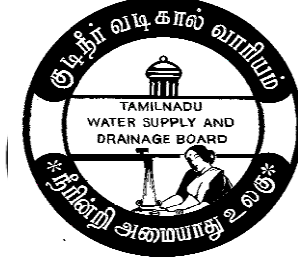


# **TAMILNADU WATER SUPPLY AND DRAINAGE BOARD**

## **CHIEF ENGINEER, THANJAVUR**



## **TECHNICAL SPECIFICATION**

### **Volume – II**

### **COVER- I**

#### **NAME OF WORK**

Providing 1.15 MLD Sewage Transmission main from TNSCB HFA project area for 1920 tenements at Narimedu of Pudukkottai district under deposit work to the existing 10.62 mld STP of Pudukkottai Municipality at Maurpini Grass farm under deposit work including trial run 6 months and paid maintenance for one year (Period of completion 12 months)

**Last date of submission : Up to 03.00 P.M. on 10.08.2020**

## Technical Specifications

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## I. SCOPE OF WORK

### 1. Introduction :

The Pudukkottai HFA Project for 1920 Treatment executed by Tamilnadu slum clearance Board(TNSCB) is situated at Northern periphery of Pudukkottai municipality at Narimedu at a latitude of 10°40'43" North and longitude of 78°59'23". The TNSCB construct 40 Blocks. Each Block having 48 House. The Extent of project area of is 23 acres. At the rate 5 person for each house the total no of Population Estimated in the HFA Project area is 10000 including the floating population of 400 for the facilities such as School , Community hall, Shops etc.

#### a.LIFT STATION

The sewage quantity 211 lpm generated from 11 Blocks of Zone-II HFA project area will be collected by the proposed well of following dimension and conveyed to Main Pumping Station

#### b.PUMPING MAIN:

The Sewage from the Liftwell is proposed to convey by means of 150mm CILA class pipe to a length of 400m from lift station to Main Pumping station.

#### c.MAIN PUMPING STATION:

The total estimated quantity will be collected by the proposed screenwell, Gritwell and section well and conveyed in the existing 10.62 MLD sewerage treatment Plant.

### 2. GENERAL:

2.1 The fee paid to TNEB for permanent power supply connection shall be deposited by the employer directly. IT SHOULD BE THE RESPONSIBILITY OF THE CONTRACTOR TO PROJECT POWER REQUIREMENT, PREPARE AN APPLICATION FOR THE TNEB AND HELP THE EMPLOYER WITH REQUIRED INFORMATION AND ASSISTANCE IN THIS REGARD. All other costs related to obtaining such approval are in the scope of contract. It will be the total responsibility of contractor to obtain approval of entire electrical installation from electrical inspector. The charges alone will be paid by Pudukkottai Municipality.

2.2 Power supply room of required area as per TNEB requirements shall be provided near transformer yard as required.

2.3 Illumination of STP Yard with suitable arrangement for better operation and maintenance of plants.

### 3.PROPOSED TREATMENT SCHEME

#### 3.1 Receiving of Sewage

Raw Sewage from MPS at Manachanallur and MPS at S Kannanur will be delivered through 350mm, and 250 mm dia CI pipeline at a hydraulic head of 6m from invert level of pipes respectively into Receiving Chamber from where it will be taken into down stream screens. The function of the Receiving Chamber is to reduce the incoming velocity. Receiving Chamber shall be of adequate size to meet the requirements of workability inside it. The flow from the receiving chamber will lead to screen Chamber.

#### 3.2 Coarse Screening

After the receiving chamber minimum two numbers of coarse screens are to be provided for removal of floating and oversized material coming with the sewage. One shall be mechanically operated and must be suitable for sewage applications. The other shall be

of Manual screen as standby. The coarse screens should be capable to screen out most of the medium & large floating and oversized material such as plastic rags, debris, weeds, paper, cloth, rags etc which could clog the waste water pump impellers. The coarse screen shall be inclined bar screen. The bar screen shall be of stainless steel flats. The screenings shall be dropped on conveyor above the top of the screen channel. A conveyor system of suitable width shall be provided which shall be adjacent to the screens. The screening material as collected will drop automatically into a wheelbarrows for its disposal.

### **3.3 Fine Screening**

Fine screen channels to be provided up stream of Grit removal system Minimum two nos. of Fine screens are to be provided for removal of fine floating material coming with the sewage. It shall be mechanically operated and must be suitable for sewage applications. There shall be minimum one number of Manual fine screen as standby. The fine screens should be capable to screen out most of the medium & fine floating and material such as hair, debris, weeds, paper, rags etc. which could clog the downstream units. The Fine screen shall be inclined bar screen. It should be of sturdy design and the bar screen shall be of stainless steel flats. The screenings shall be dropped on conveyor above the top of the screen channel. A conveyor system of suitable width shall be provided which shall be adjacent to the screens. The screening materials as collected will drop automatically into a wheelbarrows for its disposal.

### **3.4 De-gritting**

Screened Sewage will be gravitable to minimum two numbers of Grit separator tank for removal of grit and small inorganic particulars matter of specific gravity above 2.65 and particle size above 150 microns. The Grit separator tank shall be of RCC construction complete with mechanical internals and square in size. The grit separated shall be properly collected and be transferred for disposal. The degritted sewage shall flow through open channels from the grit separators and confluence into a single channel of suitable width.

#### **4.Free Board**

A Free Board of 0.5 m. should be provided in the each unit and designed accordingly.

#### **5.As-built Drawings:**

The contractor shall submit six copies with one set of originals of completion plans & LS plans as executed with all the details for all items of work including sewerage system, pumps, pumping main, pumping station & treatment plant. The contractor shall also submit all the above in a compact disc (in AutoCAD –2004) in a suitable readable scale as approved by the Engineer.

The contractor shall also submit six copies of operation & maintenance manual for all items of works for proper maintenance of the system in future. The successful contractor shall also maintain the entire system for a period of one years from the date of satisfactory commissioning of the project.

#### **6.SPECIFICATION**

##### **6.1INTERPRETATION:**

In this contract the following works shall be understood as having the meaning herein assigned to them.

a) “The Board” means the Tamil Nadu Water Supply and Drainage Board, a statutory body constituted under Tami Nadu Water Supply and Drainage Board Act having its office at No.31, Kamarajar Salai, Chepauk, Chennai -600 005 and any officer duly authorized by this Board to act on its behalf.

b) “Contractor” means the person or persons or firm or company contracting for the work specified, including his or their executors or administrators or legal representatives or successor.

c) “Engineer” means the Executive Engineer or his representative or any other Engineer appointed from time to time by the Board to act as such in connection with these works. Whenever any work is specified to be done or materials supplied to the satisfaction of the Engineer, it shall be taken as including his properly authorized assistance and duly authorized representatives.

d) “Works” mean works to be constructed, completed and maintained in accordance with this contract.

TNBP – Tamil Nadu Building Practice

IS – Indian Standard

ISS – Indian Standard Specification

BIS – Bureau of Indian Standards

## **II. GENERAL SPECIFICATIONS**

### **1. Contractor's Responsibility**

The information given hereunder and provided elsewhere is given in good faith but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim whatsoever will be entertained on the plea that information supplied by the Engineers is erroneous or insufficient.

### **2. Construction Water**

The Contractor shall make his own arrangement for the fresh water required for the manufacturing of the pipes, construction of civil works and testing of pipeline as well as for the potable water required for his factory & labour camps.

### **3. Construction Power**

The Contractor shall make his own arrangement for supply of electrical energy required at his sites and the works from the Tamil Nadu Electricity Board.

The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the Tamil Nadu Electricity Board and therefore the Contractor is advised to make his standby arrangement to provide and maintain all essential power supply for his work area at his expense. The Contractor shall not be entitled to any compensation for any loss or damage to his machinery or any equipment or any consequential loss in progress of work and idle labour.

### **4. Survey**

The Contractor shall, at his own expense provide and maintain survey stations which he may require to carry out the works and shall remove the same on completion of the works. The Contractor shall, at his own expense, carry out all the necessary surveys, measurements and setting out of the works and shall for this purpose engage qualified and competent engineering surveyors whose names and qualifications shall be submitted to the Engineer for his approval.

The Contractor shall for the purpose of checking the survey and setting out, provide to the Engineer all the assistance, which he may require. The surveyor shall be selected having appropriate experience and as far as possible, the same surveyor shall be provided throughout the contract period. Before commencing any work at any locations, the Contractor shall give the Engineer not less than two days notice of his intention to set out or give levels for any part of the work in order that arrangements may be made for inspection. The Contractor shall provide for the sole use of the Engineer and his staff, all necessary survey instruments and other equipment and all technicians, labour and attendants which the Engineer may require for checking the setting out and marking of the works. The Contractor shall maintain in good working order at all time during the period of contract the instruments provided by him, for the proper setting out of the works. The Contractor shall make available at his own expense, any poles, staging templates.

### **5. Temporary Fencing**

The Contractor shall, at his own expense, erect and maintain in good condition temporary fences and gates along the boundaries of the areas assigned, if any, to him by the Employer for the purpose of the execution of the works.

CONTRACTOR

CHIEF ENGINEER/TNJ

The Contractor shall, except when authorized by the Engineer, confine his men, materials and plant within the site of which he is given possession. The Contractor shall not use any part of the site for purposes not connected with the works unless prior written consent of the Engineer has been obtained. Access shall be made to such areas only by way of approved gateways.

#### **6.Return Of Labour And Plant**

The Contractor shall supply to the Engineer by 9 a.m. every working day a return of the men employed by him and his sub-contractors on the previous working day and all of the work on which they were engaged specifying also the number employed in each trade. He shall also supply monthly any other returns which may be required as to the number of men and constructional plant employed and the nature and type of the work done.

#### **7.Sanitary Facilities**

The Contractor shall provide and maintain in a clean and sanitary condition adequate W.C.'s and wash places which may be required on the various parts of the site for use of his employees, to the satisfaction of the Engineer. The Contractor shall make all arrangements for the disposal of sewage or drainage in accordance with the directions of the Engineer.

#### **8.Restricted Entry To Site**

The Contractor shall get the prior permission of the Engineer before any person not directly connected with the works visits the site.

#### **9.Existing Services**

Drains, pipes, cables, overhead electric wires and similar services encountered in the course of the works shall be guarded from injury by the Contractor at his own cost, so that they may continue in full and uninterrupted use to the satisfaction of the Employer and the Contractor shall not store materials or otherwise occupy any part of the 'site' in a manner likely to hinder the operation of such services. Should any damage be done by the Contractor on any mains, pipes, cables or lines (whether above or below ground), whether or not shown on the drawings, the Contractor must make good or bear the cost of making good the same without delay to the satisfaction of the Engineer and of the Employer.

#### **10.Local Roads and Haul Roads**

The approach roads and other public roads in the state may be used by the Contractor to haul construction materials and equipment subject to restriction of load carrying capacity on the roads in particular over bridges and culverts. However, the Contractor will have to pay customary vehicles license and permit fees for use of public roads.

The Contractor shall plan transportation of construction materials to site in such a way that road accidents are avoided.

### **11.Permission for Road Cuts**

Wherever the Contractor considers that it is necessary to cut through an existing road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commence.

In the event of cutting a road by the Contractor without permission from the Engineer the Contractor shall pay compensation as claimed by the owner of the road until it is restored at the cost of the erring Contractor.

Trench Digging:

Digging of trench by the Contractor beyond the length than that is specified by the Engineer shall invite a fine of Rs.500/- per day till such time the damage is restored.

### **12.Temporary Diversion of Roads**

During the execution of the works the Contractor shall make at his cost all necessary provision for the temporary diversion of roads, cart-tracks, footpaths, drains, water courses, channels etc., Should he fail to do so, the same shall be done by the Engineer and the cost thereof will be recovered from the Contractor.

### **13.Notice to Telephone, Railways & Electricity Supply Under Takings / Depts., etc.**

The Employer shall deposit an amount to the respective local bodies/Highways department for restoration of road surface after completion of pipe laying work. The Employer shall obtain general permission to cut the road.

Before commencing operations the Contractor has to obtain specific permission from local bodies/Highways Department when he wants to cut any section of the road. Where operations involve cutting of roads, shifting utilities etc. during the process of work, the Contractor shall also give notice to the concerned authorities viz. the panchayats /the Municipalities, the Railway department, the Electricity Board, Telegraphs department, the Traffic department attached to the police and other departments or companies as may be affected by the work. The notice should identify the specific details so that the necessary diversion of traffic may be arranged and permissions obtained. 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 provide at his own expenses watching and lighting arrangements during day and night and erect required notice board such as "Caution Road closed for Traffic" etc. He should also provide and maintain at his own cost the necessary supports for underground cables etc. to afford best protection to them in consultation with the authorities in-charge of the properties and to their best satisfaction. The Contractor has to make necessary arrangements to get supply of electricity from TNEB for operating the machinery and equipments. The Employer will pay the necessary service connection and S.D. charges. The Contractor should obtain all approvals for the installation and commissioning of machinery and accessories offered by them from the respective inspecting authorities such as CEIG or CFIG etc., Fees if any, to be paid to the inspecting authorities will be reimbursed by the Employer.

### **14.Barricading**

The pit / trench shall be barricaded on all four sides. The Contractor who has dug up the trench shall be responsible for any mishap, which may occur. Non-barricading of trenches by the Contractor shall be liable for a fine of Rs.500/- per day.

### **15.Length of Trench Open at One Time**

The Pipe line shall be excavated in such length as may be ordered by the Engineer depending on the nature of the ground, the depth from the surface and the risk of damage to the adjoining property. The pipes shall not be covered until they may have been tested to the satisfaction of the Engineer. But in bad ground in close proximity to buildings or in other places where the Engineer shall consider necessary he may limit the length of trench so that there shall not be more than three pipes lengths from the refilled trench to the unbroken ground ahead

### **16.Watching and Lighting**

The Contractor shall at his expense provide at the site of work sufficient lighting and watching and fencing by night and by day and shall in every respect conform to the police regulations in these matters and he shall free and relieve the Employer, Should he neglect to do so, the same shall be provided by the Engineer and the cost thereof will be recovered from the Contractor.

### **17.Filling In Holes and Trenches Etc.**

The Contractor immediately upon completion of the Works shall fill up holes and trenches which may have been made or dug, level the mounds, or heaps or earth that may have been raised or made, and clear away all rubbish which may have become superfluous or have been occasioned or made in the execution of the works, and the Contractor shall bear and pay all costs, charges etc. Failure to carry out the work within two days will attract a fine of Rs 500/- per day.

### **18.Power to Vary Work**

The Engineer reserves the power to vary, extend or diminish the quantities of Work, to alter the line, level, or position of any work to increase, change or decrease the size, quantity, description, character or kind of any Work, to order the Contractor to execute the Works or any part thereof, by day or night Work, or to add or to take from the Work included in the contract as he may think proper without violating the contract and the Contractor shall not have any claim upon the Employer for any such variation, extension, diminution, alteration, increase, change or decrease other than for the Work actually done, calculated according to the prices tendered and accepted in this contract.

### **19.Extra or Varied Work**

If the Engineer uses the power reserved to him under Clause 18 above an order in writing signed by the Engineer, shall be given to the Contractor to that effect and any Work executed under such order shall be paid for at the rates set forth in the Schedule of Prices prevailing at the time of execution where such rates in the opinion of the Engineer apply. This shall apply to unforeseen items of work which are not found in the Bill of Quantities. If the rates are not available in the Schedule of Prices, a rate or price shall be agreed upon between the Engineer and the Contractor in writing and failing their agreement the Contractor shall forthwith execute such order and the Engineer shall determine the rates or prices at which the work shall be paid of.

### **20.Free Flow of traffic**

While executing the work, as soon as possible, the Contractor should allow as much traffic as possible on the roads/streets, by refilling the trenches cut across.

## **21. Tools and Plants**

All tools and plants required for the work including sheet piles and timber for shoring and strutting, pump sets etc. shall be supplied by the Contractor at his own cost. The rate for the relevant items of work are inclusive of all such tools and plants and apparatus required for the execution of the work.

## **22.Excess Materials**

The Contractor shall be responsible for the procurement of required quantity of materials like pipes, specials, machinery, electrical items etc. Any materials procured for the work, if found excess due to any reasons after completion of the works, shall be taken back by the Contractor and the Employer / Engineer shall not be responsible for such excess materials. Amount paid if any for such excess materials shall be deducted from any bills payable to the Contractor.

## **23. Commissioning of Works**

The Contractor shall be responsible for successful commissioning and stabilizing the plant before the commencement of operation and maintenance period of five years.

## **24. General**

Before submitting the bids, the bidder should carefully go through all the bid documents, drawings and also inspect the place of work so as to get full and first hand knowledge of the site conditions based on which he has to quote his rate.

The process submitted should be a well-established process for treatment of sewage. The tenderness are to adopt the same nomenclature used for various treatment units in their design report as used in the tender document.

### **24.1.Accidents**

It shall be the duty of the Contractor to arrange for the execution of the works in such a manner as to avoid the possibility of the accidents to persons or damage to the properties at any stage of the progress of work. Nevertheless he shall be held wholly responsible for any injury or damage to persons and properties, which may occur irrespective of any precautions he may take during the execution of the works. The Contractor shall make good all claims and loss arising out of such accidents and indemnify the Employer from all such claims and expenses on account thereof.

### **24.2.Flood Damages etc.**

The Contractor has to take risk insurance at his cost against losses due to unprecedented floods and other acts of God. No claim shall be entertained on this account and paid for.

### **24.3.Water and Lighting**

The Contractor shall pay all fees and provide water and light as required from Municipal mains or other sources and shall pay all charges therefor (including storage tanks, meters etc.) for the use of the works and workmen, unless otherwise arranged and decided on by writing with Engineer. The water used for the works shall be free from earthy vegetable or organic matter and from salts or other substances likely to interfere with the setting of mortar or otherwise prove harmful to the work and conform to relevant standards.

#### **24.4.Rates**

The Contractor shall particularly note that the accepted rates of the various items shall be inclusive of all incidental charges such as bailing by manual labour, dewatering, shoring etc. if found necessary during the execution and no extra shall be due therefore on any account during the currency of the contract, unless stated other wise.

#### **24.5.Royalty Charges**

The Royalty will be charged for the materials obtained from P.W.Department, or other Government quarries. Assistance as necessary will be given to the Contractor by the Engineer. No plot rent shall be charged for materials stacked on Employer's lands during the course of construction provided all such materials are removed within one month after the work is completed. Royalty or charges due in the case of private quarries and private bodies shall be paid by the Contractor.

#### **24.6.Payment to Labourer**

The Contractor should note that in the event of emergency, he shall pay all Labourers every day and if this is not done, the Employer shall make requisite payment and recover the cost from the Contractor. The Contractor shall not employ any laborer below the age of 15 years.

#### **24.7 . Night Works**

If night work is required to fulfill the agreed rate of progress and to complete the work within the period stipulated, prior written approval is necessary and all arrangement shall be made by the Contractor including lighting without any claim for extra rate.

#### **24.8.Errors, Omissions And Discrepancies**

In the case of errors, omissions, and/or disagreement between the written and the scaled dimensions on the drawings or between the drawings and the specifications, the following order of precedence shall apply;

- i) In case of discrepancies in dimensions of any item of work as described between the descriptive specifications and detailed working drawings, the dimensions given in the detailed working drawings shall apply.
- ii) In case of discrepancies in description of scope of work between what is indicated in the item of work given in Bill of Quantities and the corresponding detailed technical specifications, the latter shall apply.
- iii) Figured dimensions shall supersede scaled dimensions. The drawings on a large scale shall take precedence over those on a smaller scale.
- iv) Drawing issued as construction drawings from time to time shall supersede the corresponding drawings previously issued.

