps, turbine pumps submersible motors, motors for turbine and centrifugal pumpset transformer, generators, Panel Boards to be supplied by the firm will be inspected by the Inspecting Agency fixed by the Employer at the manufacturers premises and test certificate will be issued. The contractor should make necessary arrangements for the inspecting staff at his own cost for testing the above pumpsets.

    All tests necessary to ensure that the plant and machinery or equipment complies with the specification and guarantees shall be carried out at site and at the contractor's cost and such test shall be carried out within one month of completion of erection. Should the result of these test not done within the margin specified, the tests shall if reported

within one month from the date of plant is ready for retest and the contractor shall repay to the Engineer all reasonable expenses to which he may be put by such test.

13) If the complete plant or any portion there of is found to be deffective the Engineer shall give the contractor a notice in writing to verify such defects. If the contractor fails to rectify the defects within the specified period the Engineer will rectify the defects at the contractor's risk and cost.

2(a) TURBINE PUMP

The pump shall be of manufacturer's latest standard design to give maximum efficiency when operated under the most exacting conditions at medium speed 1000/1500 RPM, conforming to IS 1710-1972 as amended upto date. The equipment shall conform to the following specifications:

i) IMPELLER

The impeller shall be of bronze. They shall be turned and bered to gauge accurately finished and hydraulically balanced on the won shaft for maximum lifting capacity without overloading the prime mover irrespective of water level fluctuations. The impeller shall be locked to the shaft with sleeves and lack nuts.

ii) IMPELLER SHAFT

The shaft shall be of carbon steel of ample size and stiffness to transmit power without strain or vibration.

iii) LINESHAFT

The shaft shall be of special grade shaft steel having exceptionally high torsion strength. The shaft shall be in standard length of 1.50 M/ 3. M suitably coupled. The shaft shall be held in proper vertical position by provided bearings of high quality phospher bronze.

iv) BEARINGS

The line shaft shall be supported by oil lubricated/water lubricated bearings and be bearing retainers shall be designed for noiseless operation shaft coupling shall be specially machined for true alignment of the driven shaft.

v) COLUMN PIPES:

Heavy steel column pipes with machine cut in 1.5 M/ 3 M length of suitable diameter shall be provided. The bowl design shall be such as to provide the straightest possible water passage to minimise friction and turbulance.

vi) NAME PLATE

Each pump shall be provided with a brass name plate with duty conditions and with all other particulars clearly engraved in it.

vii) PERFORMANCE CURVES

Performance curves for the pump indicating the head in metres. Efficiency and BHP absorbed at the pump shaft against the output in litres per minute shall be furnished. The pump offered shall have working range of plus 10% of the operating head. The performance curve should be duly signed.

The performance curve must contain the following:

a. Discharge (full range) Vs. Total head in Meters.
b. Discharge (full range) Vs. Pump efficiency in Percentage.
c. Discharge (full range) Vs. Overall efficiency percentage (Pump to Motor)
d. Discharge (full range) Vs. BHP absorbed in KW.
e. Discharge (full range) Vs. Power input in KW.

2(b) MOTOR

i) TYPE OF MOTORS

The Motors (suitable for Turbine pump) shall be vertical hallow shaft AC squirrel cage induction motor with drip proof screen protected continuous rating suitable for operation in the range of 360/440 volts 3 phase 50 cycles and the speed 1000/1500 rpm.

ii) OUTPUT OF MOTORS

The motor shall be capable of developing the mechanical output for the required conditions and shall have continuous normal rating to suit the maximum load when operated at the pump speed. The efficiency and power factor shall be to suit the wide range at load conditions and shall be designed and manufactured in accordance with relevant BIS.

iii) BEARINGS

The motors shall be provided with suitable bearings of ample size readily available from stocks in India. The bearings shall be accurately fitted and provided with moisture and dust proof bushes. The contractor shall state the name of the manufacturers and the bearing No.

iv) OVERLOAD

The motors shall be capable of withstanding the overload specified in the relevant condition of B.I.S.

v) TEMPERATURE RISE

The temperature rise in windings shall not exceed over an ambient temperature after a full load continuous run of 12 hours. The temperature rise shall not reach a value where there is risk of injury to any insulated materials of adjacent part irrespective of that has been mentioned above.

vi) EARTH TERMINALS

Provision shall be made for suitable double earth copper connections on base plate or motor frame and the earth terminal shall be fixed with lugs suitable for the size of earth wire in accordance with the rules of the Indian Electricity Act.

The motor HP shall be such that it should safely take the load when the total head is reduced by the rise of water level in river during flood conditions in the river.

The HP of motor offered shall have a margin of 10% above the BHP absorbed by the pumpset at duty point and also above the maximum HP absorbed by the pump offered.

vii) STARTING

The motor shall give full load torque when taking 1 to 1.5 time of full load current.

viii) CAPACITOR

Capacitor shall be designed to conform to 0.95 lagging Power factor for motor with control switches. The test certificate from TESTING AGENCY has to be furnished. The motor shall have name plate giving the following information:-

1. Induction motor (Squirrel cage)
2. Name of manufacturer
3. Manufacturers number and frame reference
4. Type of enclosure
5. B.H.P
6. Rated output in K.W.
7. Rated Voltage and winding connections.
8. Number of phases.
9. Frequency in HZ
10. Current approximate in amperes at rated output.
11. Speed in revolutions per minute at rated output.

3(a) CENTRIFUGAL PUMPS

The pumps shall be designed, manufactured, erected, tested and commissioned as per standards laid down by IS 1520-1980 and as amended from time to time. The standard accessories required for may be supplied along with irrespective of whether such items are specifically mentioned or not in the specification. The design should ensure the noise pollution level below the permissible limit. The rotating parts are to be statically and dynamically balanced. The name plate in stainless steel should indicate the Sl.No., discharge, head, speed specific gravity of water to be pumped pump input, motor rating, make etc.

The casing should be free from blow holes, cracks and other imperfections conforming to relevant standard. Bearing housing shall be of such design to exclude entry of water bearing may be of oil lubricated of grease lubricated type. The shaft design should ensure the deflection not exceeding. 1 mm per meter length. The flexible tyre type rubber coupling is recommended for coupling pump and motor of horizontal mounting.

Painting may be done as per relevant Bureau of Indian Standard specifications.

i) CASING

The casing shall be coarse grained, east iron split along with the horizontal central line separately machined free from bow holes or other defects. The suction and delivery branches shall be casted integral with the lowest half of the casing so as to permit the removal of the impeller for inspection and repairs without disturbing suction and delivery pipe connections and the pump alignment with the motor.

ii) IMPELLERS

The impeller shall be of phospher bronze steel. It shall be turned and trimmed to gauge and hydraulically balanced on its pump shaft to ensure the same for running without vibration to suit the required duty to meet the conditions under which the pumps are to be operated.

iii) IMPELLER SHAFT

The shaft shall be of stainless steel of ample size and stiffness to transmit maximum power without strain or vibration. It should be turned and ground to the exact diameter and key fitted to prevent the impeller rotating with any play. The shaft shall be protected from contact with water at the stuffing box with readily renewable phosper bronze sleeves.

iv) STUFFING BOX

The stuffing boxes shall be of ample depth and size for the packing and shall be provided with lantern rings and connections for sealing water under pressure to prevent leakage of air.

v) BEARINGS

The impeller shall be supported by ball or roller bearings mounted in housings. The bearing caps shall be removable and the bearings shall be ample size to ensure cool running with a minimum of attention and shall be provided with an efficient lubricating system. The bearing shall be of standard type of design which are readily available from stocks held in India.

vi) ACCESSORIES

Each pump shall be provided with the following accessories.

i) Lifting Hook
ii) Priming funnel
i) Approved type of lubrication system
ii) Drip water pipes
iii) Pressure gauge as specified
iv) Compound gauge as specified

v) NAME PLATE

Each pump shall be provided with name plate bearing the following particulars clearly marked on it.