#### **24.9.Equivalence of Standards And Codes**

Whenever reference is made in the contract to the respective standards and codes in accordance with which plant, equipment or materials are to be furnished and work is to be performed or tested the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly set forth in the contract. Where such standards and codes are national in character, or relate to a particular country or region, other authoritative standards which ensure equal or higher quality than the standards and codes specified will be accepted subject to the prior review and written approval by the Engineer. Difference between the standards specified and the proposed authoritative standards must be fully described in writing by the Contractor and submitted to the Engineer well in advance for approval. If on the prior review, the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards set forth in the contract document.

#### **24.10 Bidder To satisfy Himself**

It will be the Contractor's responsibility to satisfy himself from the inspection of the site that sufficient quantities of construction materials required for the works exist in the designated borrow areas and quarry sites.

Failure by the Contractor to have done all the things, which in accordance with this condition he is deemed to have done shall not relieve him of the responsibility for satisfactorily completing the work as required.

#### **24.11 Employment Of Scarcity Labour**

If Government of Tamil Nadu declares a state of scarcity or famine to exist within 16 kms. of the project site, the Contractor shall be required to employ in his works for which he will need unskilled labour and to the extent his works can accommodate any person or persons certified to him by the Engineer to be in need of relief and the Contractor shall pay to such persons wages not below the minimum wage which the Government may fix in this behalf from time to time.

**24.12** All labourers and other employees of the Contractor should be covered by a suitable accident insurance policy to cover liabilities under the Workman's Compensation Act.

#### **24.13 Electricity Tariff**

The unit rates and prices quoted by the Bidder in the Bill of Quantities shall include the cost of electric energy required for construction at the rates fixed by the Tamil Nadu Electricity Board.

### III. GENERAL SPECIFICATION FOR 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.

#### I. 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 12269/1989 with the latest revision thereof for ordinary port land cement and IS 8112/1989 with the latest revision thereof for 43 grade ordinary portland cement. The Sulphate Resisting Portland Cement procured by the contractor shall comply with the requirements of IS 12330 with the latest revision. 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 1.

#### **Corrosion Resistance steel and structural steel .**

1.3. The steel bars shall comply with the requirements set forth in the IS 432 Part 1 / 1982, IS 1786 / 1985 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 bond. Each bundle containing the bars shall bear the ISI Certification marks.

1.4. The Cement/steel shall be tested in nearby laboratories of TWAD Board 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 cooperate 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 testing charges will be paid by TWAD Board and for failed samples, contractors have to borne the charges.**

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 retested 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 of 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.

#### **Bricks:**

##### **a. Manufacture :**

Common burnt clay building bricks shall conform to the requirements of IS 1077 and shall be of quality not less than class 50 with moisture absorption rate not exceeding 15% as defined in IS: 1077. The bricks shall be chamber burnt and shall not be damaged in any manner and sizes shall conform to the works sizes specified with tolerates as given in 6.2 of IS:1077.

##### **b. Samples :**

The Contractor shall deliver samples of each type of brick to the Engineer, and no orders shall be placed without the written approval of the Engineer. All the bricks used in the works shall be of the same standard as the approved samples. The samples shall be preserved on site, and subsequent deliveries shall be checked for uniformity of shape, colour and texture against the samples. If in the opinion of the Engineer any deliveries vary from the standard of the samples, such bricks shall be rejected and removed from the site.

##### **c. Uniformity :**

The bricks selected for exposed pointed brickwork walls shall be of uniform colour, deep cherry red or copper colour and uniform texture. Only such bricks as are permitted by the Engineer shall be used.

##### **d. Testing :**

Samples of the bricks shall be tested in accordance with IS : 3495 by the Contractor for compliance with the aforesaid, before any order is placed, and soon after receipt of a consignment. Tests shall be carried out as and when required by the Engineer on samples selected by the Engineer's representative.

#### **Brick works:**

##### **a. Laying :**

Brickwork shall be uniformly bedded, bricks being laid upwards. Each brick shall be floated and rubbed in upon such sufficient quantity of mortar that the mortar is squeezed up into the joints, but if such joints are not filled with mortar by this process they shall be flushed up with the mortar from the next succeeding bed. The courses shall be laid truly and strictly to line and horizontal level.

**B. Bond :**

Brickwork courses shall be alternately laid in stretcher bond and header bond. Damaged bricks shall not be used. The greatest care shall be taken to prevent mortar dropping on to or in any other way disfiguring or discoloring the bricks, and all edges and sides shall be kept strictly plumb and square, in-line, and flush with the required finished face. As the work proceeds, it shall be continuously checked with a 2 m long straight edge and spirit level.

**c. Construction :**

Walls shall be carried up in a uniform manner and no one portion raised more than 1 m above another at any one time, the open end being racked out. Over-hang work shall in no case be permitted. Brickwork shall be cleaned down after each day's work and newly laid brickwork shall be protected by suitable means.

**d. Dry Weather :**

In dry weather the suction rate of clay bricks shall be adjusted by wetting as necessary before use. Bricks shall be stored in a free draining area and protected from rain.

**e. Lintels :**

Where brickwork rests upon lintels or supporting ribs of concrete, the bricks shall be cut as necessary and carefully bedded so that proper support to the outer leaf of brickwork is obtained.

**f. Pointing :**

At the time of laying, all joint of exposed brickwork shall normally be raked out neatly and pointed to 15mm depth.

**g. Approval :**

All workmanship shall be strictly in accordance with the foregoing. The Engineer or the Engineer's representative reserves the right to reject any of the work on grounds of shabby workmanship. Such rejected work shall be removed and rebuilt to the Engineer's satisfaction.

**Quantity of Mortar :**

Quantity of mortar to be used in one Cum. of masonry shall vary from 0.30 Cum. for thin masonry to 0.32 Cum. for massive masonry of conventional bricks (second class).

**Cement Mortar :**

The cement mortar to be used on the work should be generally conform to specification No.13 of TNBP. Only sufficient mortar shall be mixed as required for immediate use. Partly set mortar shall not be used.

**2.Aggregates:**

2.1 Sand for use in masonry and plaster works shall conform to relevant specification in TNBP (specification No.7) and I.S.2116/ 1985, I.S.1542/ 1992

2.2 The coarse and fine aggregates for concrete shall conform to I.S.383/ 1970 and as specified in the relevant clauses of I.S.456/ 2000 . 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/ 1970. 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 4082/1996 and specification no. 5 of TNBP volume I.

2.4 Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without the special permission of the Engineer.

### **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 conform to the provisions in the class 4.3 of IS 456/ 2000.

### **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 conform to IS 9103/ 1999

### **5. Form Work and Centering**

5.1 Steel/ wooden form centering 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/ 2000 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/ 2000.

### **7. Pipes , Specials and Valves**

#### **7.1 General**

7.1.1 All types of pipes required for the works should be of good quality conforming 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. **The testing charges will be paid by TWAD Board and for failed samples, contractors have to borne the charges.** 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** C.I. pipes shall be procured from the reputed manufacturer and the pipe shall conform to IS 1536/ 2001 or IS 1537/1976. The pipes shall bear ISI mark. The test certificate furnished by the manufacturer should be produced.

## **7.3 D.I.pipes**

- 7.3.1** The DI pipes shall be centrifugally cast (spun) for Water and Sewage and confirming to IS 8329-2000. The pipes used shall be both gasket joints and flanged joints. The minimum class of pipe to be used shall be class K-9 conforming to IS 8329. In general, pipes inside the buildings and below the structures shall be jointed as double-flanged pipes and those outside the building can be either EPDM gasket in accordance with IS 5382 and manufactured by the pipe manufacturer only. The pipes shall be supplied in standard lengths of 5.5m and 6.00m length with suitably rounded chamfered ends. Any change in the stipulated lengths will be approved by the Engineer's representative. The flanged joints shall confirm to the Clause 6.2 of IS 8329. The pipe supply will also include one rubber gasket for each flange.

### **7.3.2 Inspection and Testing:**

The pipes shall be subjected to following tests for acceptance:

- (i) Visual and dimensional check as per clause 13 and 15 of IS 8329.
- (ii) Mechanical tests as per clause 10 of IS 8329.
- (iii) Hydrostatic test as per clause 11 of IS 8329.
- (iv) The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5382 and in accordance to clause 3.8 The sampling shall be as per the provisions of the IS 8329.

### **7.3.3 Markings**

All pipes shall be marked as per clause 18 of IS 8329 and shown as below:

- (i) Manufacturer name / stamp
- (ii) Nominal diameter
- (iii) Class reference
- (iv) A white ring line showing length of insertion at spigot end.

### **7.3.4 Packing and Transport**

The pipes should be preferably transported by road from the factory and stored as per the manufacturer's specifications to protect them from damage.

### **7.3.5 Specials for DI Pipes**

The DI specials shall be manufactured and tested in accordance with IS 9523 or BS 46.926.922. The mechanical test and hydrostatic test shall confirm to clause 9 and clause 10 respectively of IS 9523. The tolerances on dimensions shall be as per IS 9523. The manufacturer of the pipes shall supply the fittings.

- 7.3.6** D I pipes of shall be used in Pumping Main. DI pipes shall be procured from the reputed manufacturer and the pipe shall conform to IS 8329 / 2000. The pipes shall bear ISI mark. The test certificate furnished by the manufacturer should be produced

#### **7.4 UPVC pipes.**

- 7.4.1** The unplasticised PVC rigid pipes shall strictly conform to IS 15328/2003 and as amended from time to time and shall carry ISI marking in every pipe.
- 7.4.2** The contractor should procure the UPVC 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°C, internal hydraulic pressure test, diameter, thickness etc, in TWAD Board laboratory.
- 7.4.6** The PVC pipes 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.

#### **7.5 GI pipes.**

- 7.5.1** GI pipes should be procured by the contractor from reputed manufacturer or from their authorised dealer of reputed manufacturer and should conform to IS 1239/part 1/ 1990, 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.

#### **7.6 CI D/F pipes.**

- 7.6.1** The CI D/F pipes procured for use in the work should conform to the BIS specification No.7181 / 1986 and suitable for use in the work.

#### **7.7 Valves.**

- 7.7.1** The Contractor should procure reputed make of sluice valves, scour, reflux valves and air valves from the manufacturer or his authorised dealer and they should conform to the BIS specification No. 14846 / 2000 PN 1 for Sluice valves and IS 5312 / part I / 1984 for Reflux valve and suitable for use in the work. The valves shall bear ISI marks.

#### **7.8 CI/PVC/GI Specials and Fittings**

- 7.8.1** The Specials and fittings should be in conformity to the relevant BIS specification.

## **7.9 RCC Pipes**

**7.9.1** RCC pipes shall be manufactured with sulfate resistance cement and lined internally with high alumina cement by centrifugal process to resist corrosion and acid formation. RCC Pipes of sizes from 200 mm to 450 mm of NP3 class shall be used for sewer line, with rubber rings as the jointing material. The pipes shall conform to IS:458 in regard to the internal diameter, type, class and 3 edge bearing strength. The pipe laying shall conform to IS 783.

### **7.9.2 Specification for High Alumina Cement Lined RCC Pipes:**

The main purpose of using High Alumina Cement for lining is to protect the pipe against sulfate attacks when it is used in sewer lines. All reinforced concrete pipes shall be of spun concrete and lined with a 12 mm thick High Alumina lining.

The normal proportion of the mix shall be as follows:

- i. High Alumina Cement one part – as per IS:6452.
- ii. Granite dust passing through IS sieve 150 micron – one part
- iii. Fine aggregate passing through IUS sieve 1.18 mm as per IS 383.
- iv. Water cement ratio of the lining mix shall not be more than 0.35 and shall be sufficient to ensure maximum density.

### **7.9.3 Process of manufacture**

The pipes shall be made by spinning process. The centrifugal force generated by spinning action will force the concrete against the mould, removing excess resulting in a dense concrete. The mix for high alumina cement lining shall be mixed in small separation mixer. All the ingredients shall be weighed. As soon as the spinning pipe is completed, the cement mortar shall be fed into the rotating mould uniformly and the pipe shall be spun until the cement mortar is set.

### **7.9.4 Precaution to be taken for high alumina lining**

- i. It is not desirable to mix and do the lining in high constant temperature (temperatures more than 40° c)
- ii. Steam curing should not be used for curing pipes.
- iii. The high alumina lining shall be kept moist and cool for the first 24 hours. The curing of lining shall be started after 3 to 4 hours after operation.
- iv. The water cement ratio of the lining shall not be more than 0.35

### **7.9.5 Socket and Spigot**

The outside of the spigot portion of the pipe shall be coated with epoxy coating and poly solution coating inside the socket portion shall be made before lowering into the trenches.

## **7.10 Unplasticized Poly Vinyl Chloride (UPVC) Pipes**

**7.10.1** The latest versions of Indian standards and codes of practice shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling, and transportation, laying, and jointing of the UPVC pipes. The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS 15328, to which only those additives shall be added that are absolutely needed to facilitate the manufacture of the polymer and the production of sound, durable pipes of good surface finish, mechanical strength and opacity. The

total quantity of additives like plasticizers, stabilizers, lubricants and fillers shall not exceed more than 6.92.0%. The bulk density of UPVC pipes shall be 1.39 to 1.44 g/cm<sup>3</sup>. The PVC resin of suspension grade K-66/K-66.92 shall be used for extrusion of UPVC pipe.

#### **7.10.2 Tests on Material:**

Following in house tests shall be carried out on the raw material:

- (i) Grade (K-value)
- (ii) Particle size distribution
- (iii) Bulk density of resin
- (iv) Bulk density of compound

#### **7.10.3 Test on Pipes:**

The acceptance test shall be conducted in accordance with IS 4985 and in presence of the Engineer's representative—

- (i) Visual and dimensional check
- (ii) Reversion test
- (iii) Vicat softening test
- (iv) Ash Content
- (v) Bulk density
- (vi) Resistance to external blows
- (vii) Internal hydrostatic pressure test for pipes and joints
- (viii) Opacity

#### **7.10.4 Marking on Pipe:**

Each pipe shall be clearly marked as indicated below:

- (i) Manufacturer's name and trade mark
- (ii) Outside diameter (OD) in mm
- (iii) Class of pipe and pressure rating
- (iv) Month and year of manufacturing
- (v) Length of pipe
- (vi) Marking of insert depth of spigot

### **7.11 Stoneware pipes**

- 7.11.1. The stoneware pipes shall strictly conform to IS 651/ 1992 and as amended from time to time.
- 7.11.2. The contractor should procure the stoneware pipes from a reputed manufacturer.
- 7.11.3. The contractor should furnish the test certificate issued by the manufacturer.
- 7.11.4. The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works.
- 7.11.5. In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the stoneware pipes for its quality such as internal hydraulic pressure test, diameter, thickness, crushing strength etc. in TWAD Board laboratory

**Salt glazed stoneware pipes:**

The stoneware pipe to be used shall be of the approved make and shall conform to IS:651-2007. All pipes shall be perfectly straight and truly cylindrical, glazed inside and outside, free from cracks and flaws, and perfectly burnt. Those not conforming to above mentioned requirements shall be rejected. The pipes used in the project shall be of **200mm, 250mm & 300mm.**

**Laying and jointing of stoneware pipe not on concrete**

1.1 Before laying the pipes, the Contractor shall carefully brush them to remove any soil, stones or other materials which may be therein, even and regular bed having been prepared, and joint pit excavated to form a recess under the socket of each pipe of no greater width and depth 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 on the solid ground for a distance of not less than two thirds of its entire length.

1.2 Each pipe shall be brought into a true line from manhole to manhole, for this purpose, a strong twin line (rat thread) sufficiently long to reach the full length between manholes shall be used. Each pipe shall be set correctly to level by means of the boning rod and sight rails.

1.3 The spigot of each pipe shall be carefully wrapped with a ring a spun yam dipped in cement grout or tarred gasket sufficiently thick to properly fit the socket of the adjoining pipe and to allow true alignment. The Pipe shall then be driven fully home into the socket of the adjacent previously laid pipe and yam or tarred gasket carefully driven home with caulking tool.

1.4 The remaining space in the socket shall then be tightly and completely filled with cement mortar composed of one part of Portland cement and one and a half parts sand and shall be neatly beveled off around the circumference and finished at an angle of 45 degree outside the socket of the pipes. A wooden caulking tool shall be used for forcing the mortar into the sockets.

1.5 A tightly fitting bag of shavings or straw having a rope attached shall be drawn through the pipes as the work proceed to ensure that there is no cement or yam or other obstruction projecting into the interior.

1.6 All joints shall be kept moist either by means of wet bags, wet clay or wet earth which ever may be ordered by the engineer to protect them from the sun. Such covering shall be removed when the length is tested for water tightness.

**2. Laying stoneware pipes on Concrete**

2.1 In trench where ordinary socket and spigot stoneware pipes are to be laid on concrete bed, the method to be adopted is as follows,

2.2 When the earth is taken out to the proper depth and gradient, a concrete bed of suitable thickness and width is to be laid as directed by the Engineer. The top of this concrete bed shall also be to the required gradient

2.3 When the concrete has set sufficiently, a series of special concrete invert blocks are to be laid about 60cm apart and leveled so that their top surface may be exactly the level of the sewer invert, less the thickness of the pipes. The correctness of level of the pipes is to be ascertained by working a straight edge from the invert of each pipe to block ahead.

2.4 The pipe must also be checked at intervals for the proper line and level and the first pipe of any length must be very carefully bedded and leveled into position.

2.5 The object to be obtained by the method above described is to ensure that the outside of the sockets shall be raised approximately 25mm above the concrete bed in order to allow the joints to be made properly in the under side.

2.6 In his prices for laying concrete, the Contractor must allow for doing the work in the manner as above described including cost of blocks.

### **3 Junctions on stoneware pipes**

3.1 Where shown on the drawings or where directed by the Engineer Junctions pipes shall be provided at intervals during the construction of sewers, the jointing being effected in a similar manner to the pipe of the sewer in which they are placed.

3.2 These junction arms shall be closed with stoneware or cement disc and the sockets filled with cement mortar. The trench shall not be filled in until the position and orientation of each junction has been measured and recorded by the Engineer.

### **4. Laying of stone ware / RCC pipes on rocky strata:**

4.1. In trenches where the soil is rocky & slushy or at road crossings, socket and spigot stone ware pipes / RCC pipes are to be laid on sand bed & the method to be adopted is as follows:

When the earth is taken out to the proper depth and gradient, bedding of suitable thickness is to be laid as directed by the Engineer. The top of this bedding shall also be to the required gradient and to the required hydraulic level.

In case concrete bedding is necessary in shallow trenches of rocky, slushy or road crossings M15 concrete at the bottom and around the pipe shall be carried out, keeping the hydraulic level as per the approved drawings.

### **4.2. Junctions on stoneware pipes:**

Where shown on the drawings or where directed by the engineer junction pipes shall be provided at intervals during the construction of sewers, the jointing being effected in a similar manner to the pipes of the sewer in which they are placed. These junction arms shall be closed with stoneware or cement discs and the sockets filled with cement mortar. The trench shall not be filled in until the position and orientation of each junction has been measured and recorded by the engineer.

### **7.11 Testing of Pipes**

7.11.6 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. **The testing charges will be paid by TWAD Board and for failed samples, contractors have to borne the charges.**

7.11.7 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.

## **IV . CIVIL WORKS.**

### **1. General.**

- 1.1. Tamil nadu 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 specifications and conditions of contract, the provisions of the later shall be deemed to supercede 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 reconveyed 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 filling and after allowing for settlement will have to be removed, spread and sectioned at places shown on the site during excavation 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 made for this and the unit rate for trench work of excavation and refilling shall include the cost removal of surplus earth to disposal site approved by the Engineer in charge, its spreading and sectioning at the bidder's expense.

#### **2.4. Shoring, Strutting and Baling out water.**

The rate for excavation of trench work shall include charges of shoring, strutting, bailing out water wherever necessary and no extra payment will be made for any of these contingent works. While baling out water, care should be taken to see that the bailed out water is properly channelised to flow away without stagnation or inundating the adjoining road surfaces and properties.

For shoring and strutting, the rate for excavation for the first 2 m depth from G.L. shall include. Shorting and strutting beyond 2m depth from G.L., payment will be made as per respective item in BOQ.

### **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-charge.

#### **3.2. Mixing 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 rehandling and adequate manpower shall therefore 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 entrainment. When the mix is placed in position, no further water shall be added to provide 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 honey combing 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 safety and architectural concept, all at the cost of contractor.

### 3.5. Removal of Form Work.

- 3.5.1. 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 stripping 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 / 1959 and IS 516 / 1959 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 TWAD Board laboratory. The testing charges will be paid by TWAD Board and for failed samples, contractors have to borne the charges.
- 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/Brick work must be done as per TNBP Specification.

## 5. Plastering.

- 5.1. Plastering would be 12mm, 20mm and 25mm thick cement plaster .either plain or waterproof as may be specified.
- 5.2. The plastering items shall be executed in thickness and cement mortar of proportion as detailed in respective items in the BOQ. Similarly the plastering shall be either ordinary or waterproof as specified in respective item in the BOQ.
- 5.3. In case of water proof plaster standard 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. Neat finish wherever directed by the Engineer shall be done at no extra cost.
- 5.6. Curing and watering shall be one as directed and plaster shall be in alignment and level. Any sub standard 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.**

- 6.1. 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 shall be made as directed by the Engineer.

## **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. Plain planked panelled, 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 from the Engineer-in-charge before manufacture. The CW/TW to be used for wood work shall be uniform in substance straight, free from large dead 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 wood work is approved by the Engineer-in-charge.
- 7.6. Any substandard work not conforming to the specifications are liable to be outright rejected and Executive Engineer's decision in such case shall be final and binding on the Contractor.
- 7.7. The mode of measurement shall be on area units as mentioned in BOQ.

## **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.

#### **9. Suction Well (Wet Well):**

Diversion of Surface Flow and Isolating the Site of Work

- 9.1. The contractor himself has to arrange for necessary diversion of surface flow for isolating the site of work for construction of collection well, 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.
- 9.2. 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.
- 9.3. 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.

#### **10. Earthwork Excavation:**

- 10.1. 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.
- 10.2. 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 the plans irrespective of the facts that the contractor excavates the same with more side slopes for his own convenience.
- 10.3. 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.

#### **11. Excavation for Foundation:**

- 11.1. Unless otherwise specified open well excavation shall be resorted to upto water levels as directed by the Engineer.
- 11.2. All precautionary measures for the safety of labourers while excavation shall be made as per the relevant BIS. for safety code for earth work
- 11.3. 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 rates 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.

## **V. SPECIAL SPECIFICATION FOR SEWERAGE WORKS**

### **1. Sight rails and Boning rods**

1.7 The works will be set out by the Contractor. The Contractor shall be required to fix over the centre of each manhole or where a change in direction or gradient occurs a strong timber sight rail, 150mm x 25mm with top edge placed straight and true. These shall be supported and fixed to stout wooden posts at each side of the excavation. The centre line of the sewer shall be marked on each sight rail both back and front by a single vertical line drawn thereon and on other side white. All lengths of sewer shall have three sight rails fixed one at each end and one in the centre and worked one with the other. The boning rods shall have a movable cross head at right angles to the rod. So arranged that it can slide up and down the rod and capable of being fixed at any required position on the rod by screws. The foot of the boning rod shall be provided with the shoe made truly at right angles to the rod so that when placed on the pipe being laid it shall rest properly on the pipe when the rod is truly vertical.

### **2 Laying and jointing of UPVC pipe not on concrete**

2.1 Before laying the pipes, the Contractor shall carefully brush them to remove any soil, stones or other materials which may be therein, even and regular bed having been prepared, and joint pit excavated to form a recess under the socket of each pipe of no greater width and depth 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 on the solid ground for a distance of not less than two thirds of its entire length.

2.2 Each pipe shall be brought into a true line from manhole to manhole, for this purpose, a strong twin line (rat thread) sufficiently long to reach the full length between manholes shall be used. Each pipe shall be set correctly to level by means of the boning rod and sight rails.

2.3 The spigot of each pipe shall be carefully wrapped with a ring a spun yam dipped in cement grout or tarred gasket sufficiently thick to properly fit the socket of the adjoining pipe and to allow true alignment. The Pipe shall then be driven fully home into the socket of the adjacent previously laid pipe and yam or tarred gasket carefully driven home with caulking tool.

2.4 The remaining space in the socket shall then be tightly and completely filled with cement mortar composed of one part of Portland cement and one and a half parts sand and shall be neatly beveled off around the circumference and finished at an angle of 45 degree outside the socket of the pipes. A wooden caulking tool shall be used for forcing the mortar into the sockets.

2.5 A tightly fitting bag of shavings or straw having a rope attached shall be drawn through the pipes as the work proceeds to ensure that there is no cement or yam or other obstruction projecting into the interior.

2.6 All joints shall be kept moist either by means of wet bags, wet clay or wet earth which ever may be ordered by the engineer to protect them from the sun. Such covering shall be removed when the length is tested for water tightness.

### **3. Laying UPVC pipes on Concrete**

3.3 In trench where ordinary socket and spigot UPVC pipes are to be laid on concrete bed, the method to be adopted is as follows,

3.4 When the earth is taken out to the proper depth and gradient, a concrete bed of suitable thickness and width is to be laid as directed by the Engineer. The top of this concrete bed shall also be to the required gradient.

3.5 When the concrete has set sufficiently, a series of special concrete invert blocks are to be laid about 60cm apart and leveled so that their top surface may be exactly the level of the sewer invert, less the thickness of the pipes. The correctness of level of the pipes is to be ascertained by working a straight edge from the invert of each pipe to block ahead.

3.6 The pipe must also be checked at intervals for the proper line and level and the first pipe of any length must be very carefully bedded and leveled into position.

3.7 The object to be obtained by the method above described is to ensure that the outside of the sockets shall be raised approximately 25mm above the concrete bed in order to allow the joints to be made properly in the under side.

3.8 In his prices for laying concrete, the Contractor must allow for doing the work in the manner as above described including cost of blocks.

#### **4. Junctions on stoneware pipes**

Deleted.

### **5. Manholes**

5.1. Manholes shall be constructed on the sewers in the positions shown in the drawings or in such position as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings except where alterations are required by the Engineer. The excavation shall not be larger than sufficient to admit of the trench being properly timbered and to facilitate plastering outside. The bottom of the excavation shall be properly leveled up, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the construction of the brick walls shall then be proceeded with and all stoneware pipe connections through the walls shall be made and all iron work fixed in as constructions proceeds. Manhole less than 2.5m from invert to sewer to ground level shall be built rectangular and shall have a flat top constructed as shown in the drawings, Manholes more than 2.5m from surface to invert shall be built circular as shown in the drawing. The inside of all manholes shall be plastered with cement mortar 1:3 20mm thick and out side of all manholes with cement mortar 1:3 12mm thick. The manholes bottoms shall be properly formed with channels fixed in cement mortar. The channels shall be neatly formed to the radius of the pipe and all side connection curved and channeled to admit the sewage to entire at an angles of 45 degree to the line of flow Manholes shall be topped with a circular cast iron frame with cover or cover of such pattern as may be ordered by the Engineer. The manhole frame shall be fixed to the top of the brick work by a layer of cement mortar.

5.2. Where pipes pass through walls of manholes relieving arches shall be turned neatly over the upper half of the pipes. If any pipe enters at such an angle that a relieving arch cannot be properly turned the bricks shall be carefully cut and laid so as to fit closely and neatly against the pipe, and a RCC lintel shall be provided to avoid load of the walls being transmitted to the pipes.

5.3. The drop pipe connection in manholes shall be secured to the wall of the manholes by suitable clamps and shall be built in as the work proceeds in accordance with the drawings and the above instructions. The cost of this work will be paid separately.

5.4. PVC encapsulated steps shall be built in each manhole as the work proceed one being inserted to every four courses of brick work, horizontal distance centre to centre of each row being 30cm

5.5 The Contractor shall include in his prices for completing all manholes in accordance with the drawings.

## **6 Cleaning out Sewers and Manholes**

During the whole of the work the contractor shall keep interior surface of sewers and manholes free from cement mortar, bricks, soil or other superfluous matter and shall handover the sewers perfectly clean and free from deposit on completion.

## **7. Water Test of Sewers**

7.1 All sewers shall be tested before the filling in of the trench or other excavations. Testing shall also be done after refilling of the trench or other excavation, if considered necessary by the Engineer. The testing or retesting shall be carried out by and at the expenses of the Contractors who shall also provide the necessary appliances and water for the same. The tests will only be made from manhole to manhole after the manholes connected with the length under test have been completely finished.

7.2. The test shall be carried out in the following manner.

7.2.1 The pipes shall be carefully cleared of all earth or materials that may be lying thereon or therein and all joints shall be exposed right round so that through examinations may be made while the pipes are under test.

7.2.2 The ends of the pipe shall be closed by means of expanding stoppers and all junctions with stoneware stoppers or cement disc fixed in cement mortar.

7.2.3. The last but one pipe at the higher end of the length shall be a junction pipe with the junction arm at the top which will permit of the filling of length with water and also allow the escape of all air in the pipes.

7.2.4 The expanding stoppers at each end of the length under test shall have a hold in the centre with a small piece of a pipe screwed therein and threaded on the projecting piece to permit of a flexible tube not less than 2m long fixed there to by a coupling. At the end of the tubing, the following shall be fixed.

- a) at lower end of length, a sock.
- b) at top end of length, a funnel of 15cm diameter.

7.2.5 The top of the runnel shall be fixed rigidly at a height of 30cm above the ground level, or such other height as may be decided by the Engineer.

7.2.6 After the above-mentioned expanding stoppers have been fixed together with flexible tubing and funnel, the length shall then be filled with water through the junction arm of the pipe provided therefore. As soon as the water has risen of the level of the filling junction arm an expanding stopper shall be fixed thereon. After a short time has been allowed for absorption, water shall be poured into the funnel until the same is filled to the top.

7.2.7 If any of joints are leaking or if during a period of ten minutes the water level in the funnel drops 25mm or more (no more water being added or sewer interfered with in any way during the period) the test shall be considered unsatisfactory. If the water does not drop more than 25mm and there is no sign of leakage at any of the joints, the test shall be continued for one hour and at the end of the hour the pipe lines including the joints shall be examined and, if no indication of sweating or leakage is found then the test will be considered satisfactory. Should the test be unsatisfactory, all such joints or pipes found to be defective shall be removed, replaced or re-laid to the satisfaction of the Engineer by the Contractor at his cost.

7.2.8 The test shall be done as many times as may be necessary until the length is found to be watertight to the satisfaction of the Engineer.

7.2.9 The water required for testing shall be clean.

## **8. Providing, Laying and Jointing of Pipes & Fittings:**

### **Scope:**

This specification covers the requirements for providing, laying & jointing of UPVC, RCC, CI, PSC pipes used for the sewerage system as per the relevant IS & National building code.

### **Materials:**

#### **UPVC:**

The UPVC pipe to be used shall be of the approved make and shall conform to IS:15328/2003 non pressure pipes of SN8-SDR 34 (S16.5). Those not conforming to above mentioned requirements shall be rejected.

#### **RCC pipes:**

RCC pipes shall be manufactured with sulphate resistance cement & lined internally with high alumina cement by centrifugal process to resist corrosion and acid formation. RCC pipes of NP3 class shall be used for sewer line, with rubber rings as the jointing material. The pipes shall conform to IS:458 in regard to the internal diameter, type, class and 3 edge bearing strength. The pipe laying shall conform to IS 783.

### **Specification for High Alumina Cement Lined RCC Pipes:**

#### **General:**

The main purpose of using High Alumina Cement for lining is to protect the pipe against sulphate attacks when it is used in sewer lines. All reinforced concrete pipes shall be of spun concrete and lined with a 12mm thick High Alumina lining.

The normal proportion of the mix shall be as follows:

1. High Alumina cement - one part - as per IS : 6452
2. Granite dust passing through IS sieve 150 micron - one part
3. Fine aggregate passing through IS sieve 1.18mm as per IS 383
4. Water cement ratio of the lining mix shall not be more than 0.35 and shall be sufficient to ensure maximum density.

### **Process of Manufacture:**

The pipes shall be made by spinning process. The centrifugal force generated by spinning action will force the concrete against the mould, removing excess resulting in a dense concrete. The mix for High alumina cement lining shall be mixed in small separation mixer. All the ingredients shall be weighed. As soon as the spinning of pipe is completed, the cement mortar shall be fed into the rotating mould uniformly and the pipe shall be spun until the cement mortar is set.

### **Precaution to be taken for high alumina lining:**

1. It is not desirable to mix and do the lining in high constant temperature (temperatures more than 40° c).
2. Steam curing should not be used for curing pipes.
3. The high alumina lining shall be kept moist and cool for the first 24 hours. The curing of lining shall be started after 3 to 4 hours after operation.
4. The water cement ratio of the lining shall not be more than 0.35

### **Socket and Spigot:**

The outside of the spigot portion of the pipe shall be coated with epoxy coating & poly solution coating inside the socket portion shall be made before lowering into the trenches.

### **Cast Iron pipe and fittings:**

Cast iron pipe of LA clause shall conform to IS:1536 and fittings as per IS:1538 and laying shall be as per IS:3114. The test procedure, the scale of sampling and the criteria for acceptance of rubber rings shall be as per IS 5382 and IS 3400 in case of rubber ring joints.

The spigot socket joints shall be with lead joints. The lead jointing is done by first caulking in spun yarn and then filling the remainder of the joint space by running in molten lead, taking care that no extraneous material enters the joint and then thoroughly caulking the lead. The spun yarn shall be used to center the spigot in the socket and to prevent the flow of molten lead in to the bore of the pipe. The CI flanged pipes and specials shall conform to IS 1538. After laying and jointing of CI pipes and fittings the pipe line shall be tested at work site in suitable stretches before back filling excavated earth, as per specifications.

### **Manhole-frames & cover:**

The manhole frames & covers shall be of fibre reinforced concrete with clear opening of 600mm diameter pipe & of extra heavy duty type to withstand heavy load of traffic (i.e IRC class AA load). The manhole frame & cover shall conform to IS.12592 part I of 1982. It shall be inspected before supply by the Engineer in-charge.

### **Manhole steps:**

The footrest or steps for entry into the manhole or flush tank shall be of plastic encapsulated steps instead of Cast iron steps generally used. The plastic encapsulated steps shall be of 3mm thick plastic encapsulated as per IS - 10910 on 12mm dia steel bar as per IS - 1786 having minimum cross section as 23 x 25mm and overall minimum length 263mm and width as 165mm with minimum 112mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring / projection on tail length of 138 mm and suitable to withstand the bend test, twist test, plastic integrity test

and chemical resistance test as per detailed specification. The manhole steps shall be inspected before supply by the Engineer in-charge.

**Carting & Handling of pipes / specials:**

Pipes and fittings / specials shall be transported from the factory to the work sites as directed by owner / engineer. Contractor shall be responsible for the safety of pipes and fittings / specials in transit, loading / unloading. Every care shall be exercised in handling pipes and fittings / specials to avoid damage. While unloading, the pipes and fittings / specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes or by any other approved means. Padding shall be provided between coated pipes, fittings / specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. In case of spigot socket pipes, care should be taken regarding orientation of pipes while unloading. As far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage shall be prohibited.

**Storage of pipes:**

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

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

## **9. TRENCH EXCAVATION**

**General:**

Trench excavation means excavation of trenches into which the pipe is to be laid. The line and levels of trenches shall be as shown on the drawings or as may be directed by the Engineer-in-charge. Before commencing trench excavation, the route of the trenches shall be pegged out accurately and the natural ground levels shall be agreed with the Engineer-in-charge.

**Width of Trench:**

The width of trench measured at the crown of the pipe shall permit adequate working space. The trenches shall be widened at sockets and other structures as may be found necessary. Payment for excavation shall be made on quantity basis as per actual dimensions of trench excavated subject to the condition that the quantity shall be limited as per the trench cross-section necessary to keep the trench in vertical position.

**Depth of Excavation of Trenches:**

The depths for the trenches will be calculated from the surface to the invert of the manholes for the pipes. The trench shall be so dug that the pipe line may be laid to the required

gradient between the adjacent manholes and to the required depth. A minimum cover of 0.8 m is to be taken above the crown level of pipe upto the ground level / road level.

#### **Barricading by Fencing, watering, lighting:**

The parts of the fencing shall be of timber, securely fixed in the ground not more than 2.50 m. apart. They shall not be less than 10cm in dia or not less than 1.25 m above the surface of the ground. There shall be two rails, one near the top of the post and the other about 0.5m above the ground and each shall be of 5 cm to 10cm in diameter and sufficiently long to run from post to post to which they shall be tied with strong ropes. The method of projecting rails beyond the posts and tying together where they meet will not be allowed on any account. All along the edges of the excavated trenches, a bund of earth about 1 m high shall be formed when so required by the Engineer for further projection. The contractor shall also provide a display special board printed with fluorescent prints indicating the progress of work along the road. In the event of the contractor not complying with the provisions of the clause, they will be imposed fine which will be decided by the Engineer. Further, in all such cases, the work may be carried out at the risk and cost of the contractor. The Contractor shall be held responsible for all claims for compensation as a result of accident or injury to persons during the course of execution of the project.

The contractor shall at his own cost provide all notice boards before opening of roads as directed by the Engineer. Arrangements shall be made by the contractor to direct traffic when work is in progress.

#### **Blasting for pipe laying:**

In case of excavation in rock whether by chipping or chiseling in crowded localities or blasting using explosives in other localities, pre measurement of the area to be removed shall be got approved by the engineer in-charge. After the excavation is completed, the rocky material shall be stacked & got measured by the engineer, so that the removed & stacked material shall agree for the purpose of payment.

In case of refilling of the trench, where the pipe are to be laid in rocky strata, the pipe shall be laid true to line & gradient over proper bedding & while the sides & the top of the pipes shall be refilled with borrowed earth from adjoining areas or conveyed earth from other areas. Blasted materials shall not be used for refilling the trenches.

#### **Trench excavation in roads and footpaths:**

All trench excavation and other work carried out within the limits of any road shall be completed as rapidly as possible and not more than half of the width of the carriage way shall be obstructed at one time. Road drains shall be kept free from obstruction. In any event the Contractor shall take special precautions, which shall include the continuous support of the sides of the excavation, from the time when excavation is begun until the refilling of the trench in places, to ensure that there is no disturbance of the adjacent road or road foundation.

Where excavated material has temporarily been deposited on a grass margin or road pavement, the margin or road pavement shall on completion of refilling be restored entirely to its original condition to the satisfaction of the concerned department and left free from loose stones.

### **Trench excavation in fields:**

The term "fields" includes fields, moorlands, grass verges and the like and all private lands, and no length of trench excavation located in fields shall be commenced until suitable temporary fencing has been erected around that length unless the Engineer permits otherwise. Temporary fencing shall not be removed without the Engineer's permission, which will not normally be given until the Trench Excavation has been refilled and reinstated to the original ground condition or as directed by the Engineer.