Make
Litres per minute
No. of stages
Revolution per minute
Diameter of suction branch
Index No.
Total Head in metres
Diameter of delivery branch

vi) BASE PLATE

The base plate shall be of extended type for accommodating the pumps and the motors and it shall be rigid substantial casting with machined faces for the feet of the pumps and motor and it shall be faced on the under side.

vii) COUPLING

The shaft coupling for connectiong up the Impeller shaft with the motor shaft shall be of flexible type. It shall be made of cast iron turned over to obtain perfect balance bored to shaft size and securely keyed to the shaft.

viii) CHARACTERISTICS CURVES

Performance curves for the pump indicating the head in meter, efficiency, B.H.P. observed at pumpset against the output in litres per minute shall be furnished.

3(b) MOTOR

i) TYPE OF MOTORS

The Motors (suitable for centrifugal pump) shall be AC squirrel cage induction motor with drip proof screen protected continuous rating suitable for operation in the range of 360/440 volts 3 phase 50 cycles at the speed of 1500 RPM.

ii) OUTPUT OF MOTORS

The motor shall be capable of developing the mechanical output for the required conditions, shall have continuous normal rating to suit the maximum load when operated at the pump speed. The efficiency and power factor shall be to start the wide range of load conditions and shall be designed and manufactured in accordance with relevant BIS.

iii) BEARINGS

The motors shall be provided with ball end or rollers S.S. bearings of ample size readily available from stocks in India. The bearings shall be accurately fitted and provided with moisture and dust proof bushes. The contractor shall state the name of the manufactrers and the bearing No.

iv) OVERLOAD

The motors shall be capable of with standing the overload specified in the relevant condition of I.S.

v) TEMPERATURE RISE

The temperature rise in the windings shall not exceed over an ambient temperature after a full load continuous run of 12 hours. The temperature rise shall not reach a value where there is risk of injury to any insulated materials of adjacent part irrespective of that has been mentioned above.

vi) EARTH TERMINALS

Provision shall be made for suitable double earth copper connections on base plate of motor frame and the earth terminal shall be fixed with lugs suitable for the size of earth wire in accordance with the rules of the Indian Electricity Act

VII) TECHNICAL DATA

Bidder shall complete as fully as possible the attached annexures which should be returned duly filled in signed.

The motor HP shall be such that it should safely take the load when the total head is reduced by the rise of water level in river during flood conditions in the river.

The HP of motor offered shall have a margin of 10% above the BHP absorbed by the pumpset at duty point and also above the maximum HP absorbed by the pump offered.

VIII) STARTING

The motor shall give full load torque when taking 1 to 1.5 time of full load current.

IX) CAPACITOR

Capacitor shall be designed to conform to 0.95 lagging Power factor for motor. The control switches are to be provided. The test certificate from TESTING AGENCY has to be furnished. The motor shall have a name plate giving the following information :

a) Induction motor (Squirrel cage)
b) Name of manufacturer
c) Manufacturers number and frame reference
d) Type of enclosure
e) B.H.P.
f) Rated output in K.W.
g) Rated Voltage and winding connections
h) Number of phases
i) Frequency in HZ
j) Current approximate in amperes at rated output
k) Speed in revolutions per minute at rated output.

4(a) SUBMERSIBLE PUMP

The pump shall be of latest standard designed to give maximum efficiency when operated under most exacting condition at speed 1500/ 3000 rpm. The equipment shall confirm to the following specifications as per IS 8030 – 1996.

i) PUMP BOWL

The pump bowl shall be manufactured to offer resistance to corrosion. The bowls may be equipped with replaceable bearing.

The bowl assembly shall bear a name plate giving the following information.

a. Name of the manufacturer or trade mark
b. Serial Number of the pumpset
c. Pump type
d. Number of stages
e. Total head
f. Capacity
g. Speed

ii) IMPELLERS

The impellers shall be open or closed or semi closed type. They shall be turned and accurately finished and balanced on their own pump shaft for maximum lifting capacity without over loading the prime mover irrespective of water level fluctuations. The impeller may be of the enclosed or semi enclosed type and shall be properly balanced. Dynamic balancing is recommended. Enclosed impellers may be equipped with sealing rings on their hubs.

iii) PUMP SHAFT

The pump shaft shall be stainless steel of ample size and stiffness to transmit maximum power without strain or vibration. The pump shaft shall be guided by bearings provided below and above the impeller shaft assembly. The shaft without protecting sleeves shall have a surface finish of 0.75 micron.

iv) BEARING SLEEVE

The bearing sleeve shall be of leaded bronze

v) DISCHARGE CASING

The discharge casing shall be manufactured to offer resistance to corrosion

vi) SUCTION CASING

The suction casing shall be manufactured to offer resistance to corrosion

The opening in the suction case of the entrance shall be of proper size and shape to reduce loss. The suction case shall be fitted with a strainer made of corrosion resistant materials. Suitable guard shall be provided just above the suction case bearing to prevent the entry of foreign matter into the suction case.

vii) COUPLING

A suitable coupling arrangements shall be provided in case of directly coupled pumpsets.

viii) NON RETURN VALVE

Non return valve shall be provided above the pump discharge case.

9. CHARACTERISTIC CURVES

The performance curves for the full range of operation indicating the head in metres, efficiency and BHP absorbed at the pump shaft against the output in litres per minute shall be furnished.

3 (b) SUBMERSIBLE MOTORS

i) TYPE

The submersible motor shall be wet type, squirrel cage induction motor suitable for operation on 360/440 volts, 3 phase 50 Cycles AC supply and capable of developing the required HP at a speed 1500/3000 RPM. The motor windings and the bearing bushes of the rotar shaft shall be lubricated by pure water or oil, filled in the motor before erecting the pumpsets. The motor shall confirm to IS 9283 – 1979

The motor shall be connected by means of cable glands rubber seals etc., from inside of borewell to arrest the entry of sand and other foreign matter.

The motor shall be provided with a breathing attachment like bellows diaphragm etc., to compensate the Volumetric variation due to changes in the temperature. The motor shall be made of corrosion resisting materials or suitably treated materials to resist corrosion under normal condition.

ii) BEARINGS

The thrust bearing shall be of adequate size to withstand the weight of all rotating parts as well as the imposed hydraulic thrust. These shall be lubricated suitable.

The thrust bearing housing shall be provided with a drain plug to empty the oil pure water filled into thrust bearing housing rotor.

iii) Motor

The rotor shaft shall be provided with shaft protective sleeves having a surface finish of 0.75 micron.

iv) EARTHING ARRANGEMENT

The earthing of motor shall comply with IS : 3043 – 1966 Code of practice for earthing provision shall be made for double earth copper connection. Two separate lead should be taken to two separate earth pits located outside the pumphouse.

v) TEMPERATURE RISE

The insulation should be perfect so as to limit the temperature rise in windins.

vi) OUTPUT

The motor shall be capable of developing the Mechanical output for the required conditions and shall have continuous normal rating to suit the maximum load when operated at the pump speed.

vii) TECHNICAL DATA

The motor HP shall be such that to safely take the load when the total head is reduced by the rise of water level.