The contractor shall have particular regard to the safety of livestock in fields or which may be introduced to the fields, and shall ensure that all open excavations, access routes and steep or loose slopes arising from the contractor's operations in these fields are adequately fenced and protected.

After the erection of temporary fencing the Contractor shall remove top soil to such depth and over such area as may be necessary to provide sufficient material to ensure adequate surface reinstatement of the working areas occupied by the contractor for construction of the pipe line.

### **Trench sides:**

Loose boulders shall be removed from the sides of the trenches before allowing workmen into the excavation, and the trench sides shall be stabilized with screening or other methods approved by the Engineer. Trench slopes shall be kept moist where necessary to prevent local sliding as ordered by the Engineer.

### **Timber shoring:**

Shoring & strutting has to be done for the total depth of trench including the top 2m when the depth of the trench exceeds 2m & above in loose soil. Shoring & strutting has to be done for both sides of the trench. However, when the depth is less than 2m shoring need not be done. Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'rolling boards'. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal wallings of strong wood at maximum 1.2 metres spacings and suitably struttled. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical wallings, which in turn shall be suitably struttled. The lowest boards supporting the sides shall be taken into the ground and the portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

The shoring material shall not be of sizes less than those specified below unless steel sheet piling is used or unless otherwise approved by the Engineer in writing:

- |    |               |   |             |
|----|---------------|---|-------------|
| a) | Planks        | - | 4cm x 25cm  |
| b) | Waling pieces | - | 10cm x 20cm |
| c) | Struts        | - | 15cm x 20cm |

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by Engineer. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc., from collapsing.

In the case of open timbering, the entire surface of the sides of trench or pit is not required to be covered. The vertical boards of minimum 25cm x 4cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50cm average width. The detailed

arrangement, sizes of the timber and the spacings shall be subject to the approval of the Engineer. In all other respects, the specification for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations / pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. Load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

#### **Inspection by Engineer:**

When the required levels of trench excavation are reached, the Engineer will inspect the ground exposed and if he considers that any part of the ground is by its nature unsuitable he may direct the Contractor to excavate further and to refill the further excavation with such material as he may direct.

Should the bottom of any trench excavation while acceptable to Engineer at the time of his inspection subsequently become unacceptable due to exposure to weather conditions or due to flooding or have become puddle soft or loose during the progress of the works the contractor shall remove such damaged, softened or loosened material and excavate further.

#### **Disposing material from trench excavations:**

The Contractor shall make his own arrangements for the temporary storage of any excavated material which is required for use in refilling trench excavations, including any necessary double handling. Any excavated material not required for or not suitable for use as refilling shall be removed.

#### **Trenches not to be left open:**

Trench excavations shall be carried out expeditiously and, subject to any specific requirements of the contract, the refilling and surface restoration of trench excavations shall be commenced and completed as soon as reasonably practicable after the pipes have been laid and joined.

#### **Refilling trenches:**

With a view to restrict the length of open trenches, on completion of the pipe laying operations, refilling of trenches shall be started immediately by the contractor. Pipe laying and testing shall follow closely upon the progress of trench excavation and the contractor shall not permit unreasonable excessive lengths of trench excavation to remain open while awaiting testing of the pipe line.

The trench shall be filled with excavated material above the top of pipe, back filling is to be done keeping at least 90 cm length of pipe open at the joints, for verification of joints for water tightness during testing.

Care shall be taken while back filling, not to injure or disturb the pipe. Filling shall be carried out simultaneously on both the sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipelines shall not be permitted unless the trench has been filled to a height of at least 30cms over the top of the pipe except as may be necessary for tamping etc. during back filling work.

Filling-in shall be done in layers not exceeding 150mm in thickness accompanied by adequate watering, ramming etc. so as to get good compaction. The trench shall be refilled so as to build upto the original ground level, keeping due allowance for subsequent settlement likely to take place. Before and during the back filling of the trench, precautions

shall be taken against the floatation of the pipeline due to the entry of large quantities of water into the trench causing an uplift of the empty or the partly filled pipeline.

**Measurement:**

The laying of sewers (RCC / UPVC) shall be measured from inside of the first manhole to the inside of the adjoining manhole. The manhole are measured from the invert of the manhole to the ground level as the depth of manhole.

**10. Laying & jointing of UPVC pipes:**

The laying, jointing & testing of stoneware pipes shall conform to BIS code. Before laying the pipes, the contractor shall carefully brush them to remove any soil, stones, or other materials which may be therein, even and regular bed having been prepared and joint pit excavated to form a recess under the socket of each pipe of greater width and depth 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 on the solid ground for a distance of not less than two thirds of its entire length.

Each pipe shall be brought into a true line from manhole to manhole. For this purpose, a strong twine line (rat thread) sufficiently long to reach the full length between manholes shall be used. Each pipe shall be set correctly to level by means of the boning rod and sight rails. The pipe shall be laid according to the invert levels provided for the sewer line, true to line and gradient. Any variation in levels during execution or any other revision in design, if found necessary shall be carried out by tenderer without any extra cost.

The spigot of each pipe shall be carefully wrapped with cement solvent to properly fit the socket of the adjoining pipe and to allow true alignment. The pipe shall then be driven fully home into the socket of the adjacent previously laid pipe .

**Laying of UPVC/ RCC pipes on rocky strata:**

In trenches where the soil is rocky & slushy or at road crossings, socket and spigot UPVC pipes / RCC pipes are to be laid on sand bed & the method to be adopted is as follows:

When the earth is taken out to the proper depth and gradient, bedding of suitable thickness is to be laid as directed by the Engineer. The top of this bedding shall also be to the required gradient and to the required hydraulic level.

In case concrete bedding is necessary in shallow trenches of rocky, slushy or road crossings M15 concrete at the bottom and around the pipe shall be carried out, keeping the hydraulic level as per the approved drawings.

**Junctions on UPVC pipes:**

Where shown on the drawings or where directed by the engineer junction pipes shall be provided at intervals during the construction of sewers, the jointing being effected in a similar manner to the pipes of the sewer in which they are placed. The trench shall not be filled in until the position and orientation of each junction has been measured and recorded by the engineer.

**Laying & jointing of RCC pipes:**

The laying & jointing of RCC pipes shall be done as per IS 783. The laying of RCC pipes between the manholes is similar to the procedure adopted for laying of stoneware pipes, perfectly true both in alignment and gradient on specified bedding. The pipe shall be laid according to the invert levels provided for the sewer line. Any variation in levels during execution or any other revision in design, if found necessary shall be carried out by tenderer without any extra cost.

After jointing, extraneous materials, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. Rubber sealing rings conforming to IS:5382 are used for jointing the pipes.

#### **Cleaning of pipes:**

As soon as stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by owner/engineer, contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by owner/engineer to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions owner/engineer consider that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory, contractor shall amend the work and carry out such further tests as are required by owner/engineer.

It shall also be ascertained by contractor that each stretch from manhole to manhole or the stretch as directed by engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line suitably enlightened by projected sunlight or otherwise.

#### **Cleaning out sewers and manholes:**

During the whole of the work the contractor shall keep interior surface of sewers and manholes free from cement mortar, bricks, soil or other superfluous matter and shall handover the sewers perfectly clean and free from deposit on completion.

#### **Rubber Ring Joints:**

The RCC pipes shall be of spigot & socket type with rubber ring joints. In the case of rubber ring 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 manufacturers recommendations.

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

The RCC pipes with the rubber ring accurately positioned on the spigot shall be pushed well home in to the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. 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 lever puller.

#### **Rider sewer:**

Rider sewers of 200mm dia UPVC pipes are to be provided on both sides of the road where the road width is more than 30m and house service connections are connected to the rider sewer. The rider sewers are connected to the main sewers at intervals wherever required as per site condition or as directed by the Engineer in-charge. Manholes are also provided in rider sewers at 30m intervals. The procedure for laying & jointing of rider sewers are as per for UPVC pipes for sewer lines.

## 11. Testing of UPVC & RCC pipes:

All sewers shall be tested before the filling in of the trench or other excavations. Testing shall also be done after refilling of the trench or other excavations, if considered necessary by the engineer. The testing or re-testing shall be carried out by and at the expense of the contractors who shall also provide the necessary appliances and water for the same. The tests will only be made from manhole to manhole after the manholes connected with the length under test have been completely finished.

The test shall be carried out in the following manner. The pipes shall be carefully cleared of all earth or materials that may be lying thereon or therein and all joints shall be exposed right round so that through examination may be made whilst the pipes are under test.

The ends of the pipe shall be closed by means of expanding stoppers and all junctions with stoneware stoppers or cement disc fixed in cement mortar.

The last but one pipe at the higher end of the length shall be a junction pipe with the junction arm at the top which will permit of the filling of the length with water and also allow the escape of all air in the pipes.

The expanding stoppers at each end of the length under test shall have a hold in the centre with a small piece of a pipe screwed therein and threaded on the projecting piece to permit of a flexible tube not less than 2m long fixed thereto by a coupling. At the end of the flexible tubing, the following shall be fixed.

- a) at lower end of length, a clock.
- b) at top end of length, a funnel of 15cm diameter.

The top of the funnel shall be fixed rigidly at a height of 30cm above the ground level, or such other height as may be decided by the engineer.

After the above mentioned expanding stoppers have been fixed together with flexible tubing and funnel, the length shall then be filled with water through the junction arm of the pipe provided therefore. As soon as the water has risen to the level of the filling junction arm an expanding stopper shall be fixed thereon. After a short time has been allowed for absorption, water shall be poured into the funnel until the same is filled to the top.

If any of joints are leaking & if during a period of ten minutes the water level in the funnel drops 25mm or more (no more water being added or sewer interfered with in anyway during the period) the test shall be considered unsatisfactory. If the water does not drop more than 25mm and there is no sign of leakage at any of the joints, the test shall be continued for one hour and at the end of the hour the pipe lines including the joints shall be examined and if no indication of sweating or leakage is found then the test will be considered satisfactory. Should the test be unsatisfactory, all such joints or pipes found to be defective shall be removed, replaced or re-laid to the satisfaction of the engineer by the contractor at his cost.

The test shall be done as many time as may be necessary until the length is found to be watertight to the satisfaction of the engineer.

The water required for testing shall be clean. In case of testing of cement concrete sewer pipes of more than 600mm diameter, the permissible quantity of water replenished can be increased by 10% for each additional 100mm dia of pipe.

## **12. SEWER APPURTENANCES:**

### **Manholes:**

Manholes shall be constructed on the sewers in the positions shown in the drawings or in such position as the engineer may direct. The work shall be done strictly in accordance with the detailed drawings except where alterations are required by the engineer. Any variation in locating the manholes and subsequent revision in levels during execution if found necessary, shall be carried out by the tenderer at his cost. The excavation shall not be larger than sufficient to admit the trench being properly timbered and to facilitate plastering outside. The bottom of the excavation shall be properly levelled up, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set all stoneware pipe connections through the walls shall be made and all ironwork fixed in as constructions proceeds. Manholes upto 2.5m from invert of sewer to ground level shall be built rectangular and shall have a flat top constructed as shown in the drawings, manholes more than 2.5m from surface to invert shall be built circular as shown in the drawings. Manholes shall be constructed of Chamber burnt bricks. The inside of all manholes shall be plastered with cement mortar 1:3, 20mm thick and the outside of all manholes with cement mortar 1:3, 12mm thick. The manhole bottoms shall be properly formed with channels fixed in cement mortar. The channels shall be neatly formed to the radius of the pipe and all side connection curved and channeled to admit the sewage to enter at an angle of 45 degree to the line of flow. Manholes shall be topped with a circular FRC frame cover conforming to IS 12592 part 1, heavy duty 600mm dia. The manhole frame shall be fixed to the top of the brickwork by a layer of cement mortar.

Where pipes pass through walls of manholes relieving arches shall be turned neatly over the upper half of the pipes. If any pipe enters at such an angle that a relieving arch cannot be properly turned the bricks shall be carefully cut and laid so as to fit closely and neatly against the pipe and a R.C.C. lintel shall be provided to avoid load of the walls being transmitted to the pipes.

Plastic encapsulated steps shall be built in each manhole as the work proceeds one being inserted to every four courses of brick work, horizontal distance centre to centre of each row being 300mm. The contractor shall include in his prices for completing all manholes in accordance with the drawings.

### **Drop manholes:**

Wherever the drop depth for sewer line exceeds 0.60m drop manholes are provided. Drop manhole shall be constructed on the sewers in the position shown in the drawings or in such position as the engineer may direct. The work shall be done strictly in accordance with the detailed specification / drawings except where alterations are required by the engineer. The UPVC drop pipe connection in manholes shall be secured to the wall of the manholes by suitable clamps and shall be built in as the work proceeds in accordance with the drawings. Any variation in locating the drop manholes and subsequent revision in levels during execution if found necessary, shall be carried out by the tenderer at his cost.

## **13. APPLICABLE CODES:**

The providing, laying & jointing at work sites of stoneware, RCC, CI pipes & fittings shall comply with all currently applicable statutes, standards & codes. In particular, the following standards unless otherwise specified herein shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of this specification conflict with the requirements of the codes and standards this specification shall be covered.

|    |   |      |  |
|----|---|------|--|
| IS | : | 458  | Specification for precast concrete pipe (with & without reinforcement)                             |
| IS | : | 782  | Specification for caulking lead  |
| IS | : | 783  | Code of practice for laying of concrete pipes  |
| IS | : | 784  | Code of practice for pre-stressed concrete pipes   |
| IS | : | 1536 | Specification for centrifugally cast (spun) Iron pressure pipes for water, gas and sewage.         |
| IS | : | 1538 | Specification for cast iron fittings for pressure pipes for water, gas and sewage                  |
| IS | : | 3114 | Code of practice for laying of cast iron pipes.  |
| IS | : | 3597 | Method of tests for concrete pipes   |
| IS | : | 5382 | Specification for rubber sealing rings for gas mains, water mains and sewers.                      |
| IS | : | 6587 | Specification for Spun hemp yarn   |
| IS | : | 8329 | Specification for centrifugally cast (spun) Ductile Iron pressure pipes for water, gas and sewage. |

## VI. PIPE LAYING WORKS

### 1. General

**1.1** The earthwork for the pipe laying work shall generally conform to the invert level given in the drawing

**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.

|                    |                             |
|--------------------|-----------------------------|
| Cast iron Pipes    | .. Clause 6 of IS 3114/1994 |
| Ductile iron Pipes | .. Clause of IS 8329 / 2000 |
| PVC Pipes          | .. Clause of IS 7634/1975   |

In portion of pipeline, 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 of pipes which shall be subjected to such test as the Engineer-in-charge deems fit to 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 15 cm thick layers duly watering and compacting each layer. The refilling may be done up to a height of 20 to 30 cm 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.

**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 bends and appropriate places.

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

## **2. Laying of Cast Iron Pipes / Ductile Iron Pipes**

### **2.1 The laying and jointing of cast 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 recess 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. /D.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. /D.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.

### **2.6 Lead Joints**

NIL

### **2.7 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.

## 2.8 Cement Joints

The cement for the joints shall conform to IS 269/ 1989 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 has undergone initial set shall not be used for jointing.

## 2.9 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 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.

## 2.10 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 lever puller.

### **2.11 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 pipeline 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 metalled road) the walls of the valve chamber shall in such cases be carried up to such height as 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.

### **2.12 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.

### **2.13 Fixing Air Valve**

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

### **2.14 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 works 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 of 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 lumpsum rate quoted in the schedule for interconnections.

### **2.15 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.

### **2.16 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.

### **2.17 Masonry Chambers**

Chambers for sluice valves, 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 not 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 20 mm thick and the outside with cement mortar 12mm thick. The chamber shall be topped with pre-cast R.C.C. Slab 1:2:4 or cast iron surface box or 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 on being inserted to every 4 courses of brick work, horizontal distance center to center 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.

### **2.18 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 be 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 cock 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 neighboring joints are not affected.

If the length of pipe line under test is found to be satisfactory and no leaks or sweatiness 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.

## **2.19 Restoring Road Surface**

The surface of the road or ground shall be finished off to the proper level with cement concrete of 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 cement concrete 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.

## **2.20 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 find a deposit thereof and anything which may have collected within the works during the period of maintenance shall also be removed before the Works are finally accepted by the Employer.

## **3. Laying and Jointing of Asbestos Cement Pressure Pipes**

- NIL -

## **4. Laying and Jointing of UPVC Pipes**

### **a) UPVC Pipes**

The UPVC Non Pressure pipes for sewerage works shall conform to IS 15328/2003

### **b) Laying of UPVC Pipes (as per IS )**

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 1 m measured from the top of the pipes to the surface of the ground. Mains which might be brought under road ways by future widening schemes should be so laid that the eventual cover will not less than 1 m.

### **c) Jointing of UPVC Pipes**

The jointing of UPVC Pipes are done by using Solvent Cement 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 cleared 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 a piece of cloth or rag. The joint should not be disturbed for at least 5 minutes. The pipe should not be subjected to working pressure for 24 hours after jointing.

## **5. Laying and jointing of Ductile iron pipes.**

Deleted

## **6. Laying and Jointing of RCC Pipes**

The laying and jointing of RCC pipes shall be done as per IS 783 -- 1985 and testing will be done as prescribed in the relevant Indian Standards.

## **VII. LIQUID RETAINING STRUCTURES**

### **1. General**

- 1.1 All structures shall be designed as liquid retaining RCC structures with minimum M30 grade concrete minimum cover shall be 45 mm-50 mm. All structures coming in contact with sewage shall be constructed with sulphate resistant cement.
- 1.2 Wet Well shall be executed as per the drawings and specifications and as directed by the Engineer in charge.
- 1.3 The wet well shall be provided with suitable size C.I.D/F. Pipes for inlet and delivery connections and painted with two coats of anti-corrosive paint as per BOQ / Drawing.

### **2. Testing for Water Tightness:**

- 2.1 The testing of the liquid retaining structures and other retaining structures should be done by the contractor at his own cost inclusive of all necessary equipment and water etc., complete. The test for water tightness of the structure as well as materials of construction used shall be conducted in conformity with the standard specification as per IS.
- 2.2 In case of wet well 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.
- 2.3 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.
- 2.4 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 satisfactorily at no extra cost to the Employer.

|      | <b>Steel reinforcement</b>  | <b>Shall comply with the relevant sections of</b>  |
|------|-----------------------------|--|
| i.   | IS: 1784 - 1986             | Specifications for prestressed concrete pipes  |
| ii.  | IS: 1785/1983 (Part I & II) | Specifications for plain hard drawn steel wire for prestressed concrete  |
| iii. | IS: 432 - 1982              | Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement  |
| iv.  | IS: 226 - 1975              | Specification for structural steel   |
| v.   | IS: 1139 - 1966             | Hard rolled mild steel for concrete reinforcement  |
| vi.  | IS: 1566 - 1982             | Specification for hard drawn steel wires   |
| vii. | IS: 456 - 2000              | Code of practice for plain and reinforced cement concrete.   |
|      | Rubber jointing gaskets     | The joint shall be sealed with a continuous ring gasket made of a special composition rubber of such size and cross section as to fill completely the recess provided for it. The gasket shall be the sole element depended upon to make the joint water tight and shall have smooth surfaces free from pits, blisters, porosity and other imperfections. The rubber compound shall contain not less than 5 percent by volume of first grade synthetic rubber. The remainder of the compound shall consist of pulverised fillers free from rubber substitutes, reclaimed rubber and deleterious substances. The compound shall meet the following physical requirements when tested in accordance with appropriate ASTM specifications of BV Class of BS 2494 Part I - 1955. |
|      |                             | <b>TENSILE STRENGTH</b>  |
|      |                             | The tensile strength of the compound shall be atleast 2,700 psi for natural rubber gaskets and 2300 psi for synthetic - rubber gaskets (method of test for tension of vulcanised rubber. ASTM designation D.412).  |
|      |                             | <b>ELONGATION AT RUPTURE</b>   |
|      |                             | The elongation at rupture shall be atleast 400 per cent for natural rubber gaskets and 350 per cent for first grade synthetic rubber gaskets (method of test of tension testing of vulcanised rubber ASTM Designation D.412)   |
|      |                             | <b>SPECIFIC GRAVITY</b>  |
|      |                             | The specific gravity shall be consistent within 0.05 and within the range of 0.95 to   |

|  |  |  |
|--|--|--|
|  |  | 1.45 (methods for chemical analysis of rubber products "ASTM Designation B.297".   |
|  |  | <b>COLD FLOW</b>   |
|  |  | The percentage of cold flow shall not exceed 20. The cold flow determination shall be made in accordance with "Methods of Test for Compression Set of Vulcanised Rubber" . Method – B ( ASTM Designation D.395) with the exception that the disc shall be a 12 mm thick section of the rubber gaskets. |
|  |  | <b>TENSILE STRENGTH AFTER AGING</b>  |
|  |  | The tensile strength of the compound, after being subjected to an accelerated aging test for 96 hours in air at 158°F shall not be less than 80 percent of the tensile strength before aging "Method of Test for accelerated aging of Vulcanised rubber by the Oven Method" ( ASTM Designation D.573)  |

### 3.Designation of pipes and fittings:

3.1 Pipes and fittings will be classified according to their diameter, workinghead and they shall be marked as shown below:

- a. Name of manufacturer
- b. Date of manufacture
- c. Internal diameter of pipe
- d. Test pressure
- e. Permissible working head
- f. Effective length of the pipe
- g. Serial Number.

Recessed markings will not be permitted.

3.2 Whenever practicable, each rubber rings shall be plainly and clearly marked in a suitable position with

- a. Manufacturers name of trade marks
- b. Month and year of manufactured
- c. Class of ring
- d. Number of the British Standard, i.e. BSS 2494 – 1955. In case where marking of the actual rings is not practicable or is likely to be detrimental to their effective use, the rings shall be supplied, fastened together in parcel of suitable size, each bearing a label giving the above particulars.

## **VIII. ELECTRICAL WORKS AND PUMPING MACHINERY**

### **A ELECTRICAL**

#### **1. General**

Following clauses specify General Electrical requirements and standard of workmanship for the equipment and installations. General specification classes shall apply where appropriate except where particularly redefined in the Special Specification Clauses.

#### **2. Standards**

The equipment offered shall comply with the relevant Indian Standards. The equipment conforming to any other approved International Standards which is considered equivalent or superior shall be acceptable. The tenderer however, shall have to substantiate equivalence or superiority.

#### **3. Requirement of Statutory Authorities**

The electrical equipment/installations shall comply with the requirements of Rules/Regulation as amended up-to-date, required by Statutory Acts or Authorities.

- The Indian Electricity Rules, 1956
- The Indian Electricity Act.
- The Indian Electricity (Supply) Act, 1948
- The requirements of Chief Electrical Inspector to the Government of Tamil Nadu.
- The requirement of Tamil Nadu State Electricity Board.
- Fire advisory Committee Insurance Act.
- The contractor shall get the drawings, layouts of HT sub station etc. approved from TNEB and chief Electrical inspector to the Govt. of Tamilnadu, wherever necessary. The contractor also shall arrange to get the installation inspected by CEIG and carryout modifications/ rectification as required by CEIG, prior to commissioning of sub station/electrical equipments.

#### **4. H-Frame Steel Structure**

H-frame galvanized steel self supporting structure shall generally have the following equipments.

- Lightning Arresters
- Gang Operated A.B Switch
- DO Fuses
- String Insulators
- Pin Insulators
- ACSR conductors of appropriate sizes to connect all the equipments

##### **4.1 Lightning Arrester**

Lightning arresters shall be provided on each 11KV line before the termination on the 11KV isolators in the switch yard. Lightning Arresters shall be suitably mounted on H pole structure or 4 pole structure for receiving 11kv supply as per IS 3070 Part I.

##### **4.2 Gang Operated AB Switch**

The Switches shall be provided with horizontal connecting bar, for gang operation, G.I pipe as down rod lever coupling and operating handle with padlock and other components necessary for complete assembly.

### 4.3 11KV Drop-Out Fuses

The 11KV drop-out fit off fuses shall offer protection against short circuit and suitable for use in conjunction with 11KV system having fault level of 500 MVA as per relevant ISS.

A suitable insulated operating rod shall be provided with each fuse assembly. Two pairs of rubber hand gloves for working on 11KV shall be provided.

### 4.4 Insulators

The disc, pin and post type insulators used shall be of high quality glazed porcelain. The electrical and mechanical characteristics shall conform to IS:731 and IS:254. The insulators shall have following characteristics suitable for use in an effectively earthed system.

- System voltage : 11kv
- Dry Wet one- minute power Frequency to withstand voltage : 22 kv
- 1.2/50 micro second impulse withstand voltage : 75KV
- Power frequency puncture withstand test voltage on units : 1.3 times of the dry flash over voltage of the unit.
- Visible discharge voltage : 9 KV
- Total minimum creep age distance for post and disc insulator : 320 mm for post insulation  
320 mm for disc insulation

## 5. HT Sub Station

- 5.1 In general HT sub station shall be out door type. The transformer shall be suitable for out door type and installed on cement concrete platform, having capping level well above the flood level of that area. The size of the platform shall be decided by the contractor, depending on the capacity number of transfer to be installed. In case of indoor sub station, the transformer shall be suitable of indoor type. The transformer HT/MV panel rooms shall be decided to suit requirement. The transformer may erected on the structure also with suitable provision made in the H pole structure . Fencing shall be provided as per relevant IE rules.

## 6. Power Transformers

### 6.1 General

TRANSFORMER SHALL BE 11 KV /0. 433KV

Type: Outdoor in general. In case of indoor, sub station shall be indoor type, mineral oil filled natural cooled ONAN as per standard IS 2026 with of circuit tap changer of + 5 to - 10% in steps of 2.5%. Adequate number of radiator elements made of low carbon sheet steel should be provided for cooling.

Technical Particulars:

- No. of Winding : 2
- No. of Phase : 3
- Winding connection: primary - Delta
- Secondary - Star
- Connection Symbol: DYN 11
- Rated frequency: 50 Hz
- Rated kVA: 400
- Rated primary voltage: 11kV
- Short circuit level: 26.2kA
- Method of system earthing : Solidly earthed
- Rated Secondary voltage: 433 V
- Impedance voltage: 4%
- The temperature rise at reference ambient as per IS: 2026
- Top oil 45oC by thermometer method
- Winding 55oC by resistance method
- Primary and secondary side cable box for cable termination.
- All standard fittings and accessories as per IS
- Acceptable makes CGL, EMCO, Bharat Bijlee, WSON

## 6.2 Insulating Oil

The transformer shall be supplied with insulating oil duly filled. The insulating oil shall conform to IS: 335 10% excess oil shall also be supplied to account for loss.

## 6.3 Transformer Accessories

The transformers shall have the following Accessories

- Off Circuit manual tap changing switch externally operated as specified and positioned on side of transformers accessible from the ground level;
- Conservator with drain plug, filling as specified.
- Explosion vent with diaphragm
- Air-relief vents;
- Inspection cover on the tank covers for all transformers;
- Filtering connections with required valves
- Following valves shall be provided
 

|                    |   |         |
|--------------------|---|---------|
| Oil sampling valve | - | One No  |
| Oil Drain valve    | - | One No  |
| Filtering valves   | - | Two Nos |
- Grounding terminals, two for the transformers tank for clamping to purchaser's grounding grid connection;
- Lifting lugs or eyes for the over top part of tanks, cores and coils, and for the complete transformers

- Pulling eyes, for pulling the transformers parallel to and at right angles to the axis of bushings.
  - Diagram and rating plate for transformers,
  - Rollers
  - Thermometer pockets with dial type thermometers for top oil temperature indication. The thermometer shall be clearly visible from ground level as specified.
  - Weather proof control cabinet
  - Buchholz relay
- Transformer shall be tested as per IS 2026.

## 7. HT /LT Panel Board

### **PANEL BOARD:**

Supply and delivery of floor mounting type weather vermin and dust proof powder coated LT cubical panel board of 14 SWG mild steel sheet and suitable steel angle frames with enclosed energy efficient Aluminium busbar of electrolytic grade E91 PVC sleaved of suitable size for phase and neutral with hinged front door and railway type lock and key arrangements 4 Nos. of required current carrying capacity with all internal wiring as per IE rules and as per IS:8633. The design of panel board should facilitate for quick operation of all switches from the front side, and the panel board should be completed with all internal wiring including necessary twin copper earthing arrangements and consists of the components for controlling incoming and outgoing supply.

### **INCOMING:**

- a) As per drawings , the required capacity of MCCB with insulation voltage of 600 V. 50 KVA breaking capacity with under voltage release and with suitable current transformers,with over load relay.

### **OUTGOING:**

- b) As per drawings , the required capacity of MCCB with insulation voltage of 600 V. 50 KVA breaking capacity with under voltage release and with suitable current transformers,with over load relay.
- c) 144 mm Square type Ampere Digital Ammeter with phase selector switch & side lock fuses,one for the motor and other for capacitor bank in the outgoing feeder.
- d) 144 mm Square type 0-500 V.Digital Volt Meter with phase selector switch & side lock fuses,one for the motor and other for capacitor bank in the outgoing feeder.
- h) 3 phase & wire digital KW Hr meter for direct reading 3 phase CT operated digital energy meter suitable for the motor to monitor the specific energy consumption of each motor with IS mark as per IS :13010/89 and amended from time to time.
- i) 144 mm Square type digital Power Factor Meter.
- j) 5 Nos.RYB & LED ON /OFF indicating lamps with control fuse/switch.
- k) ISuitable Current Transformer for the above metering.

- l) Earth fault relay-1set
- m) Vertical Three Phase Lighting Distribution Board with MCBS

## 8. Air Circuit Breakers

The Air Circuit Breakers shall conform with IEC/Indian standards. The ACBs shall be manually draw out type in open execution with over current trip device adjustable 64% to 110% time setting for overload adjustable current setting for short circuit protection and adjustable current and time setting for earth fault protection.

|                                    |   |
|------------------------------------|---|
| No. of poles                       | - 4 or 3  |
| Rated insulation voltage           | – 1000  |
| Rated short circuit breaking       | - 50 KA – (AC – 415V)   |
| Rated making capacity AC           | – 105KA   |
| Rated short time withstand current | – 50KA  |
| Total making time                  | – 30 millisecond  |
| Total Breaking time                | – 38 ms.  |
| Motorised mechanism                | – 220/240V  |
| Under voltage released AC          | – 150/(66)VA  |
| Opening line delay                 | – 20 – 30 MS  |
| System protection                  | – overload, short circuit, Earthfault   |
| Overload protection                | – adjustable current settings ariation<br>50% to 100%                             |
| Short circuit protection           | – adjustable pickup level   |
| Earth fault protection –           | relay shall have sensitivity of<br>adjustable Between 10% to 30%<br>of ACB rating |

Air circuit Breaker shall be fitted with following

- Heavy duty switch having not less than 4 No. + 4 N C - contacts
- Built in resin cast current Transformer
- Auxiliary contacts
- Shunt and under voltage tripping device
- Neutral CT for earth fault protection
- ACB shall be suitable for locking the breaker in various positions. Provision of door locking with requisite end termination lug and sockets. Terminal bars for connecting more than one terminal.

## 9. Moulded case circuit breakers

The Moulded case circuit Breakers shall have overload, and Short-circuit protective elements. The contact system shall be designed to have minimum wear and also energy loss. Arc extinguishing device shall be provided. The MCCB shall have 'ON'

– ‘OFF’ or ‘Trip’ indicators. The interrupting capacity of the breaker shall be 35KA – 50 KA at 415V. The MCCB shall be tested as per IS 2516.

The container shall be of non-conducting materials and withstand high temperature, and flame retardant.

## **10. Miniature Circuit Breakers**

Miniature circuit breaker working on residual current device having 6000A short circuit breaking capacity and 30 milli amp. sensitivity and 30 millisecond tripping time conforming to IS 12640 trip free mechanism operating for rated leakage at nominal 10 Volts. Earth leakage circuit breaker also may be provided wherever necessary instead of MCB.

### **10.1 Fuse Switch Units.**

The fuse switch unit shall be suitable for 415/430V operation and conform to IS 13947 (Part 3) and IEC 947-3.

The switch shall conform to following Technical specification

|  |                              |
|--|------------------------------|
| Rated operational voltage                        | - 415V                       |
| Rated insulation voltage                         | - 660V                       |
| Rated Thermal current                            | - 125A/160A/250/400A         |
| Number of Poles                                  | - Three (TPN) isolate        |
| Rated operational current                        | - as required                |
| Rated making capacity                            | - 10 times the rated current |
| Rated fuse short circuit making capacity at 415V | - 176 KA                     |
| Rated fuse short circuit withstand capacity      | - 80 KA                      |

### **10.2 Indicating Instruments**

All electrical indicating instruments shall be digital square type of size suitable to the panel. These shall be suitable for flush mounting with only flanges projecting on vertical panel. Instrument dial shall be white with black numerical lettering.

Instrument shall conform to IS 1248 and shall have accuracy class 1.00 or better. The current coil and potential coil of Ammeters and Voltmeters respectively, shall withstand 120% of rated current and voltage, without loss of accuracy.

The meters shall have external zero adjustments. The ammeters fitted in the motor circuits shall have suppressed scale to indicate the maximum starting current. The instrument shall be provided with glass cover to avoid the possibility of measurements due to static charge.

The three phase three wire trivector meter shall comprise of KWH meter and KVAH meter mounted together with KVAH meter in one case with special summator mounted between them to register correct KVAH at all power factors.

All the factors shall have respective maximum demand indicators to record the average power over a period of half an hour. The trivector meter shall conform to relevant IS.

### **10.3 Under Voltage Relays**

The induction disc type, single pole under voltage relay shall have inverse time voltage characteristics on all taps. The relay shall be designed to develop maximum torque at supply frequency and shall be insensitive to the voltage at harmonic frequencies.

The operating time shall be adjustable by time setting multiplier. Selection of the required voltage setting shall be possible by means of a plug setting bridge having an insulated plug. The relay shall conform to IS-3231.

## **11. Protective Relays**

Relays shall be rectangular in shape, flush mounting type, having dust tight covers, removable from front, and shall be equipped with externally reset, positive action operations indicators. The relay shall have auxiliary units of either series connected or shunt connected type. All auxiliary relays shall be non-draw out type and protection relays shall be draught type with test facilities.

Test plug shall be supplied loose. All relays shall conform to the requirements of IS - 323 or relevant IEC in general and IS - 3231 in specific.

Relays shall be provided with adequate number of potential free self reset/hand reset output contacts as required. Provision shall be made for easy isolation of trip circuits of each relays for the purpose of testing and maintenance. Current transformer short circuiting arrangement shall be provided in case of draught type relays.

Voltage relays shall have sufficient thermal capacity for continuous energisation using external resistance, if necessary.

No control relay, which will trip a circuit breaker when relay is de-energized, shall be used.

## **12. CABLES**

### **12.1 1100V/660V Grade cables shall be PVC insulated, PVC sheathed, G1 strip armoured, Aluminum conductor.**

The control cables and cables for lighting system shall be with PVC insulated, multi stranded copper conductors. Cables in general shall conform to IS 694, IS 1554 part I & II, and cross section 25,16, 10, 6, 4, 2.5 and 1.5 sq.mm

### **12.2 Laying of cables**

- Cables shall be laid directly buried on earth, in conduits along walls, ceiling etc. The cable installation shall conform relevant ISS.
- Cable inside the Sub-station/Building shall be laid in the prepared trench. If any hole or breaking of wall is required for cable laying work, it shall be done by the contractor and the wall shall be closed after completion of the work as original.

- The cable trench dimensions inside the Sub-station and the route shall be indicated to the civil contractor well in advance while Sub-station civil work is in progress, depending upon the cable entry, and location of different equipments, transformers, panels, etc.
- Laying of underground cables outside the building shall be done by excavating a trench covered by brick and sand of 0.75 metre depth for HT and LT cable and protecting each run of cable by sand and earth filling.
- The HT and LT cables shall be taken through the cable duct provided on the ground floor roof as shown in the sketch, by properly clamping.
- Fixing of cable on the wall by clamping the cable, using suitable GI clamps with wooden saddles. The distance between two clamps shall not be more than 750mm. The cables shall also be taken through PVC pipes on the wall. The cable route on the walls shall be decided with the Engineer in site. The cables shall be covered with GI plates, trays or wooden covering. Sharp bending, twisting and Kinking of cables shall be avoided. Suitable cable duct shall be provided in the wall connecting all switch rooms of Railways and Commercial Complex.

### **13. Distribution Boards**

All the switch Boards, Panels shall be neatly wired using 1100/660V PVC insulated stranded copper cable of minimum 2.5 sq.mm. Copper Bus Bars also may be provided to suit the requirements.

Each wire shall be identified at both ends with cable marker.

Distribution Boards shall be housed in metal clad case or board conforming IS 4237.

The Sub-distribution Boards shall be equipped with rigidly fixed miniature circuit breaker complying IS8828 in the phase leads with over load and short circuit protection. The MCBs shall have adequately sized terminals for the outgoing leads. The distribution boards shall have adequately rated phase and neutral bus bars of high conductivity copper. Earth bus bar with the necessary number of terminals for connecting the earth continuity conductors.

Each SDB shall have circuit schedule pasted or permanently fixed inside the cover stating the details of circuit controller and rating of MCB. Non-flammable insulating shields shall be provided to prevent fire hazards during operation of MCBs.

The Sub-Distribution Boards shall not be mounted at a height exceeding 180CM from ground level.

Main Distribution Boards shall be surface mounted. Main Distribution Boards shall be erected in each switching room, and sub-distribution boards shall be located according to the distribution of load and the equipments to be connected and its location.

### **14. Lighting System**

#### **14.1 Point Wiring**

Point wiring shall include all work necessary to complete wiring from switch circuit of any length from the tapping point on the distribution circuit switchboard to the following:

- Ceiling rose for fans, lighting etc.
- Socket outlet (in the case of socket outlet points)
- Lamp holder (in the case of wall brackets, batten points, bulk head and similar fittings).
- Call bell buzzer (in the case of the works "via the ceiling rose/socket outlet or bell push where no ceiling rose/socket outlet is provided").
- 

#### 14.2 Circuit wiring

Circuit wiring shall mean the length of wiring from the distribution board upto the tapping point of the nearest first points of that circuit, viz., upto the nearest first switchboard measured along the run of wiring. Such wiring shall be measured on linear basis.

#### 15. Electric Motor

Type : Squirrel case induction motor suitable for continuous duty.  
 Standards : Performance – IS 12615/ IS 325, IEC 34  
 Dimensions - IS 1231, IEC 71  
 Site condition : Ref. Ambient -45°C  
 Max humidity - 100%

Cast iron body with integral feet and frame. The stator core shall be that of high grade carlita insulated low loss silicon steel lamination stacked together and fully tightened. The rotor shaft made of high grade forged/rolled steel. A spacious terminal box to be provided to accommodate aluminum conductor cables.