The H.P. of the motor offered shall have a Margin above the H.P. absorbed by the pumpset at duty point and also above the maximum BHP absorbed by the pump set offered.

viii) OVERLOAD CAPACITY

The motor shall be capable of withstanding the over load specified in the relevant condition of BIS.

ix) STARTING

The motor shall give full load torque when taking 1 to 1.5 times full load current. The motor shall have a name plate giving the following information.

a. Induction motor
b. Name of manufacturer
c. Manufacturers number & frame reference
d. Type of enclosure
e. B.H.P
f. Rated voltage and winding connections
g. Rated output in K.W.
h. Number of phases
i. Frequency in HZ
j. Current approximate in amperes at rates output
k. Speed in revolutions per minute at rates output

5 (a) TRANSFORMERS AND ACCESSORIES

i) SCOPE

This specification covers the power transformers with fittings and accessories to be used in the electrical system. The transformer shall conform to BIS No. 1180/1964

ii) STANDARDS

The equipment and accessories covered by this specification shall be designed, manufactured and tested in accordance with the latest relevant standards and codes of practice published by the Bureau of Indian standard amended upto date.

All electrical equipment shall also conform to the latest Indian Electricity rules in regard to safety/earthing and other essential provisions specified therein for installation and operation of electrical plants.

iii) DESIGN BASIS

All equipment shall be capable of operating at the required capacity in ambient air temperature of 45°C maximum and 40° C average over 24 hours. The derating of all equipments shall be done on an ambient temperature of 45°C The equipment and apparatus to be installed outdoor/ indoor as per latest BIS.

All equipment and accessories shall be designed to withstand the operating conditions in the plant and the atmospheric conditions at site.

iv) SYSTEMS VOLTAGES

Electric power for the transformer accessories will be available at 415, 3 phase, 4 wire, 50 Hz.

Special care shall be taken to make the enclosed equipment proof against entry of rats, lizards, and other creeping vermin which may create electrical short circuit inside the live equipment

All ventilating and forced draft opening shall have suitable screen protection. Where screens are provided on top of the equipments, means shall be provided to protect them from falling object.

All equipments shall be complete with approved safety services whereover a potential hazard to personnel exists and with provisions for safe access of personnel to an around equipment for operational and maintenance functions, designs shall include all reasonable precautions provisions for the safety of operating and maintenance personnel.

v) GENERAL DESIGN FEATURES

All transformers shall be of the latest design, as called for in the technical specification, unless otherwise specified, all transformers shall be suitable for outdoor installation.

Each transformer shall be suitable for operation at full rated power on all tapping without exceeding the applicable temperature rise.

The transformers shall be designed to be capable of with standing without injury, the thermal and mechanical effects of short circuit between phases or between phase and earth at the terminals of any winding with full voltage applied across the other winding for periods given in relevant standards.

The transformers shall be designed to suppress harmonic content especially the third and fifth so as to eliminate distortion in the wave form and consequent additional insulation stress noise on communication system and undesirable circulation currents.

The transformers shall operate with minimum noise and vibration, the cores, banks/ protective housing and other structural parts shall be properly constructed and windings properly braced so that the mechanical vibration are kept to the minimum thus reducing the noise. The core coil assembly shall also be fixed in such a manner that no shifting or deformation occur during shipment or installation.

Each transformer shall be designed for minimum no – load losses within the limit.

The design of each transformer shall be such that, the risk of accidental short circuits due to birds or vermin are obviated. All outdoor apparatus, including bushing insulators and fittings shall be so designed that they do not collect water at any point.

All electrical connections and contacts shall be of ample section for carrying the rated current without excessive heating.

All mechanisms shall be of stainless steel, brass, gunmetal or other suitable materials to prevent, sticking due to rust or corrosion, all valves shall be of gunmetal

If any temporary fitting is made in the tank protective housing of a transformer for transporting purpose, these shall be identified as well instructions, and illustrated drawings shall be furnished to facilitate their removal at site before commissioning.

vi) CORE

The frame work, clamping arrangement and general structure of the cores of each transformer shall be of robust construction and shall be capable of with standing any shock to which they may be subjected during transport installation and service. The assembled core shall be securely clamped on the limbs and the yoke, to build up a rigid structure. The clamping pressure shall be uniform over the whole of the core and so adjusted to minimise noise and vibration in the core when the transformer is in operation. The frame work and the core bolts shall be efficiently insulated from the core so as to reduce the eddy currents to a minimum.

The magnetic circuit shall be built of high quality low loss, non ageing, cold rolled, preferably grain oriented, silicon steel laminations having excellent magnetic properties and being specifically suitable as core materials, Laminations shall be insulated from each other with materials having high inter alienation. Insulation resistance and rust inhibiting property and also capable of withstanding pressure, machanical vibration and action of heat and all in case of oil immersed transformers.

The limbs and the yokes of the core shall have similar sections to minimise heat and noise arising from transformer flux. The joints in the laminated magnetic circuit shall be inter leaved. Necessary cooling ducts shall be provided for heat drssipation from

the core so that the anticipated maximum hot spot temperature in the core shall not be injurious to any material used in the core assembly.

The core clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly.

The core assembly of oil immersed type transformers shall be electrically connected to the transformers tank for effective earthing.

vii) WINDING

The coils used for transformer winding shall be circular in shape and made of paper insulated continuous and smooth, tinned or enamelled electrolytic copper conductors of high conductivity and 99.9% purity. The windings shall be duly sectionalised. Similar coils shall be connected by accessible joints Brazed or welded and finished smooth. No core discharge shall result on the winding open resulting the transformer for induced voltage test as specified in applicable standard. The insulation materials for all immersed type transformers shall be of class `A' type.

viii) TANK FOR IMMERSED TYPE TRANSFORMER

The transformer tank shall be made of good commercial grade low carbon steel plate of adequate thickness, shaped in such a way that minimum of welding is required. All seams shall be electrically welded for absolute oil tightness. Tank walls shall be reinforced by adequate stiffener to ensure mechanical rigidity permitting hoisting of complete transformer unit filled with oil and also to damp transformer noise. The tank shall be sufficiently strong to withstand shocks likely to be encountered during transport of the transformer without any deformation or weakening of joints. Guides shall be welded on the inner side of tank to facilitate tanking and untanking of the transformer core and coil assembly.

Tank cover shall be bolted into the flanged rim of the tank with a suitable wooden proof hot oil resistance resilient gasket in between for complete oil tightness. If the gasket is compressible, metallic steps shall be provided to prevent over compression. The bottled tank cover shall be provided with lifting eyes and shall be arranged that it can be removed and the core inspected without removal of the radiators. All requisite access and inspection holes shall be provided with bolted, oil tight market scaled cover plates. Bushing currents, covers of access holes and other devices shall be designed as to prevent only leakage of water into oil from the tank. Surfaces of the transformer tank or other parts of the transformer of auxiliary equipment which are in contact with oil shall not be galvanised.

The transformer tank shall be provided with lifting locking and pulling lugs etc. as may be necessary for lifting and healage of the complete oil filled unit. The tank shall be mounted as a suitable under carriage to meet the requirement of the technical specification.

After fabrication, each tank with its conservator and radiator/ cooler fitted with their respective valves and filled with oil, shall be pressure tested for a minimum period of 24 hours to withstand a pressure equal to the static head of oil up to service level plus an air pressure of one atmosphere to ensure that the valves do not leak nor any welded joint sweat.

ix) INSULATION OIL

Mineral oil shall be used for oil immersed type transformers. The oil shall conform to the relevant applicable B.I.Standard and shall be suitable in all respects for operating the transformer at the ratings and under conditions specified.