Technical Particulars : Rated voltage: 415V $\pm$  10%  
 Frequency: 50Hz $\pm$  3%  
 Temperature rise of 75°C over ambient of 45°C  
 Enclosure: IP 55  
 Type of cooling: Totally enclosed fan cooled  
 Acceptable makes : Siemens, NGEF, CGL, KEC, ABB, BB

#### 15.1 Auto transformer starter

Automatic auto transformer starter shall be assembled in 14 SWG sheet steel, floor mounted with following accessories

- Oil immersed auto transformer with 50%, 65% and 80% tapping including first filled oil.
- Bimetallic overload relay
- Timer on delay and off delay.
- Ammeter with CTS and selector switch.
- Voltage with selector switch.
- No voltage release
- Indicating lamp, Power On, Trip  
 (Single phasing current sensing preventor with protection CTS)
- Thermo stat for oil temperature.(Optional)

#### 16. Earthing

- Earthing in general shall comply with C.P.(Code of Practice) 3043 of Indian Standards.

- Earth electrode either in the form of pipe electrode or plate electrode should be provided at all premises for providing earthing system.
- As far as possible, all earth connection shall be visible for inspection and shall be carefully made.
- Except for equipment provided with double installation all the non-circuit carrying metal parts of electrical installation are to be earthed properly. All metal conduit trunking cases. Sheets, switch gears, distribution fuse boards, lighting fittings and all other parts made of metal shall be connected to an effective earth electrode.
- The main earth electrode should be a G.I perforated pipe driven into the soil as per standard practice. continuous looped earthing should be provided with adequate size G.I. wire /feet. Earthing work should conform to I.E. Rules.
- The electrodes shall be situated at a distance not less than 3.0 m from the building fencing structure and equipment foundations. The earth pit shall conform to IS: 3043 and GI earth electrodes of not less than 100 mm external dia shall be driven to a depth of at least 3 m in the ground below the ground level. The surrounding the electrodes, soil shall be treated up with salt, coke and charcoal.
- Earth electrodes shall be installed near the main supply point and shall comprise a copper/GI earth of appropriate diameter and driven to depth of 3 metres below ground level, or to a greater depth, if so required to obtain a sufficiently low earth resistance value. Alternatively copper plate may be used as the main earth electrode conforming to IS: 3043. The electrodes shall be driven at least 3 m away from the building or any other earth station.

Minimum requirement of earth pits as per I.E. rules are as under:

- Two numbers independent for transformer body
- Two numbers independent for transformer neutral
- Two numbers independent for four pole structure
- One number for lightning arrestors.
- Two numbers of L.T. panel at sub-station and at pump house.

the main earth electrodes after being driven into the ground shall be protected at the top by constructing a concrete or block masonry chamber of size 300 mm x 300 mm x height 300 mm. and shall be provided with CI cover. The resistance of any point in the earth continuity system of the installation to the main earth electrode shall not exceed 1.0 ohm. The remaining space in the borehole shall be filled with bentonite. The bentonite will hold the earth rod in position. The neutral conductor shall be insulated throughout and shall not be connected at any point to the consumers earthing system.

- An earth continuity conductors shall run continuously from the farthest part of installation to the main earth electrode and shall be connected by branch conductor to all metal casing and sheathing housing electrical apparatus and/or wires and cables. all branch shall be connected to earthing. The earth continuity

conductors shall have a cross-sectional area at least half to the size of the phase conductor and in no case less than 1.5 sq.mm of copper/GS.

- All earth wires and earth continuity conductor shall be galvanized M.S flats of appropriate size. Interconnections of earth continuity main conductors and branch wires shall be brazed properly, ensuring reliable, Permanent and good electrical connections. The earth lead run on structures must be securely bolted. Neutral earth leads shall be run on separate supports without touching the body of the transformers. Earth wires shall be protected against mechanical damage and possibility of corrosion particularly at the junction points of earth electrodes and earth wire interconnections. Earth electrodes shall be connected to the earth conductors using proper clamps and bolt links.
- It shall not be allowed to use the armour of the incoming feeders cable to the sub-distribution board as the only earthing system.
- Sheathed lugs of ample capacities and size shall be used for all underground conductors for sizes above 3 mm<sup>2</sup> whenever they are to be fitted on equipment of flat copper conductor.
- The lugs shall be fitted on equipment body to be grounded or flat copper only after the portion on which it is to be fixed is scrubbed, cleaned of paint or any oily substance on a subsequently tinned.
- No strands shall be allowed to be cut in case of stranded ground round conductors. G.I embedded conduits shall be made eclectically continues means of good continuity fixing and also be rounding copper wires and approved copper clamps.

#### 16.1 Earthing of Lighting Poles

All external poles are to be looped together with continuous 8 SWG GI earth wire clamped at dollies provided on every fuse box of poles and looped onwards to the other pole. Every fifth pole shall be connected to earth through an earth electrode.

#### 16.2 Earthing for Lighting Installation

This shall be common grid system, the main grounding conductor laid and embedded in concrete being grounded at earth pits outside the buildings at approved locations or other places. The earthing of L.T. panels shall be connected to two main grounding conductors each of which along with main cables shall run with cables to distribution boards in which floor. This shall run along with th4 cable and at the top floor be connected same section completing the grid.

#### 16.3 Sizes of Earthing Conductors

| SL. No | System   | Earthing conductor size and Material    |              |
|--------|--|---|--------------|
|        |  | Buried in ground/ Above ground concrete |              |
| -      | Main earthing grid                             | 40 X 10 mm MS                           | -----        |
|        | 11 kV outdoor sub-station and 11 kV switchgear | 40 X 10 mm MS                           | 50 X 6 mm GS |

- 415 V switchgear, suitable to its rating. Suitable to its rating.  
transformer, DG set,  
Capacitor Control Panel
- Battery charger - 25 X 3 mm GS
- 415 VLT Motors

- Valve motors 10 SWG GS wire
- 0 - 15 HP 8 SWG GS wire
- 15 - 40 HP 4 SWG GS wire
- 40 - 50HP 25 X3 mm GS flat
- 50 HP and above 25 X6 mm GS flat
- Lighting distribution Board,  
30 V DC Tripping Unit. 25 X 3 mm GS flat
- Local Push Button stations,  
Junction Boxes. 14 SWG GS wire
- Lighting and receptacle system 12 SWG GS wire
- earth Electrode 50 mm dia. 3000 mm long heavy duty  
GI Pipe electrode
- Street lighting Poles 8 SWG GS wire

- Notes:
1. Conductors above ground shall be galvanized steel to prevent atmospheric corrosion.
  2. Conductors buried in ground or embedded in concrete shall be mild steel.
  3. Drawings; The typical earthing details are shown on drawing.

#### 16.4 Battery, Battery Charger & DC Distribution Board

- The charger and DC distribution board shall be enclosed on a common sheet steel enclosure with necessary compartment for each incoming and outgoing feeder.
- Complete information regarding battery layout, space requirement for locating battery, wall painting of battery room floor, ventilation, method of lighting etc. shall be supplied by the Contractor. The battery room shall preferably be located inside MCC room as shown,. The battery room shall have acid proof tiles as flooring and upto 4 ft. level. Also there shall be an exhaust fan of appropriate capacity to extract vapours from the room.

**16.5 Tests**

- Batteries and battery chargers shall be routine tested before despatch, in accordance with Indian Standards. Capacity test shall be carried out on the batteries at site after installation.

**17. Street Light**

Street Light fixtures shall be complete with integral semi-cut off lantern with glass cover complete with internal wiring, control gear, mounting accessories, street light bracket for HPSV 150W made from 60mm dia (B Class G I Pipe) 2 m in length and welded to the pole cap of size 100mm and 30 cm long duly welded.

**18. Street Light Poles**

The street light mast shall be 65mm/75mm diameter G.I pipe of 7.5 meter long with 300mm x 300mm x 6mm of M.S base plate, duly welded at the bottom. A suitable MS box to have 5A control switch, 16A fuse unit with suitable frame work shall be fitted in the street light mast with door and locking arrangements.

A terminal box with fuse shall be fixed in all the poles.

**19. Capacitor**

To improve the power factor capacitor shall be provided in the LT bus bar in the sub station.

- The capacitor shall be as per ISS 2834 and IS 2544.
- The capacitor shall be all polypropylene film capacitors. The film shall be oriented bi-axially.
- The oil used for impregnation under vacuum shall highly purified non- toxic.
- Low loss discharge resistance, to reduce the residual voltage to 50V or less within one minute after the capacitor is disconnected.
- The capacitor container shall be painted with epoxy-based paint, to prevent corrosion/rusting.
- 4 stage switching ON/OFF shall be provided to match with the load.
- Automatic Power Factor Correction Unit shall be provided .

**20. Safety**

The following minimum safety equipments shall be supplied and installed in the Sub-Station switch rooms and Diesel Generating rooms.

- Portable chemical fire extinguishers conforming to IS 935 or its latest version shall be supplied and installed at the Sub-Station, Switch rooms and Diesel Generating Stations.
- Fire buckets with M.S. angle stand each consisting of 4 Nos. round bottom fire buckets painted with red and marked fire and filled with clear dry river sand shall be supplied and installed at a convenient locations at the proposed Sub-Station.

- First-Aid boxes equipped fully with required materials, shall be supplied and kept at a convenient place in the Switchgear room so that the same is easily accessible.
- Shock Treatment chart.
- Rubber matting of not less than 25 mm. thick and 600 mm width and standard lengths, shall be provided in from of all the switch gear panel, Transformer, Control cubicles, etc.
- Rubber gloves tested for 15 KV about 4 sets shall be supplied.

## **21. . Diesel Generating Equipment**

Supply delivery erection Testing and commissioning of Silent Outdoor Generator set of following capacities with complete enclosure with lock and key arrangement mounted on suitable concrete pedestal as per standard specification and model with suitable Diesel Engine, water cooled, developing required BHP, electrical starting arrangements, coupled with alternator of capacity maximum 125 KVA with silent proof eco friendly Genset of reputed make 3 phase 400V 1500rpm with AMF Panel, base frame, fuel tank, radiator, battery with lead with other std accessories with powder coated canopy designed like box structure and acoustic enclosure silencer mounted inside/out side canopy lockable doors ,fuel filling arrangements externally accessible emergency stop button and temperature raise inside canopy maintained with 5 to 7 degree etc., complete with central pollution control board approved type with ISI marking and third party inspection certificate etc., complete including erection and commissioning complete with cables conforming to TNPCB Norms. DG SET AMF PANEL Specifications: The control cubical shall be of fabricated construction made of best quality sheet metal and is of the free standing/floor mounting type.It shall be provided with removable side panels and s hinged front panel for easy accessibility.Suitable provisions for connecting incoming and outgoing loads are made on the control panel.The standard instruments to be incorporated in the AMF Panel are as follows

1. AC Voltmeter - 1 No.
2. Voltmeter selector switch- 1 No.
3. AC ammeter suitably scaled with Selector Switch.
4. Battery charging set cinsisting of.- 1 No.
- a) Transformer/Rectifier
- b) DC Ammeter-
- c) Charging rate selector switch OFF/TRICKLE/OFF BOOST
- d) DC VOLTMETER
5. Main supply contactor (3pole)-1 No.
6. Current Transformers- 3 Nos
7. Low voltage high rupturingcapacity fuses for shortcircuitprotection of the main supply-1 set
8. Alternator Contactor-1 No.
9. Pole bimetal release for overload protection of alternator.-1 No.

10. Main voltage monitor - 1 No.
11. Set of DC control relays incorporating engine ,start,stop,three attempts starting facility and failure to start ,lockout.-1 No
12. Selector switch. AUTO / MANUAL. - 1 No
13. Push Button " Start".- 1 No.
14. Push Button "Test"- 1 No.
15. Push Button " Stop". - 1 No.
16. Signal Lamp for indicating " LOAD ON SET "- 1 No.
17. Signal Lamp for indicating " LOAD ON MAINS "- 1 No.
18. Signal lamp for indicating "SET FAILS TO START"
19. 4 pole Double brake fuse switches with mechanical interlock. - 2 Nos

**21.1****General**

- Electrical power supply for each pumping station will be availed from nearby TNEB supply point. According to the load requirement HT at 11KV/22KV or LT at 415V - 3 Phase will be availed from TNEB.
- One Diesel driven alternator set of capacity as specified shall be provided to permit operation of the Pumping Station in the event of failure of the TNEB electricity supply, complete with all equipments like. The equipment shall conform to the latest relevant ISS or BS.
- Control gear, circuit breakers, cabling, synchronising equipment etc.
- The engine alternator sets shall be designed such that the starting power peak shall not exceed 10 per cent of the continuous engine rating and the voltage dip shall not exceed 15 per cent whilst starting the connected load under the worst conditions.
- The Contract Drawings show the building, floors and other details as they will be constructed and the space allocated for the generating plant, control gear and circuit breakers. If any departures from the proposed layout are necessary the Contractor shall show the modifications on the drawings submitted with his Tender, and shall can attention to these suggested alterations.
- Tenderers attention is specifically drawn to the operating conditions where by generator sets could be running at little or no load due to the intermittent and differing flow rates and pump capacities.
- A system using dummy loads to maintain a safe minimum working level is envisaged and the Tenderer is required to comment upon this or any other proposed system at the time of Tender submission together with supporting documentation and calculations.

**22. Statutory Approval**

The Contractor shall be totally responsible for obtaining statutory approval from the electrical inspector or any other statutory authority for the entire installation carried out by him unless otherwise specified and agreed. Necessary test reports shall be submitted by him to electrical inspector. This will be an integral part of the contract and shall not be paid for separately. However fees payable to statutory authorities shall be borne by the tenderer.

**23. Acceptance of Installation**

On completion of the work the Engineer, together with the Contractor, will carry out an inspecting of the installing. The Engineer will issue a completed copy of the Purchaser's Acceptance of Electrical Installation to the Contractor as confirmation that the work has been accepted, subject to any matters noted on the form being attended to.

## IX. PUMP SETS AND ACCESSORIES

### 1 General

- 1.1 All the Materials used shall confirm 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.
- 1.2 The rates should include all the minor items of civil works, if any required for installation complete.
- 1.3 All necessary civil works for erection of all equipments and accessories offered by the contractor under this contract should be done by the contractor
- 1.4 Test certificates for machinery and equipments should produced along with supply
- 1.5 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 authorized dealer. In the event of non compliance the offer shall be summarily rejected.
- 1.6 The contractor shall make necessary arrangements to get supply of electricity from TNEB for operating the machinery and equipment. Necessary payment to be made to the EB shall be borne by the employer
- 1.7 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.
- 1.8 Obtaining approval of electrical layout diagram for the installation of all the equipments (transformers, generators, pumpsets and other accessories) and obtaining safety certificates 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.
- 1.9 All the materials should be supplied as per BOQ and should be of standard makes mentioned below:-

**Table 2:**

| SI No | Description                     | Make   |
|-------|---------------------------------|--|
| 1     | Submersible non clog Pump       | Kirloskar/ ABS / KSB/ AQUA/ Grundfos or equivalent                     |
| 2     | Make of Motor                   | Jyothi/ NGEF/ GEC/ Crompton/ AQUA & Greeves/ Siemens or equivalent     |
| 3     | Make of Transormer              | Kirloskar/ GEC/ Indo TECH/ Hidustan / IPL or equivalent                |
| 4     | Diesel Generator                | Kirloskar/GEC / Leland / Cummins or equivalent                         |
| 5     | Starter                         | Built by any CPRI approved panel builder or equivalent                 |
| 6     | Switch Fuse and circuit breaker | L&T/ Cutler Hammer/ Siemens/ Schnider or equivalent                    |
| 7     | Cables                          | Finolex/ Unista/ Uniflex/ Polycab or equivalent ISI branded equivalent |
| 8     | Valves                          | Venus/ Upadyaya/ CALSONS/ Durga or equivalent                          |

- 1.10 The right of choosing the make among the makes offered by the contractors rest with the employer only
- 1.11 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.
- 1.12 If the complete plant or any portion thereof is found to be defective 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. Submersible Sewage pump

### 1. Non clog submersible pump set

#### General

The submersible sewage pump shall be mono-block type of non-clog design. It shall be suitable for pumping raw unscreened sewage containing sludge, long fibers, plastic pieces, cigarette butts, etc. The pump shall be able to pass through soft solids of minimum 100 mm dia and capable of dealing with sewage / sludge with specific gravity of 1.05. **Pumps shall be of 960 rpm for high duty pump and 960/1450 rpm for low duty pumpsets.**

Impellers shall be of single / double vane non-clog design. Additionally, a special contra-block cutting and tearing system should also be incorporated on the suction side of the pump for disposing off soft material which would otherwise clog the pump.

Maintenance free antifriction, permanently grease filled ball bearing shall be provided and this shall take care of all the axial and radial forces at any point of operation. The weights of the revolving parts of the pumps including the unbalanced hydraulic thrusts of the impellers shall be carried by thrust bearings provided in each pump assembly.

The pump installation design shall be such as to facilitates automatic installation and removal of the pump without having to enter into the sewage pit. Profile gasket shall be provided in automatic coupling system so to avoid metal to metal contact between the pump and delivery bend to ensure leak-proof joint.

### 2. Pump Constuction

#### 2.a. Pump Casing

Pump casing should be of CI as per IS 210 Gr FG 260 . The internal surfaces shall be free of rough spots. The casing shall have centre line discharge.

The high capacity pumps at New Pumphouse shall work in parallel two at a time to discharge peak flow. Third pump will be stand by.

#### 2.b. Impellers

Impellers should be of CI as per IS 210 Gr FG 260. Impeller shall be of single/double vane non clog design.

### 2.c. Pump Shaft

The pump shaft should be of stainless steel (SS-410). The shaft shall be of one piece construction.

### 2.d. Pump bearing:

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. **Pump bearings shall be designed with a minimum life of 1,00,000 hours.** The bearings shall be grease lubricated for life and shall be maintenance free.

### 2.e. Mechanical seals:

Double mechanical seal shall be provided to prevent pumped liquid entering into the motor winding. The seal shall be situated in oil chamber to ensure proper lubrication. The face combination of lower mechanical seal shall be Silicon carbide Vs Silicon carbide and upper mechanical seal shall be Carbon Vs Chrome steel.

### 2.f. Moisture sensor:

Moisture sensor (seal monitor) shall be provided in the oil chamber to detect the failure of the mechanical seal.

The sensor will drip the pump motor in the event of increase of moisture into the oil chamber.

## 3. Lifting chain:

Each pump shall be provided with **Stainless steel lifting chain** of adequate strength. The chain shall have rings of same sizes as chain, fixed at an interval of about 1 M for engaging the hook of the chain pulley block.

## 4. Foundation Nuts and Bolts:

D.D. Foundation shall be provided

## 5. Protective coating:

The pump shall be epoxy painted.

## 6. Pump balance:

All rotating parts shall be statically and dynamically balanced as per the relevant standards.

Electrical specifications:

## 7. Submersible motor:

The submersible motor shall be dry squirrel cage type, suitable for three phase supply, continuous duty, with **class H insulation**. Winding of the motor shall be impregnated by resin. Motor shall have integral cable entry port and cable entry shall be properly sealed.

The pump motor may often requires starting after intermittent clogging. The motor should therefore incorporate aluminium die cast rotors only to ensure better starting torque characteristics.

The enclosure for motor shall be IP 68 as per IS 4691. Each phase of the motors shall be provided with thermic switches or bimetallic electromechanical temperature detectors. The motor shall operate satisfactorily at all operating levels in wet well.

Motor shall be sealed against entry of liquid being pumped by using two mechanical seals.

#### **8. Motor:**

##### **Type 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 IS.

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 the flood conditions in the river.