Sufficient oil shall be supplied for the first filling of transformer, the oil circulation equipments and also the chamber containing on load top changing mechanism where provided.

x) TAP CHANGER

All transformers shall have provision for tap changing for mineral oil immersed type. The tap changing mechanism should be of manually operated off load circuit type tap changing switch as called for in the technical specification.

OFF CIRCUIT TAP CHANGER

For off circuit tap changers the tap changing switch shall be mechanically coupled to the external operating handle and the operating spindle shall be carried through an oil tight gland in the tank side. A register plate clearly indicating the tapping in use shall be fixed to the external operating mechanism and provision shall be made for securing and pad locking the switch in any of the working positions and for ensuring that the contacts are fully engaged before the transformers is energised.

xi) COOLING

The cooling system for oil immersed type transformers may be oil natural/ air natural (NAN) as called for in technical specification.

In oil immersed transformers, the Radiators/ Cooler tubes shall be commercial grade low carbon steel or approved equivalent with clean bright internal surface and shall be suitably supported to withstand mechanical shock. The radiator/ cooler shall be designed for the same pressure condition as specified for the transformer tank. The radiator/ cooler tubes

for transformers shall be so arranged that every part of the cooling surface can be cleaned by hand.

xii) TERMINAL ARRANGEMENTS

The terminal arrangements for external connection shall be suitable for the type of connection as called for in the technical specification. Over head conductor connectors/ bus duct termination arrangement/ cable terminal boxes shall be suitable for the required type, size and arrangement of the overhead conductor/ bust duct/ cable. For out door transformer the bus duct termination arrangement/ cable boxes shall be weather proof design.

The type of natural terminal shall be as specified in the technical specification.

The relative orientation in space of the terminal bushings when mounted on transformers shall be such as to permit maintenance of specified clearance between the phase conductors and between any phase conductor and the earth. Bushing insulators shall be so mounted that the jumper connection, where specified can be taken away clear of all obstacles. The orientation of the set of bushings on the LV side in relation to that on the HV side will have to be fixed as required by equipment layout at the substation where the transformer will be installed.

The terminals and terminal fittings shall be of appropriate size and construction. These shall be designed for carrying the full rated transformer current continuously without exceeding permissible temperature rise and withstanding all stresses under normal working and short circuit conditions.

The bushing insulators of the transformers shall be made of wet process, single piece glazed porcelain and shall have high mechanical strength, stable insulation and very high puncture strength. These shall remain unaffected by atmospheric conditions due to proximity to the sea, fumes, acids, dust or rapid change of temperature likely to be met with at site.

Poccelain shall not engage directly with hard metal and where necessary and approved resilient material shall be interposed between and the fittings. The fixing materials shall be of approved quality and shall not enter into chemical action with the metal parts stresses due to expansion and contraction in any part of the insulator shall not lead to the development of any defect. Connection between the bushing terminal and windings shall be flexible.

The construction of oil filled or condenser type bushing, where offered, shall be such as to allow free expansion of the control conductor. These bushing shall be provided with test taps to facilitate measurement of tangent delts by anchoring bridge.

xiii) TRANSFORMING FITTINGS

Each transformer shall be provided with all fittings and accessories specified in the applicable standard for the size and type of transformer concerned. Additional fittings shall also be provided as called for in the technical specification.

The oil temperature indicator shall be direct actuated dial type thermometer fitted with a pointer to register the highest temperature attained. The indicator shall be provided with a set of adjustable contact for high oil temperature.

The local winding temperature indicator shall be direct actuated dial type thermometer fitted with a pointer to register the highest temperature attained. The winding temperature indicating device shall be complete with current transformer, heater element and dial type thermometer with two separate sets of contacts one for alarm and the other for circuit breaker trip. Each set of contacts shall be of specified range and to reopen when the temperature fails to present desired value.

Conservators for oil-immersed transformers shall be suitably located and shall be fitted with oil filling hold and cap, drain value, oil level indicator shut off value etc.

Oil immersed transformers shall be provided with dehydrating breather filled with silicagel or other suitable dehydrating agent. The breather shall be complete with inspection windows connecting pipe and oil seals.

Oil level indicators shall be gauge glass type or magnetic dial indicator type as called for in the technical specification. Dial indicators shall be complete with requisite set of contact for giving low oil level alarm.

The explosion vent shall be provided with suitable diaphragm which shall break at a static pressure applied for the transformer tank. It shall have an equalising pipe connection to the conservator air space.

Two earthing terminals of adequate mechanical and electrical capacity shall be provided. Separate earthing terminals shall also provided on each separate radiator/ cooler tank.

Complete set of rating and diaphragm plates as per adopted standard shall be provided for each transformer.

Lifting lugs and jacking pads as required shall be provided for the transformers.

Suitable under carriage fitted with either flanged bi-directional wheels for specified gauge of rails of flat rollers or skids as called for in the technical specification (Bill of quantities) shall be provided. The wheels and rollers shall have adequate mechanical strength and shall be so designed that the transformer will roll without undue effort after it has been immobile for a considerable period. The edges of rollers shall be duly rounded off to permit skidding of transformers on flat surfaces.

xiv) PAINTING

All painting shall be in accordance with the latest BIS for painting.

xv) TESTS

All equipment shall be fully tested in accordance with relevant clauses of applicable standards. All components and devices shall be checked for correct operation before despatch.

5. (b) TRANSFORMER YARD

The transformer yard should have 6 pole/ 8 pole structure according to relevant I.E. rules along with lightening arrestors, insulators, air break switches D.O. switches with jumper connections duly complying with the regulations of Chief Electrical Inspector to Government. Required no. of earth pits, spreading of 40mm stones in the transformer yard as stipulated by the CEIG is to be provided.

The transformer yard earthing shall be done in accordance with relevant I.E. rules

6. GENERATOR

The generator should be brushless, self excited and self regulated with test response to load charges and coupled to diesel engine of suitable HP rating.

MECHANICAL CONSTRUCTION

It should conform to IS 2253 and 4722 and amended therein.

The rotor assembly should be dynamically balanced to ensure vibration free running.

TERMINATION

Termination box provided at the end of the Generator should have four leads brought out for three phase supply.

VOLTAGE

The Generator should be designed for 415V, 3 phase and 50 HZ.

MOTOR STARTING

The generator should have a good motor starting ability and can be drawn upto twize the full current for 10 seconds.

DIESEL ENGINE

Diesel engine should enable should have adequate power margin to take care of the starting torque. The diesel engine should have all standard fittings as per BIS.

STARTERS

The starters shall suitable for the motor offered. This should have single phasing preventor, mounted on Ammeter, suitable capacity fuses etc. with all the standard safety devices such as Np volt coil, over load releases with time lag arrangements dry running preventor suitable interlocking devices, cable entries name plates and earthing facilities etc.

These starters to be supplied should be of FOL upto a range of 5 HP, star delta starter upto the range 15 HP and auto transformer starter above range of 15 HP.

SWITCH BOARD

The switch board shall be complete with all necessary internal connections and accessories as mentioned in the BOQ and as per latest I.E. Rules and CEIG regulations. This switch board should contain all equipments housed in cubiele, the bus bars should have ample current carrying capacity for connected load and painted with powder coated painting.

CABLES

The cables shall be supplied as mentioned in BOQ with ISI mark. Laying and jointing of cables shall be as per I.E.Rules. The cable should have current carrying capacity to withstand over load due to low voltage and voltage drop. Cable jointing should be done in such manner that there is adequate bondage strength and safety to equipments and operators.

EARTHING

Twin copper earthing of the plants and equipments shall be done as per IS 3043/1966 & I.E. rules 1996 and amended from time to time. Two separate lead should be taken to two separate earth pits located outside the pump house.

PUMP HOUSE WIRING AND LIGHTING

Pump house wiring and lighting shall be carried out, as per I.E.Rules with sufficient number of light points, lamps and other accessories (to be supplied by the Contractor) as prescribed in the BOQ and shall be of standard free of cost.

ERECTION AND TESTING

The contractor shall provide a skilled Engineer and skilled labour for the entire execution of the work and final testing of the plants at site.

All erection tools including spanners, diesets etc. shall be supplied by the contractor and the contractors representatives shall have full and uninterrupted access to the site during erection.

The Employer may depute any officer under his control to visit the works at any time during the stage of erection for inspection. The plant shall be tested by Employer. Post delivery inspection by the third party inspection agency in the presence of the firm's Engineer or any other representative to ensure performance and all testing equipments as may be reasonably required shall be provided by the contractor .Installation testing and

commissioning should in accordance with relevant ISS. The pre delivery inspection certificate for the pumpsets, panel board and other equipments and TNEB. Test certificate for transformer to be obtained by the bidder.

SPARE PARTS

Supply of spares and tools shall be made as per the list prescribed in BOQ with index card.

TOOLS

Standard tools for the maintenance of the equipments shall be supplied as detailed.

D/E spanners	1 set
Ring spanners	1 set
Bearing puller	1 no.
Grease gun	1 no.
Hand Gloves tested for electrical operation	1 pair
Ball peen hammer	1 no.
Screw drivers	1 set
Electrical tester	1 no.
Electric megger	1 no.

COMPLETION PLANS

The successful bidder shall be requested to furnish completion plans in triplicate within one month from the date of the first testing of the plants. The plan should show the entire layout of the plant executed. Two copies of plan should be supplied to the Employer and one to be framed and suspended in the Head works. The contractor shall in addition to the above furnish detailed specifications of the equipment provided to the Employer with all technical data.

MAINTENANCE MANUAL

The periodical maintenance schedules for each equipment shall be given with reference to the hours of operation. Detailed information about the spare parts (part name, identification number etc.) should be given. The copies of the manuals should be furnished within one month from the date of commissioning.

VIII . TESTING OF PLANT

General

The requirements for testing shall be as specified below.

Pumps, valves and pipework and general purpose machinery Off-site inspection and testing

(a) Pumps

Pumps shall be individually tested in accordance with Relevant IS Code and the tests shall be with clean water. Site conditions shall be simulated as nearby as possible including the NPSH condition. Pumps shall be tested with their own prime movers. Where it is impracticable to include the full length of the connecting shaft, the Contractor shall state the allowances to be made for the losses incurred by its omission and shall demonstrate the accuracy of the allowances to the satisfaction of the Engineer. Pumps shall be tested at the guaranteed duty point and over the full working range from the closed valve condition to 20 percent in excess of the quantity when a single pump runs alone at minimum head. The tests shall provide information for performance curves to be drawn for head/quantity, efficiency/quantity, power absorbed/quantity and net positive suction head/quantity. Readings shall be taken at a minimum of seven points in addition to shut-off condition. Each pump shall also be run at its duty point for at least 30 minutes.

Positive displacement pumps shall be tested in accordance with BS EN ISO 9906.

For eccentric helical rotor pumps the tests shall provide information for performance curves to be drawn for pump speed/flow, input power absorbed/flow differential pressure/flow and pump efficiency/flow.

Pump casings shall be subject to a pressure test at 1.5 times the pressure obtained with the delivery valve closed. The positive suction head when installed shall be taken into account in determining this pressure. During the test, the casing and joints shall show no signs of leakage, distortion or defect.

In addition to confirming the specified hydraulic performance of the pumpset, the test shall demonstrate that vibration is within the specified limits, the mechanical performance is satisfactory and the noise level is within the specified limit. Additionally chemical dosing pumps shall be tested in accordance with API standard 675 and the specified flow linearity, steady state accuracy and flow rate shall be demonstrated.

(b) Gate valves

Gate valves shall be tested in accordance with relevant IS Codes or

equivalent whichever applies, valve seat tests shall be made under open-end

conditions, the test pressure being applied to each face of the valve in turn.

(c) Butterfly valves

Butterfly valves shall be tested in accordance with IS Codes or equivalent. The seat test shall be for tight shut-off and low leakage. Valves shall be tested under maximum unbalanced water test pressure in either direction

(d) Air valves

Air valves shall be water tested for drop-tightness at all pressures from 0.2 bar in steps of 2 bar up to the specified pressure. The valve body shall be water tested at 1.5 times the specified pressure, at which pressure no damage or permanent deformation of the valve body, ball or seat shall occur. Two valves of each type and size incorporating large orifices shall be tested for exhaust of air at a differential pressure up to 1 bar in steps of 0.1 bar and for inflow of air at a differential pressure up to 0.5 bar in steps of 0.1 bar. During the tests the air flow rates shall be measured by orifice plates in accordance with BS 1042. Pressures (positive or vacuum) shall be measured by Bourdon tube gauges or by mercury-in-glass manometers. The temperature of the flowing air shall be measured in accordance with relevant parts of IS Code or equivalent. The barometric pressure shall also be measured

If the manufacturer provides results of independently witnessed air flow tests similar to those specified and these are accepted by the Engineer, the specified airflow tests shallbe deemed to be completed

(e) Pressure and flow control valves

Pressure and flow control valves shall be tested hydrostatically as follows:-

Body strength:	closed-end test, valve open, test pressure 1.5 times working pressure;
Valve element strength:	open-end test, valve closed, test pressure of 1.5 times working pressure applied to each end;
Leak tightness:	open-end test, valve closed, test pressure of the working pressure applied to inlet end, no visible leakage permitted.

(f) Pipe work

Pipe work shall be tested in accordance with the appropriate IS Codes or equivalent.

(g) Castings
Castings shall be tested hydrostatically to 1.5 times the maximum working pressure for a minimum period of 1 hour.

(h) Surge vessels
Surge vessels shall be tested in accordance with the relevant IS Codes or equivalent.