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

#### **9. Spare parts**

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

|   |        |
|---|--------|
| D/E spanners 6 to 32                        | 1 set  |
| Ring spanners 6 to 32                       | 1 set  |
| Bearing puller                              | 1 No   |
| Grease gun                                  | 1 No   |
| Hand gloves tested for electrical operation | 1 Pair |
| 800gm Ball peen hammer                      | 1 No   |
| Screw Drivers                               | 1 set  |
| Digital Tong tester                         | 1 No   |
| Digital Multimeter                          | 1 No   |
| 150 mm Chain wrench                         | 1 No   |
| 200 mm Chain wrench                         | 1 No   |
| Connector screw driver                      | 1 No.  |
| 200 mm cutting plier                        | 1 No.  |
| 300 mm Screw spanner                        | 1 No.  |
| 300 mm hacksaw blade                        | 1 No.  |
| 24' pipe wrench                             | 2 Nos. |
| 12' flat rough site                         | 1 No.  |

#### **10. 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. Five 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.

#### **11. 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.

- 8 The contractor should supply one set of tools for the pumpset maintenance of the machinery and equipments supplied by them under this contract.

## **12 General**

- 12.1 Cable lengths given are only approximate and payment will be made for the actual lengths of cable laid.
- 12.2 The contractor has to make necessary arrangements to get supply of electricity from TNEB for operating the machinery and equipments. The necessary service connection and S-D charges will be paid by the Board.
- 12.3 The Contractor should obtain all approvals for the installation and commissioning of machineries and accessories offered by them from the respective inspecting authorities such as CEIG or CIFG etc. Fees if any, to be paid to the inspecting authorities will be reimbursed by the Board.
- 12.4 Before supply of the machinery equipments and other materials, prior approval of the Engineer should be obtained giving the name of maker and other details required.

## **13 Electrical Wiring and installation of fittings**

- 13.1 The materials used for conforms to the relevant I.S.S wherever applicable. The make and other details of materials to be used should be furnished along with the tender.
- 13.2 Continuous earth connection are to be made with 14 SWG T.C. wire.
- 13.3 The wiring work done shall be neat, true to line, level etc. and in such a way that it gives an impressive and aesthetic appearance to the building.
- 13.4 The actual location and number of points for lights, fans power plugs etc. may be altered at the time of execution by the Engineer.
- 13.5 Entire wiring and cabling work should be done as per IE rules.
- 13.6. Any damages or breakages, chipping etc. caused by the electrification works to the structures have to be rectified by the contractor at his cost to the satisfaction of the Engineer.
- 13.7. The Contractor has to test and every point after completion of wiring to the entire satisfaction of the Engineer by taking temporary supply from the existing service.
- 13.8. Wiring to light point (both internal and external) and fan point will be treated as complete only when supply as well as connection upto the ceiling rose is completed.
- 13.9. Whenever conduit pipe wiring is done, cover for switch boards containing switches, plugs, etc. should be of hylam sheet or other specified sheet only.

## X . PUMPSETS ANNEXURES

- I) Pump characteristics
- II) a). Submersible Pump  
b) Motor for Submersible Pumpset
- III) Starters

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

### ANNEXURE I Pump Characteristics

| Sl.No. | Description   | Technical Details | Remarks |
|--------|---|-------------------|---------|
| 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.I. Conditions in Bore well/well.

CONTRACTOR

CHIEF ENGINEER/TNJ

**ANNEXURE – II (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                           | : |

**ANNEXURE – II (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<br>as per BIS |
|     |   | Full          |         |                         |
|     |   | $\frac{3}{4}$ |         |                         |
|     |   | $\frac{1}{2}$ |         |                         |
| 11. | Over load capacity                                |               |         |                         |
|     | a) 25%  |               |         |                         |
|     | b) 50%  |               |         |                         |
|     | c) 100%   |               |         |                         |
| 12. | Power Factor                                      | Load          | Percent | as per                  |
|     |   | Full          |         |                         |
|     |   | $\frac{3}{4}$ |         |                         |
|     |   | $\frac{1}{2}$ |         |                         |
| 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<br>(driving end) | :             |         |                         |
| 19. | Size of coupling and its type                     | :             |         |                         |
| 20. | Does the Motor conform to BIS<br>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                 | :             |         |                         |

CONTRACTOR

CHIEF ENGINEER/TNJ

**ANNEXURE - III****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 :

## **XI. TESTING, ERECTION, TRIAL RUN, COMMISSIONING AND ACCEPTANCE**

| Clause | Description   |
|--------|---|
| .1     | General   |
| .2     | Test Certificate  |
| .3     | Hydraulic Tests   |
| .4     | Manufacturer's Works Inspection Tests and Guarantees <sup>1</sup> |
| .5     | Site Testing <sup>1</sup>   |
| .6     | Pumping Plant   |
| 7      | Cranes  |
| 8      | Valves  |
| 9      | Power Transformer   |
| 10     | Tests on Cables During Manufacture                                |
| 11     | Process control and Indicating Instruments                        |
| 12     | Electrical Measuring Instruments and Meters                       |
| 13     | Alarm Systems   |
| 14     | Site Tests  |
| 15     | Tests on cables During Installation                               |
| 16     | Pump Sets   |
| 17     | Electrical plant  |
| 18     | Tests cables after Installation                                   |
| 19     | Earthling System Tests  |
| 20     | Testing Pipelines   |
| 21     | Testing Pressure Pipeline   |
| 22     | Test on Instruments   |
| 23     | Other Tests   |
| 24     | Erection - General  |
| 25     | Leveling and Grouping of Machinery                                |
| 26     | Completion of Erection  |
| 27     | Installation Inspection   |
| 28     | Recommissioning Trials, Tests                                     |
| 29     | Commissioning   |
| 30     | Acceptance  |

## TESTING, ERECTION, TRIAL RUN, COMMISSIONING AND ACCEPTANCE

### .1 General

This part deals with specifications for - Erection, testing, recommissioning, commissioning and acceptance.

### 1.1 Test Instruments

The contractor shall satisfy the Engineer as to the accuracy of all the instruments used for tests and if required shall produce recent calibration tests, otherwise have them calibrated at his own expense by an independent authority.

### 2 Test Certificate

Copies of certificates of all works hydraulic tests shall be provided as details.

The contractor shall obtain and submit to the Engineer and to other parties as may be directed, certificates of test of all times, certifying that they have been satisfactorily tested and giving full particulars of such tests.

### 3 Hydraulic Test

All equipment subject to water pressure including casting, pressure vessels, pumps, pipes, fittings, and valves, shall be hydraulically tested to the pressure specified or in accordance with the applicable standard or to at least 1.5 times the maximum working pressure, whichever shall be the greater. Hydraulic test shall be given at the manufacturer's works.

Any of the hydraulically tested items shall be subject to the Engineer's inspector's random item proof re-test and notice of testing dates shall be submitted to the engineer.

Unless otherwise specified hydraulic tests to 1.5 times the maximum working pressure shall also be applied at site to all pipework installed by the contractor.

### 4 Manufacturer's works inspection tests and guarantees

All schedules of particulars shall be completed and the guaranteed particulars and the efficiencies of the equipment offered at the duties specified will be binding and may not be varied except with the consent in writing of the Engineer.

The Engineer shall be provided with the facility for inspection of all equipment and material and shall be given at least 30 days notice when such equipment or material is ready for inspection of works test.

Full witness testing to the relevant standards and to prove guarantees given will be required for the following items:

- i. All pumps
- ii. Electric motors
- iii. All control panels

- iv. All circuit breakers
- v. All transformers
- vi. All lifting equipment
- vii. Cables
- viii All process control and indicating instruments
- xi. All electrical measuring instruments and meters
- x. Flow measuring equipment and gauges.

In addition all other items of equipment not subject to witness testing shall be temporarily erected at the manufacturer's works and tested for satisfactory operation and shall be offered for inspection. Copies of manufacturer's test readings shall be submitted to the Engineer, all prior to packing for shipment. Such inspection, examination, or testing, shall not release the contractor, manufacturers or supplier of any item from any obligation under the contract.

Certified copies of manufacturer's test readings of all items shall be submitted to the engineer within 7 days of the satisfactory completion of the test.

Whilst the engineer shall be provided with facilities for witness testing and/or inspection of all items of equipment at the manufacturer's works. He may at his discretion advise that the test shall proceed in his absence. These test shall be made as if in his presence, and duly certified copies of test readings shall be submitted.

Where items of equipment are of identical sizes and duty it may be required, at the Engineer's discretion, that a reduced number of the items be subjected to witness test; however this shall not relieve the manufacturer from the requirement of carrying out the performance tests on all items prior to offering a witness testing.

If after inspecting, examining or testing any material or equipment, the Engineer shall decide that such items or any part thereof is defective, or not in accordance with the specification or performance requirements, he may reject the said items or part thereof, giving to the manufacturer within a reasonable time, notice in writing of such rejection, stating therein the ground upon which the said decision is based. All re-testing shall be at the contractor's expense.

## 5 Site Testing

The Contractor shall arrange for the full site testing of all items of equipment and shall include Provision of:

- a. All skilled and qualified operating and test staff for the testing of all equipment.
- b. Provision and disposal of all services, lubricants, and fuels other than electricity
- c. All measuring and testing instruments to demonstrate equipment operates to the fulfillment of the works test
- d. All loading weights for the load testing of all lifting equipment

All test shall be carried out by the contractor to the approval of the Engineer.

The Contractor shall be responsible for co-ordinating the programme of site testing of all items and to ensure that all parties concerned are present during any tests to obligate their responsibilities.

#### Manufacturer's Works Tests

### 6 Pumping Plant

Pumping plant shall be tested as follows:

1. Each pump shall be tested individually in accordance with part I of BS 5316. Site conditions shall be simulated as near as possible particularly the minimum site NPSH condition.
2. Each pump shall be tested complete with all shaft bearings, thrust bearings and directly driven auxiliaries or, where this is impracticable, the contractor shall state what allowances shall be made for losses incurred by these items, and shall demonstrate the accuracy of these allowances to the satisfaction of the Engineer.
3. Each pump shall be tested with its own motor wherever feasible. It shall be tested particularly at the guarantee performance duty point and over its full working range where possible from its closed valve condition to 30% in excess of the guaranteed quantity or minimum head. Head/quantity curves and overall efficiency/quantity curves shall be plotted to demonstrate that the plant will be capable of meeting the full range of operating conditions at site.
4. Pump casings shall be subject to pressure test at 1.5 times the maximum pressure obtained with the delivery valve closed. The positive suction head shall be taken into account in determining this pressure.

### 7 Cranes

All cranes lings and lifting beams shall be tested at the manufacturer's works with a load 25% in excess of the rated load. Tests shall include measurement of deflection and speed of lifting etc.

The test shall be repeated at site when erection is complete using test weights to be provided under the contract.

Certificates shall be provided for both tests.

### 8 Valves

All valve bodies shall be hydraulically tested closed ended to 1.5 times the rated pressure. Isolating valve sate shall be tested to the maximum working pressure, at which pressure they shall be drop tight.

- 9 The contractor shall include for all necessary tests as laid down in the specification and those required in order to comply with the relevant Indian standards as follows:

a. Power Transformers

- i. Measurement of winding resistance
- ii. Ratio polarity and phase relationship
- iii. Impedance voltage
- iv. Load Losses
- v. No-Load losses and no-load current
- vi. Insulation resistance
- vii. Induced over voltage withstand
- viii. Separate source voltage withstand.

Type test:

- i. Impulse voltage withstand both chopped and fullwave
- ii. Temperature rise.

Unless otherwise stated by the Engineer, evidence of type of tests carried out on identical transformers to those being provided under the contract will be accepted in lieu of actual tests.

b. Circuit breakers and control gear

- i. Routine tests including H.V. pressure test, mill-volt drop (Doctor) test;
- ii. To ensure operation of the closing child and satisfactory closing of the circuit breaker with the voltage on the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of the rated voltage.
- iii. To ensure the satisfactory trip operation of the circuit breaker at no load conditions with the trip coil energized at 50% of its rated voltage.
- iv. The test figures for heat-run tests performed on identical panel types shall be made available.

c. Protection and control circuits

Based on the completeness of the circuits in the final manufactured form within the manufacturer's works, the following tests shall be carried out:

- i. Primary in injection test to ensure correct operation of the current operated protection relays and direct acting coils over their full range of setting.
- ii. balanced earth fault stability tests by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.

With differential pilot wire schemes it may not be possible to apply primary injection testing. In this case the circuits shall be proved by secondary injection. Current transformer characteristics and calculations associated with the above tests shall be available for inspection by the engineer.

- iii. Tests on auxiliary relays e.g. Buchholz auxiliary, at normal operating voltage by operation of associated remote relays.
- iv. Correct operation of control circuits at normal operating voltage by operating voltage by operation of local control switches, and simulation of operation from remote control positions.

d. Motors

Motors over 22 KW site rating shall be subject to full performance test which may be witnessed by the engineer at the motor manufacturer's works.

Motors of 5.5 KW to 22KW site rating shall be subject to performance tests but will not be witnessed.

Motors under 5.5 KW site rating shall be subject to type test standards.

Type test certificates which shall include the following shall be provided for all motors;

- i. Manufacture to BIS/IS.
- ii. Class of insulation
- iii. Type of cable fittings.
- iv. Type of bearing size and lubricant.
- v. Type of and rating of motor heaters.

Motor testing shall be carried out in accordance with the requirements of BIS .

e. Instruments and Meters

Tests to ensure operation of all ammeters, voltmeters and transducers and checks for correct calibration. Kwh meter shall be changed for correct rotation and creep test shall be carried out to ensure that the meter is inoperative with voltage along, of the secondary of the current transformer is left connected with the primary Corinthian erupted.

10 Test on Cables During Manufacture

All cables supplied under the contract shall be subject to routine tests in accordance with the relevant British standard. Cables will not be accepted on site for installation until certificates giving proof of compliance with the specification and date of tests have been received and approved by the Engineer. A certificate shall be applicable to each drum.

The tests to be carried out on every drum at manufacturer's premises shall include:

- a. High voltage A.C. insulation pressure test between cores, each core to earth metallic sheath or armour as applicable
- b. Insulation resistance test
- c. Core continuity and identification
- d. Conductor resistance test.

#### 11 Process Control and Indicating Instruments

All flow, level process measurement controllers, transmitters, recorders, indicators, vacuum and pressure gauges shall be subject to routine in accordance with BIS.

Test certificate shall be provided against each item of equipment.

#### 12 Electrical measuring Instruments and Meters

Test to ensure accurate operation of all meters, voltmeters and kwh. Meter shall be undertaken in accordance with IS:9319.

#### 13 Alarm systems

The contractor shall be responsible for testing all items of equipment comprising the works alarm system for correct operation and sequence action.

#### 14 Site Tests

Leakages tests at the test pressure shall be carried out on all enacted pipe work and valves immediately after erection and before being built in. The contractor shall advise the Engineer when these tests are to be carried out.

#### 15 Tests on Cables During Installation

During the period of site installation the Engineer will carry out inspection of the works to ensure the standards of workmanship meet the specification and are to his satisfaction. In the event of any part of the cabling installation failing to meet these requirements the contractor shall remedy the deficiency to the satisfaction of the Engineer.

After completion of various parts of the installation the contractor shall provide a test engineer, labor and materials to demonstrate to the engineer that the cables have been correctly installed

The contractor shall inform the Engineer prior to the testing of cables and shall be responsible for liaison with any other contractor to whose equipment the cables may be terminated to ensure all parties concerned are aware of the impending tests, to guarantee safety of personnel and that isolation of any particular equipments has been completed. Any special isolation or preparation required to be carried out before cable testing will be completed by the contractor responsible for that equipment. The contractor to the satisfaction of the Engineer shall carry out all tests.

## 16 Pump Sets

Tenderers shall complete the schedule of particulars and guarantees and shall state therein, inter alia, the guaranteed efficiencies of the pumps and motors offered, and the overall guaranteed rates of energy consumption of the complete pump sets at the duties specified.

The contractor's guarantees given when tendering in respect both of performance and efficiency shall be binding and considered part of the contract.

The fulfillment of these guarantees shall be verified at the works test and at site trials in accordance with the procedure given in Indian standards specification etc.

The site trials shall be carried out under the control of the contractor's staff to the satisfaction of the engineer. The contractor shall provide all the necessary labor and instrumentation to conduct the tests. The discharge from the pumps shall be measured using a portable ultrasonic flow meter.

## 17 Electrical plant

After all the deficiencies apparent during the installation inspection have been rectified to the engineer's satisfaction, the following tests shall be carried out:

- a. Power transformers
  - i. Dielectric tests on insulating oil to IS: 566.
- b. Circuit breakers and control gear
  - i. Routine tests, including H.V. pressure tests
- c. Protection and control circuits

Tests at 8.9(a), (b) (c) with the addition of satisfactory operation of all inter-tripping circuits in connection with other items of plant.

## 18 Tests on Cables after Installation

Every cable shall be subject to the following tests after installation: -  
High voltage pressure tests:

The following D.C. test voltages shall be applied at full value: -

- |    |  |   |
|----|--|---|
| 1. | PLYSWS<br>Between cores<br>30,000 volts                  | 11,000 volt grade cable<br>Between any cores and armour<br>17,500 volts |
| 2. | XLPE SWAPVC.C<br>Between cores<br>10,000 v               | 3,300 Vet grade cables<br>Between any core and armour<br>5,8000v        |
| 3. | XLPE SWAPVC or<br>PVC SWAPVC<br>Between cores<br>3,000 v | 1,100 volt grade mains cable<br>Between any core and armour<br>3,000 v  |

Witnessed high voltage pressure tests shall not be carried out on PVC/SWAPVC control cables, but it shall remain the responsibility of the contractor to test the insulation of these cables both between core and between cores and earth during installation with a 'Meager' 500 volt hand generator.

The contractor shall test all cables after installation to ensure correct phasing out of cores, continuity of cores sheath and armour over the whole length of the cable.

19 **Earthling system Tests**

The contractor shall demonstrate to the Engineer that the resistance of the electrodes to earth and the earth conductor continuity is in accordance with the specification. The tests shall be made on completion of the installation.

The test shall be performed for each major item of plant, by using an Earth Meager and auxiliary return conductor.

20 **Testing pipelines**

**General**

Pipelines shall be tested in lengths between manholes or valve pits or such shorter lengths as the Engineer may direct or permit.

Pipelines shall be tested in the presence of the Engineer.

Fittings required for temporarily closing openings in pipelines to be tested shall be properly designed for this purpose and shall be adequately strutted to withstand the test pressure specified.

The arrangements for testing a pipeline shall include provision for the surging of air from the pipeline prior to a water test.

The contractor shall keep a record of all tests in a book which shall be available for inspection and handed over to the Engineer on demand.

21 **Testing pressure pipelines**

Each pressure pipeline shall be tested after completion with the exception of any backfilling not necessary for the stability and safety of the work.

Prior to the testing of a pressure pipeline valves shall be checked and sealed. The pipeline shall then be filled with water and the air released. After having been filled the pipeline shall be left under operating pressure for at least 24 hours so as to achieve conditions as stable as possible for testing.

The pressure in the pipeline shall then be raised steadily until the test pressure of 50% excess of the maximum working pressure is reached in the lower part of the pipeline and the pressure shall be maintained at this level by pumping if necessary for a period of one hour. The pump shall then be disconnected and no further water shall be allowed to enter the pipeline for a period of one hour. At the end of this period the original test pressure shall be restored by pumping and the loss measured by drawing off water from the pipeline until the pressure as at the end of the one hour test period is again reached.

The permissible loss for pressure pipelines under test shall not exceed 20 liters per mere nominal bore per kilometer length per bar of pressure (Calculated as the average pressure applied to the pipeline) per 24 hours.