Electric motors
Off-site inspection and testing
Motors shall be inspected and tested to show that they are compliant with the Specification and approved drawings.
Tests shall be in accordance with the relevant IS Codes or equivalent..
For low voltage standard production motors for general use, the tests shall be routine checks. For high voltage and low voltage motors for main drive application, the tests shall be duplicate. If the test to determine the locked rotor current of cage induction motors is carried out at reduced voltage, allowance shall be made for the effect of saturation when adjusting for rated voltage. The estimated value of locked rotor current at rated voltage shall be stated on the test certificate.
A Polarisation Index test shall be carried out for high voltage motors.
The requirement for "basic" or "special" tests shall be as specified.
Individual Tests
Each motor shall be inspected prior to site testing for:-
• Absence of damage during transportation and erection;
• Absence of moisture or other contamination;
• Ventilation openings and drain holes are free of debris;
• Cable glanding and core terminations for tightness and identification;
• Free rotor rotation;
• Free movement of brush gear;
• Remote start/stop/E.stop control box wirings and arrangement;
• Starting interlocks
Unless otherwise specified the following tests shall be carried out on each motor before energising:-
• Winding insulation resistance;
• Polarisation Index for high voltage motors;
• Insulation resistance between motor and heater windings and ancillary devices;
• Calibration of winding and bearing temperature monitoring devices and the operation of alarm and trip initiating contacts;
• Continuity and resistance of winding thermistors;
• Bearing insulation integrity;
• Brush pressure.
Any other tests recommended by the manufacturer or stipulated in the the relevant IS Codes or equivalent. On the satisfactory completion of the inspection and tests listed above, motors shall be energised to check for correct direction of rotation, noise and the vibration levels are within the specified limits. The tests shall be carried out with the motor uncoupled from the driven plant.
Transformers
Off-site inspection and testing
Transformers shall be inspected and tested to show that they are fully

compliant with the Specification and approved drawings and shall include the following tests as a minimum:-

- Routine tests;
- Measurement on winding resistance;
- Ratio, polarity and phase relationship;
- Impedance voltage;
- Load loss;
- No-load loss and current;
- Insulation resistance;
- Induced over voltage withstand;
- Separate source voltage withstand;
- Magnetic circuit voltage withstand
- Transformer tank oil leakage test (1 kg/cm2 for 24 hours);
- Transformer noise level measured in accordance with methods and procedures detailed in IEC 551 -Noise level shall not exceed 65dBA;
- Tap changer switching, mechanical and electrical tests according to BS4571;
- Zero sequence impedance measurement;
- Type tests;
- Impulse voltage withstand test;
- Temperature rise test;
- On load tap changer panels;
- Operational tests;
- Sequence tests.

Unless otherwise stated by the Engineer at the time of placing the order, evidence of records of satisfactory type test carried out on identical transformers to those ordered will be accepted in lieu of actual tests on transformers manufactured under this Contract for impulse voltage withstand test. Temperature rise test shall be carried out on one transformer of each size and type. The guaranteed no-load and load losses of each transformer shall be verified at the manufacturer's works. The positive tolerances stipulated in BS 171 shall not be accepted. The Board reserves the right to reject any transformer which does not achieve its declared guaranteed values.

Individual Tests

The Site inspections and tests to be carried out are as follows:-

- Ratio, polarity and phase relationship;
- Impedance voltage;
- Insulation resistance;
- Oil and winding temperature gauges shall be calibrated and tested;
- Pressure gauges and oil level indicator relays shall be tested with pilot cables connected by mechanical operation of contacts;
- Tap changer equipment including protective devices shall be tested to ensure correct operation;
- Oil tests;

Samples of insulating oil shall be taken and subjected to dielectric strength tests. If the insulating oil fails the site test, the Contractor shall carry out the drying of oil to remove the moisture content or replace the oil and then carry out the oil tests again to comply with the relevant IS Codes or equivalent.

IX . MAINTENANCE OF PROJECT

1. It is the sole responsibility of the contractor to maintain the entire project successfully for the **maintenance period of .....months** from the successful Commissioning of the project. Under this scope

2. The following measures are to be taken essentially by the contractor

- Necessary maintenance crew with supervisory staff shall be deployed. The staff pattern proposed by the contractor for the maintenance of the completed project should be got approved by the Employer one month before the issue of completion certificate. The entire strength of maintenance crew with the supervisory personnel should be available from the first day of the maintenance period.
- The contractor should keep all spares required for replacements at the head works, pumping main, distribution system, pumpsets etc readily available to ensure uninterrupted water supply to the beneficiaries.
- All the equipments that goes out of order during the course of the maintenance period shall be rectified/replaced immediately to ensure uninterrupted water supply. If any equipment/machinery is found to be defective either due to manufacture or due to unsatisfactory maintenance, the same should be replaced by the contractor at his cost.
- The contractor is responsible for the incidence of any theft, malpractice etc within the project area during the maintenance period and the contractor shall keep the Employer indemnified.
- During the period of maintenance, all costs towards labour, spares, consumables, chemicals, repairs and renewals shall be borne by the firm / Contractor.
- The electrical energy charges payable to TNEB during the maintenance period shall be borne by the Employer
- Complete quality service shall be ensured by the contractor during the maintenance period.
- Necessary log books indicating the quantity of water pumped, and maintenance carried out and repairs attended with details of spares changed shall be maintained by the contractor on a day to day basis and produced to the Engineer in charge whenever called for
- Date of commencement of maintenance will be from the date of commissioning of the schemes in all respects i.e. after supply effected to all beneficiaries covered under this scheme.
- In case where the work could not be completed due to the reasons beyond the control of the contractor viz. due to delay in getting permission from Railways/ Highways etc. authorities, the partial commencement of the maintenance will be permitted for other completed works/ components from the date in which these components / works were commissioned and water supply affected to the beneficiaries and of separate maintenance period may be adopted as per agreement conditions for he component after its completion.

X. ANNEXURES

I. Pump characteristics

II. a) Turbine pumps
b) Motor for turbine

III a) Centrifugal pump
b) Motor for centrifugal pump

IV a) Submersible pump
b) Motors for submersible pump

V Transformer

VI Generator

VII Starters

(The above annexures as applicable should be filled in and duly signed and enclosed with the Tehnical Bid – Cover I)

ANNEXURE - I

PUMP CHARACTERISTICS

Sl. No.	Description	Technical	Remarks	Details
a.	Capacity in LPM (discharge)			
b.	Total head in metres			
c.	Net positive suction head required			
d.	HP absorbed by the Pump			
	i) at duty point			
	ii) at max BHP point given in the range of curve furnished			
e.	HP of the motor offered			

Note :

The motor must not get over loaded, at Positive low head conditions due to Maximum W.L. conditions in Bore well/ well.

ANNEXURE II (a)

TURBINE PUMPS

1. Name of Manufacturer
2. Model
3. IS reference
4. Type

A. Pump Details

1. Nature of Lubrication :
2. Suitability for collector well/ collection well with a depth of ..... metre :
3. Stages :
4. Bowl outer dia in mm :
5. Discharge in LPM :
6. Total head in metres :
7. Speed in RPM :
8. Power input at duty point HP/K.W. :
9. Maximum power input required for entire range of operation :
10. Pump efficiency at duty point in % :
11. Shut off head in metre :
12. Minimum submergence required :

B. Column Assembly

1. Dia in mm :
2. Length in metre :
3. Type of joint (flanged or serewed) :

C. Size

4. a. i) Oil tube if necessary dia .....mm
   ii) Material
   b. i) Line shaft dia ..... Mm
   ii) Material
1. Discharge head
   Surface/ Underground
2. Delivery size in mm
3. Impeller
   i) Material
   ii) Type
4. Balancing of Impeller Dynamic/Static
   Floor space required ..... Sq.m.
5. Weight of Pump heaviest part bowl assembly -
   Weight of complete pump
6. Type of sealing rings
7. Type of impeller shaft sleeves
8. Type of bearing, make and reference number
9. Are the bearing external/internal
10. Materials of bearing
11. Whether the performance curve is attached
12. Does the characteristics curve conforms to
    Indian standard Specifications
13. What is the nature of drive
14. Type of coupling
15. Weight of the Motor
16. Does the pump and its accessories conform to IS

ANNEXURE – II (b)

Motor for Turbine Pump

1. Rate output HP :

2. Make :

3. Description type :

4. System voltage :

5. current in Amps at rated output :

6. Current Rating at full load :

7. Class of insulation :

8. Permissible Temperature rise over
   45 Degree Ambiant temperature :

9. Efficiency at 100% Load
   75% Load
   50% Load
10. Power factor ½ Load
    ¾ Load
    Full Load
11. Type of Enclosure

12. B.I.S. Reference :

13. Type of rotor :

14. Type of starting :

15. Rotor current

    a) Max Starting
    b) Normal Full Load

16. Overload capacity

    25 %

    50 %

    100%

17. Operating torque

18. Starting current

19. No. of poles

20. Bearing Make & Number

21. Type of coupling

22. Whether motor conform to
    B.I.S. Specifications

23. Weight of Motor

ANNEXURE – III (a)

Centrifugal Pumps

1.	Type & Make	:
2.	B.I.S reference	:
3.	Stages	:
4.	Suction diameter in mm	:
5.	Delivery diameter in mm	:
6.	Materials	:
	i) Casing	:
	ii) Bearing	:
	iii) Impeller	:
	iv) Base plate	:
7.	Bearing No.	:
8.	Speed in RPM	:
9.	Method of Lubrication	:
10.	Balancing of Rotating parts	:
11.	Gland Rope size	:
12.	NPSHR in metre	:
13.	SHUT off head in metre	:
14.	Type of coupling	:
15.	Materials of coupling	:
16.	Weight of (i) the pump	
	(ii) Heaviest part of the pump	:
17.	Space required in Sq. M	:

18. The clearance required/between two strainers, bottom floor and strainer :

19. Type of impeller
    i) Type of sealing rings
    ii) Bearing make & number :

20. Are the bearing internal or external :

21. Are the characteristics of pumps attached :

22. Does the characteristics conform to B.I.S.

23. Nature of drive :

24. Length of pumpset :

25. Accessories conform to B.I.S. :

26. Whether performance chart enclosed

Sl. No.	Description	Head in Metres			Discharge in LPM	Speed in RPM	Efficiency %	BHP
		Suction	Delivery	Total				
1.	At any point							
2.	At LWL condition							
3.	At MWL condition							
4.	At shut off head							

28. Are the following accessories Provided

a. Priming funnel and union
b. Air Release cocks and drain cocks
c. Drip water pipes
d. Compound gauge to suction and deliver branch
e. Are the gauges graduated in metre head of water, if so, give range.
f. What arrangement is adopted for preventing air being a drawn into the pumps.

ANNEXURE – III (b)

Motors for Centrifugal Pumps

1. Name of the manufacturer :
2. Type of Motor :
3. Output brake horse power :
4. Number of phases :
5. Cycles :
6. Voltage :
7. Speed at full load :
8. Rating :
9. Class & insulation :
10. Stator current
    (Normal full load Phase) :
11. Current
    a. Normal full load Amps Per phase
    b. Maximum starting Amps Per phase
12. Efficiency

Load	Tolerance
Full	%
¾	%
½	%

Note :

Manufacturer's Certificate should be enclosed

13. Overload capacity
    a. 25%
    b. 50%
    c. 100%
14. Power factor

Load	Tolerance
Full	%
¾	%
½	%

15. Temperature rise

	Stator	Rotor
a. With 12 Hrs. of full speed run with 45° C ambient temperature at the place	°C	°C

16. Starting torque :
    a. In percent of full load torque
    b. Starting currenting percent of
       Normal full load current system Phase
17. Details of motor
    a. Number of poles
    b. Type of enclosure
    c. Type of Motor
18. Bearing manufacturer
19. Type and size (Driving end)
20. Type and size of bearing at non-driving end\
21. Size of coupling and its type
22. Does the motor conform to BIS
23. Specification reference
24. Weight of motor
25. Degree of protection of motor.

ANNEXURE – IV (a)

Submersible Pumps

01.	Name of Manufacturer	:
02.	Type of pump and Model	:
03.	Number of stages	:
04.	Material of strainer	:
05.	Delivery Branch dia. (in mm)	:
06.	Total discharge in LPM	:
07.	Materials of casing	:
08.	Type of impeller	:
09.	Materials of impeller	:
10.	Material of impeller shaft	:
11.	Type of bearings	:
12.	Are the bearings external or internal	:
13.	Material of bearings	:
14.	Maker's name and code number of bearings	:
15.	Whether moving parts are balanced	:
16.	If so, type of balancing	:
17.	BHP of the pump	:
18.	Efficiency of the pump	:
19.	Weight of the pump	:
20.	Diameter of the pump	:
21.	Pump speed	:

22.	Are the characteristics curves of the pumps attached	:
23.	Total Head	:
24.	Does the pump conform to BIS Specification	:
25.	Specification reference	:
26.	What is the nature of drive	:
27.	Type of coupling	:
28.	Weight of the heaviest part of the pump	:
29.	Weight of the pump complete	:

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ANNEXURE – IV (b)

Motor (for Submersible Pumpsets)

01. Name of Manufacturer :

02. Type of Motor :

03. Brake Horse Power of the Motor :

04. Number of phases :

05. Cycles :

06. System Voltage :

07. Frequency :

08. Speed at full load :

09. Full load current :

a. Normal full load ..... Amps

b. Maximum starting ..... Amps

10. Efficiency	Load	Percent	Tolerance as per BIS
	Full		
	¾		
	½		

11. Over load capacity

a. 25%

b. 50%

c. 100%

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12.	Power factor	Load Full ¾ ½	Percent	as per
13.	HP of the Motor		:	
14.	Number of poles		:	
15.	Type of enclosure		:	
16.	Type of Rotor	:		
17.	Bearing manufacturer	:		
18.	Type, number and size of bearing (driving end)		:	
19.	Size of coupling and its type	:		
20.	Does the Motor conform to BIS Specification		:	
21.	If so state the No.		:	
22.	Weight of Motor		:	
23.	Total weight of pump and Motor		:	
24.	Diameter of the Pumpset		:	
25.	Overall efficiency of the pumpset		:	

ANNEXURE – V

TRANSFORMERS

1. KVA of the transformer
2. H.T voltage
3. L.T. Voltage
4. Name of the manufacturer :
5. Connection's at
   i) H.T. side
   ii) L.T. side :
6. Type of cooling
7. Type of mounting – Indoor/outdoor

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ANNEXURE – VI

GENERATOR

1. KVA rating
2. Voltage
3. Speed
4. Name of the manufacturer
5. Type of starting
6. Type of cooling

   Diesel Engine
7. HP of Engine
8. Speed
9. Name of the manufacturer
10. Type of cooling
11. Mountings attached
    - i) Radiator
    - ii) Diesel tank
    - iii) Bare frame
    - iv) Exhaust piping

ANNEXURE – VII

STARTERS

1. Name of Manufacturer

2. Type of Starter

3. Type of Cooling

4. Over load relay

5. No Volt Coil

6. No. of starters permitted in one hour

TENDERER SE/TWAD BOARD/TRY,

XI . REFERENCE TO SPECIFICATIONS/ CODE OF PRACTICE

DESCRIPTION	BIS NO.
Ordinary Portland Cement (33 Grade)	269 – 1976
43 Grade Ordinary Portland Cement	8112 – 1989
Pozzolona Portland Cement	1489 – 1991
Hydrophobic Portland Cement	8043 – 1978
Rapid Hardening portland Cement	8041 – 1990
Low Heat Portland Cement	12600 – 1989
Standard sand for testing of cement	650 – 1966
Methods of Test for Pozzolonic Materials	1727 – 1967
Methods of sampling and test for water & waste water (Physical & chemical)	3025 – 1984(Part 1 to 37)
Methods of Sampling hydraulic Cement	3535 – 1986
Methods of Physical tests for hydraulic cement	4031 – 1988(1 to 14)
Methods of chemical analysis for hydraulic cement	4032 – 1985
Aggregates coarse & Fine from Natural resources For concrete.	383 – 1970&4082/1977
Sand for Masonry Mortar	2116 – 1965&1542/1977
Methods of tests for aggregates for concrete	2386 - 1963(Part 1 to 8)
Part I – Particle size and shape	2386 – 1963(Part – I)
Part II – Estimation of deleterious Materials & Organic impurities	2386 – 1963(part – II)
Part III – Soundness	2386 – 1963(part – III)
Methods for sampling of aggregates for concrete	2430 – 1986
Specifications for test sieves Part – I – Wire cloth test Sieves	460 – 1978 (Part – I)
Common Burnt clay building bricks	1077 – 1976
Mild Steel and Medium tensile steel bars and hard	
Drawn steel wire, concrete reinforcement, Part – I – Mild steel & medium tensile steel Bars Part – II – Hard drawn steel wire	432 – 1982
High Strength deformed steel bars and wires for Concrete reinforcement	1786 – 1985
High Tensile Steel for PSC Pipes	1784 – 1986(Part 1)

DESCRIPTION	BIS NO.
Bending and flexing of bars for concrete reinforcement	2502 – 1969
Recommendations for detailing of reinforcement In reinforced concrete works	5525 – 1969
Method for tensile testing of steel wire	1521 - 1972
Method of test for determining modulus of plasticity	2854 – 1964
Glossary of terms relating to cement concrete	6461 – 1972(Part 1 to 12)
Methods of test for strength of concrete	516 – 1959
Methods of sampling and analysis of concrete	1990 – 1959
Methods of testing bond in reinforced concrete Pull out test	2770 – 1967
Methods of test for permeability of cement Mortar and concrete	3085 – 1965
Methods of test for splitting tensile strength of concrete cylinders	5816 – 1970
Methods of tests for determining setting time of concrete by penetration resistance	8142 – 1976
Code of practice for construction of Pile foundations (concrete piles) Driven cast-in-situ concrete piles Bored cast –in-situ piles Driven pre-cast concrete piles Bored pre-cast concrete piles	 2911 (Part I) Sec – 1 – 1979 Sec – 2 – 1979 Sec – 3 – 1979 Sec – 4 – 1984
Code of practice for construction of raft foundation	2950 – 1981
Design Aids for reinforced concrete	SP 16 – 1980
Explanatory Hand Book on codes for earthwork Engineering	SP 22 – 1982
Explanatory Hand Book on IS Code 456 – 1976	SP 24 – 1983
Hand Book on causes and prevention of cracks In buildings	SP 25 – 1984
Hand Book on concrete reinforcement & detailing	SP 34 – 1987
Brick Masonry	2212 – 1962
Construction of Stone Masonry	1957 – 1967
Asbestos cement pressure pipes	1592 – 1989
Concrete pipes with and without reinforcement	458 – 1988
P.S.C. Pipes (including fittings)	784 – 1978

DESCRIPTION	BIS NO.
Methods of tests for concrete pipes	458 – 1988&3597 – 1985
Materials for M.S. Specials	226 – 1976 &2062 – 1980
Specifications for M.S. Specials for P.S.C. Pipes	
Specifications for Steel cylinders reinforced Concrete pipes	1916 – 1989
Methods of tests of concrete pipes	3597 – 1985
Specials for steel cylinders reinforced concrete pipes	3597- 1985
Cast iron specials for asbestos cement pressure pipes for water, gas & sewage	5531 – 1988
Methods of test for asbestos cement products	5913 – 1989
Dimensional requirement for rubber sealing rings For CID joints in asbestos cement pipes	10292 – 1988
Centrifugally Cast (Spun) Iron pressure pipes for Water, gas and sewage Including fittings	1536 – 1989
Specifications for Centrifugally Cast (Spun) D.I. Pipes for water, Gas and Sewage.	8329 – 1990
D.I. Fittings for pipes for water, gas & seweage	9523 – 1980
Dimensional requirements of rubber gaskets for Mechanical joings and push on joints for the use with C.I.D.I.Pipes.	5382/1985
C.I. Specials for Mechanical and push on flexible joints for pressure pipe lines for water, gas & sewage	13382 – 1992
Horizontally cast iron double flanged pipes for water, Gas and sewage	7181 – 1986
Cast iron fittings for pressure pipes for water, gas And sewage	1538 – 1976(part 1 to 24)
Cast iron detachable joints for use with Asbestos Cement pressure pipes	8794 – 1988
Rubber rings for jointing C.I. Pipes, R.C.C. Pipes & AC. Pipes	5382 – 1969
Rubber rings for jointing P.S.C. pipes	5382 – 1985
Rubber rings for jointing AC pipes with AC couplings	10292 – 1985
Pig Lead (caulking lead)	782 – 1978
Hemp yarn	6587 – 1966

DESCRIPTION	BIS NO.
Rubber Insertion to be used in jointing CIDF pipes	638 – 1979
Bolts & Nuts to be used in jointing CIDF pipes	1363 – 1967
Unplasticized PVC pipes for potable water supplies	4985 – 1988
Injection moulded PVC socket fittings with Solvent cement joints for water supplies	7834 – 1987 (Part 1 to 8)
Fabricated PVC fittings for potable water supplies	10124 – 1988 (part 1 to13)
Methods of test for unplasticized PVC pipes for potable water supplies	12235 – 1986 (Part 1 to 11)
Sluice valves for water works purposes	14846/2000
Surface boxes for sluice valves	3950 – 1979
Manhole covers for sluice valves	1726 – 1974
Laying of Asbestos Cement Pressures Pipes	6530 – 1972
Laying of Concrete pipes	783 – 1985
Laying of Cast – Iron Pipes	3114 – 1985
Laying of PSC pipes	126 of APSS & 783 – 1985
Laying of DI Pipes	12288 – 1987
Laying and jointing of unplasticized PVC pipes	7634 – 1975 (Part 3)
Batch type concrete mixer	1791 – 1968
Sheep foot roller	4616 – 1968
Safety code for excavation works	3764 – 1966
Safety code for scaffolds and ladders part – I Scaffolds Part II – Ladders	3696 – 1966 (Part I) 3696 – 1966 (Part – II)
Safety code for piling and other deep foundations	5121 – 1969
Safety code for working with construction machinery	7293 – 1974
Tamil Nadu Building Practice	Volume – I Volume – II
Government of India Manual on Water Supply and Treatment	May 1999(Revised)

DESCRIPTION	BIS NO.
Gravel for packing	4091 – 1967
Hard drawn Steel Wire	1785 – 1983 (Part I and II)
Structural Steel	226 – 1975
Hard rolled mils steel for concrete	1139 – 1966
Hard drawn Steel Wire	1566 – 1982
American Society for Testing of Materials	
British Standard	2494 – 1955Part I
Welding Electrodes	814 – 1970
Steel Sheets	225 – 1975
Guniting	7322 – 1994
Welded Joints	3589 – 19667& 2041 – 62
Tensile Test	223 – 1950
Mechanical and Electrical Works	
Turbine Pump	1710 – 1972
Submersible Pump	8030 – 1976
Submersible Motor	9283 – 1979
Earthing	3043 – 1966
Transformer	1180 – 1964
Generator	2253 – 4722