Gauges used for testing pressure pipelines shall have a dial diameter of not less than 150 mm and a full-scale reading not greater than twice the specified test pressure. Before any gage is used the contractor shall arrange for it to be checked independently and a data certificate of its accuracy shall be provided for the Engineer.

The contractor shall make his own arrangements for the supply and disposal of water used for testing which shall be obtained from a source approved by the engineer.

## **22 Test on Instruments**

The contractor shall carry out on-site pre calibration test to demonstrate the accuracy of all level, pressure at rate of flow instruments, the transducers, buffers, displays amplifiers, recorders, integrator and transmitters incorporated in the works over a range of flow from the minimum to the maximum anticipated design range in the plant as required by the specification and that the accuracy obtained at the manufacturer's works tests can be obtained on site. The contractor shall supply sets of calibration curves of weirs, flow meters, metering pumps and the like.

## **23 Other tests**

The contractor shall carry out all other tests required either by himself and or the engineer to prove the plant, and to comply with the requirements specified.

These tests shall embrace all instrumentation, alarms, control systems and processes, all pumps, chemical metering devices, feeders, robes, gages and other components of the plant over the full range of operating conditions.

If, in the opinion of the engineer, any item of plant is irreparable or insufficient for its purpose or function the contractor shall, without delay, replace the item with another satisfactory item or better unit all at his own cost, paying if necessary, air freight charges to expedite prompt delivery.

## **24 Erection - General**

- a. The contractor's staff shall include at least one competent erection engineer with previous, suitable, previous experience on similar contracts to supervise the erection of the works and sufficient skilled, semiskilled and unskilled labor to ensure completion of the works in time. The contractor shall not remove any representative, erector or skilled labor from the site without the prior approval of the Engineer's Representative.
- b. One erection engineer who shall be deemed to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and contractor shall inform the Engineer's Representative in writing which erector is designated as his representative and he is in charge. Erection engineer is to report to Project manager.
- c. The contractor's erection staff shall arrive on the site on date to be agreed by the engineer's Representative before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his subcontractor's) supply has arrived on site so that there will be no delay on this account.

- d. The contractor shall be responsible for setting up and erecting the plant to the line and levels of reference given by the engineer in writing, and for the correctness (subject as above mentioned) of the positions, levels dimensions and alignment of all parts of the works and for provision of all necessary instruments, appliances and labor in connection therewith. The checking of setting out of any line or level by the engineer or engineer's representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.
- e. Erection of plant shall be phased in such a manner to as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection works the contractor shall check the dimension of structures where the various items of plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the Engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the Engineer, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the employer, make good, repair or replace the damage, promptly and effectively as directed by the Engineer and to the engineer's satisfaction.
- f. During erection of the Plant the Engineer will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the Specification. Any deviation and deficiencies found or evidence of unsatisfactory workmanship shall be corrected at instructed by the Engineer.

25 Leveling and grouting of Machinery

- a. Contractor shall check the civil works, where the plant is to be installed sufficiently in advance. For their conformity to the approved drawings for installing the plant with respect to lines, levels and accuracies of position embedment, anchorage pockets, cutouts etc. and he shall record all measurements and deviation in prescribed control formats. He shall proceed with the works, with the Engineer's approval of civil works for undertaking of installation of the plant consequent to such preparatory inspection or work.
- b. Contractor shall mark precisely the centerline and datum reference on the civil works. Where the plant is to be installed with reference to bench marks, using indelible means of marking.
- c. He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cutouts etc. to achieve uniform level of reference for erection.
- d. All concrete surfaces receiving grout shall be hacked at 35 required to ensure better bonding with grouting.
- e. Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc. Shall be made good to the satisfaction of the engineer.

- f. All grout for equipment shall be carried out using non-shrinkable continuous grout materials with suitable from work of at least 12 mm thickness. Surfaces to receive the grout be hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be blown off by compressed air before commencing grouting. Grouting shall be done in one continuous operation from one side such that grout flows in a single wave until grout reaches all confined spaces with no air pockets and air from all confined spaces is expelled. A hydrostatic head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out in the presence of the Engineer's Representative. All manufacturer's recommendations. All lines levels shall be checked up after grout is set, block outs shall be closed using cement concrete of the same grade as that of the parent structure.

## 26 Completion of Erection

- a. The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and mechanically complete and will include amount other such responsibilities the following:
  - i. Plant in the scope of the contractor has been erected, installed and grouped as per specification.
  - ii. Installation checks are completed and approved by the engineer.
  - iii. The erected plants are totally ready for commissioning checks.
- b. At the stage of completion of reaction, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the plant is fit and sound to underage commissioning check/test on completion.
- c. Upon achieving the completion as described above, the contractor shall notify the engineer by a written notice intimating such mechanical completion of units and notify the engineer for inspection and acceptance of mechanical completion. The engineer/Engineer's Representative shall proceed with the inspection of such units within 14 days of such a notice thereafter:
  - i. The Engineer shall certify completion when there are no defaults in the works and the plant is acceptable or
  - ii. The Engineer shall inform the contractor list of deficiencies for rectification hereinafter referred as punch list and the contractor shall complete the rectification work within a jointly agreed period before tests on completion and obtain the Engineer's acceptance or approval of the same before proceeding with the tests of completion or
  - iii. The Engineer may inform the contractor that the works are accepted with the 'punch' list (Items which do not hamper operability, safety or maintainability) and allow the contractors to proceed with the pre-commissioning checking following by test on completion when the contractor under takes to complete such outstanding works within an agreed time during defects liability period.

- d. Taking over shall be based on rectification of all deficiencies as advised by punch lists.
- e. The erection period indicated by the contractor would be deemed to cover all the activities upon completion as stipulated in previous paragraphs, notice of completion by the contractor, inspection by the Engineer for completion, and contractor rectification of all deficiencies as noticed by the deficiency/punch list, and acceptance by the Engineer of such rectification's, prior to test on completion.
- f. Minor defects, which in the opinion Engineer which do not hamper operability and main ability will not be taken into account for deciding mechanical completion. Such defects shall be rectified concurrent to commissioning checks before tests on completion. However, the engineer's decision in this regard is final.
- g. The commissioning period as notified by the contractor shall be deemed to occur beyond the date of completion and shall include all periods of pre-commissioning, trials and tests on completion
- h. It is in the contractor's interest to offer the sections/units/systems, progressively under identified milestones within overall erection period, duly completed for inspection by the Engineer's Representative, obtain his "punch" list, for rectification of any deficiencies pointed out by the Engineer and to achieve mechanical completion before undertaking the tests on completion within the specified erection period. The engineer also reserves a right to withhold the cost as estimated to be equivalent to the rectification of deficiencies pointed out to the contractor until such a time such deficiencies are rectified to the satisfaction of the engineer.

## 27 Installation Inspection

- a. In addition to the progressive supervision and inspection by employer the contractor shall offer for inspection to Engineer, the completely created plant/part of plant on which tests are to be carried out. After such inspection by engineer, each equipment/sub system shall be tested by the contractor in accordance with the applicable standards in the presence of Engineer. Such tests shall include but not be limited to the test specified in following clauses.
- a. Pumps, Piling and Valves
  - i. The erected pipe work shall be subjected to a hydraulic test at 1.5 times the maximum pressure of twice the working pressure which ever is higher to test the soundness of the joints, provision of the necessary pumps, gages, blank flanges, tapping etc. for carrying out these tests shall be included in the contract.
  - ii. Leakage test shall be carried out on all erected pipe work, pumps and valves immediately after erection and where possible before being built in.
  - iii. Operating tests shall be conducted on valves.

- iv. The pump set shall be tested for satisfactory operation. The vibration and noise level shall be checked to be within the specified limits.
- b. Pump motors  
Condition of winding insulation be tested and Insulation valves shall be restored to required level by suitable heating arrangements locally.
- c. Cranes and hoists  
The crane and lifting tackle shall be tested to 125 % of the safe working load. The contractor shall arrange the test load.
- d. Screen  
After erection, the screen shall be tested for its performance for checking its capability to handle stringy materials. Clearance between the dead plate and tiles shall be checked.
- e. Sluice Gate
  - i. The contractor shall perform leakage test after installation of the sluice gates.
  - ii. Under the design, seating head and unseating head the leakage shall not exceed the limit specified in AWWA 0501/IS; 13319, class I for shop testing.
- f. Instrumentation and control system  
  
Performance of the instrumentation system and function of logic control system shall be checked as per the design requirements.

## 28 .Recommissioning Trials, Tests

- a. Start up:  
  
On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the contractor for correctness, completeness of installation and acceptability for start up, leading to initial pre-commissioning test at site. The Engineer and contractor shall as mutually agree the list of pre commissioning tests to be performed.
- b. Trial Operation  
  
The contractor shall prepare a Trial operation report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation. This report, besides recording the details of the various observations during trial run shall also include dates of start and finish of the trial operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications /repairs to the plant shall be carried out by the contractor to the full satisfaction of the

engineer to enable the latter to accord permission to carry our performance and guarantee tests on the plant. However, minor defects, which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

29 Commissioning

- i. The plant shall then be on trial operation of One Hundred and Eighty days during which period all necessary adjustments shall be made while operating, over the full load-range enabling the plant to be made ready for performance and guarantee tests. The contractor shall provide necessary staff. The trial Operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified characteristics, for the period of Trial Operation.
- ii. During the contractor's commissioning/start-up engineers specifically identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily, over, the complete plant shall be placed on initial operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipments as a complete plant.
- iii. Any special equipment, tools and tackles required for the successful completion of the performance and guarantee the contractor free of cost shall provide Tests.
- iv. The contractor during these performance and guarantee tests shall provide the guaranteed performance figures of the equipment's. Should the results of these tests show any decrease from the guarantee values, the contractor shall modify the equipments as required to enable them to meet the guarantees. In such case, performance and guarantee tests shall be repeated within one month from the date the equipment is ready for re-test and costs for modifications including labor, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the contractor.  
Performance and guarantee tests shall make allowance for instrumentation errors as per specification.

30 Acceptance

- a. The employer will certify no item of plant for acceptance unless it has successfully passed the entire test called for under the contract. If nevertheless the employer uses only
- b. part of the works, that part which is used shall be deemed to have been accepted at the date of such use.
- c. An acceptance certificate for plant shall not be issued unless the following documentation are duly compiled and submitted in final formats in duly bound volumes.
  - i. A compilation of all shop inspection results/reports of the plant/machinery with due attestation that the plants have been manufactured to specified standards (6 copies).

- ii. All erection/ construction quality control checks in appropriate approved formats for all installation works with attestation that installation has been carried out as per acceptable/stipulated standards (6 copies)

On completion of the trial operation, it is the sole responsibility of the contractor to maintain the entire project successfully for the maintenance period of 12 months.

## XII. SEWAGE TREATMENT PLANT ( STP )

### 1.0. GENERATION OF SEWAGE QUANTITY & QUALITY:

|   |               |
|---|---------------|
| Sewage generation ( Ultimate)                         | : 6.41 mld    |
| Sewage Treatment Plant is designed for( Intermediate) | : 6.41 mld    |
| STP Operating Hours                                   | : 24 hrs/day. |
| Filtration Plant Operating Hours                      | : 24 Hrs/day. |
| Ave. Daily Flow ( present)                            | : 5.32 mld.   |

The sewage is expected to get generated from Toilets, Canteen. Pantry, Dining & other Institutional activities.

The quality of the Raw Sewage shall be considered as:

|   |           |
|---|-----------|
| pH  | 6.0 – 7.5 |
| Suspended Solids(SS)                                  | 450 mg/l  |
| Biological Oxygen Demand(BOD) <sub>5</sub> @ 20 deg C | 300 mg/l  |
| Chemical Oxygen Demand(COD)                           | 600mg/l   |
| Oil & Grease  | 10 mg/l   |

### 2.0. PROPOSED SEWAGE TREATMENT PLANT ( STP) SCHEME:

The planned sewage treatment scheme is designed to treat the effluent from Houses, commercial, Technical and Industrial etc and reuse the treated effluent for Green Forestry and Gardening. The treatment scheme designed to deliver the treated effluent quality norms stipulated by the Tamil Nadu Pollution Control Board (TNPCB), in order to conserve the raw water.

A brief description of the process involved in treating the sewage is given below :

The STP shall be based on the **“Activated Sludge Process with Extended Aeration” (EASP).** The sewage collected through piping network involving inspection chambers and manholes, in the Collection well and pumped to receiving chamber and let in to coarse and fine screen chambers which has suitable retention time to take care of peak flows and to prevent the settling of solids. The sewage from the screen chambers will let in to the Grit chambers subsequently Aerator through Distribution chamber.

The homogenized sewage is transferred at constant rate to the Aeration tank using submersible sewage pumps. In Aeration tank, biomass media provided for maintaining the required volume of microbes. The microbes ( MLSS > 8000) attached on the media surface and move along with water. The Moving/ Fluidized state maintained by diffused aeration.

The excess biomass growth on media shall get separated in the following Secondary Settling tank.

The Aeration tank have a min. retention time of 16 hours and provided with air grid to maintain the required Dissolved Oxygen levels of 2 mg/lit. The Settling tank has tube packs to provide the larger surface area for the effective solid liquid separation. The over flow from the settling tank shall be collected in clarified effluent tank for further treatment like disinfection and filtration.

The Bio Sludge collected in the bottom of the settling tank is transferred through sludge pump to the Sludge sump.. The Sludge sump is designed to reduce the sludge volume further. The Digested sludge shall be disposed off through the existing natural channel which runs adjacent to the site and finally let into Pullambadi channel which is located at 200m from the STP site. It is proposed to utilise the surplus water for using agriculture purpose by the nearby barren lands.

### **3. TREATED SEWAGE QUALITY DETAILS:**

Tamil Nadu Pollution Control Board (TNPCB) stipulated the following parameters for pollutants and the treated sewage quality will be well below the limits specified below:

|                             |                |
|-----------------------------|----------------|
| p H                         | : 6.5 - 9.0    |
| TSS                         | : <100 mg/lit. |
| BOD <sub>5</sub> @ 20 deg C | : <30 mg/lit.  |

### **4.0. EQUIPMENT SPECIFICATIONS**

#### **4.1. Bar Screen. / Coarse**

|          |   |
|----------|---|
| Quantity | : 1 No.   |
| Type     | : Manually Cleaned with Hand rake.  |
| MOC      | : SS 304 with 70 mm wide x10mm thick SS bars with<br>c/c spacing of 20 mm @ an angle of 60° |

#### **4.2 Bar Screen. / Fine**

|          |   |
|----------|---|
| Quantity | : 1 No.   |
| Type     | : Manually Cleaned with Hand rake.  |
| MOC      | : SS 304 with 70 mm wide x10mm thick SS bars with<br>c/c spacing of 10 mm @ an angle of 60° |

#### **4.3 Mechanical Screen. / Coarse**

|          |   |
|----------|---|
| Quantity | : 1 No.   |
| Type     | : Mechanically Cleaned with Belt conveyor.  |
| MOC      | : SS 304 with 70 mm wide x10mm thick SS bars with<br>c/c spacing of 20 mm @ an angle of 40° |

## 4.4 Mechanical Screen. / Fine

|          |  |
|----------|--|
| Quantity | : 1 No.  |
| Type     | : Mechanically Cleaned with Belt conveyor.   |
| MOC      | : SS 304 with 70 mm wide x10mm thick SS bars with c/c spacing of 10 mm @ an angle of 60° |

## 4.5 Grit separator

|          |  |
|----------|--|
| Quantity | : 2 Nos to suit the tank size.                     |
| Duty     | : To remove settled grit                           |
| Type     | : Raker and classifier.                            |
| MOC      | : Wetted parts MS FRP and above water parts SS 304 |

## 4.6. Air Blowers.

|             |   |
|-------------|---|
| Quantity    | : 3 Nos. .  |
| Duty        | : To provide required oxygen for biodegradation in Aeration tank & required air for collection and Treated effluent tank. |
| Type        | : Twin lobe compressor with low noise level.  |
| Flow        | : 1452 m <sup>3</sup> /hr @ 0.6 kg/cm <sup>2</sup>  |
| Accessories | : Suction and Exhaust silencers, NRV, Pulley, Base frame, Belt guard, etc.  |

## 4.7. Aeration Tank air grid and internals

|          |   |
|----------|---|
| Quantity | : Lot to suit the Aeration tank size of 27.5x20x4.50 m                                    |
| Duty     | : To provide oxygen required for biodegradation, Maintain Dissolved Oxygen level >2 mg/l. |
| Type     | : Diffused aeration.  |
| MOC      | : SS 304 – specials / EPDM – 1 m length   |

## 4.8 Secondary clarifier

|          |  |
|----------|--|
| Quantity | : Lot to suit the Clarifier tank size of 18 m dia x4.0 m |
| Duty     | : For bio mass settlement                                |
| MOC      | : Wetted parts MS FRP and Above water parts SS304        |

## 4.9. Inter connecting piping, fitting, valves

|          |  |
|----------|--|
| Quantity | : Lot.                                     |
| Duty     | : Connecting all tanks, pumps, filters etc |
| MOC      | : CI D/F & CI A class                      |
| Make     | : Relevant Reputed Manufactures            |

#### 4.10. Electrical Works

1 No. LT Panel, Non compartmentalized, wall mounted, comprising incoming power control switch with HRC fuses, Ammeters, Volt meters, Energy Meter Phase indicating lamps, MCBs and starters for the feeders all complete. Automatic level Controller for actuating pumps to be provided. Necessary power wiring by armored PVC cables or PVC insulated wire in conduit from LT panel to equipment motors shall be provided with necessary tray/support etc.

#### **5.0. LIST OF CIVIL UNITS :**

| Sl.No. | Item                            | Qty   | Size ( Each Unit)  | MOC                    |
|--------|---------------------------------|-------|--------------------|------------------------|
| 1      | Receiving Chamber               | 1 No  | 3 x 3 x2.5 M       | RCC                    |
| 2)     | Screen Chamber                  |       |                    |                        |
| a)     | Coarse Screen                   | 1 No  | 6 x 0.7 x 1.00M    | RCC                    |
| b)     | Fine screen                     | 1 No  | 6 x 0.7 x 1.15 M   | RCC                    |
| 3)     | Grit chamber                    | 2 Nos | 4.5X4.5 x 1.15m    | RCC                    |
| 4)     | Flow measuring channel          | 1 Nos | 6 x 0.60 x 0.80m   | RCC                    |
| 5)     | Distribution Chamber ( 3 Nos )  | 3 Nos | 3 x 3 x 1.75m      | RCC                    |
| 6)     | Aeration Tank                   | 2Nos  | 27.5x 20 x 4.5 M   | RCC                    |
| 7)     | Secondary Clarifier             | 2 Nos | 18.00 M dia x 4.0M | RCC with Hooper bottom |
| 8)     | Blower Room                     | 1No   | 8m x 5 m           | BW / RCC               |
| 9)     | Centrifuge feed sump            | 1No   | 2m dia x 2.50m     | RCC                    |
| 10)    | Centrifuge House                | 1No   | 8 x 5 m            | BW / RCC               |
| 11)    | Chlorine contact Tank           | 1No   | 18 x 3 x 3 m       | RCC                    |
| 12)    | Chlorinator Building            | 1No   | 6 x 5 m            | BW/RCC                 |
| 13)    | Sub station Room cum MCC room   | 1No   | 8 x 5 m            | BW/RCC                 |
| 14)    | Administration cum Lab Building | 1No   | 12 x 7 m           | BW/RCC                 |
| 15)    | Return Sludge sump              | 1No   | 2m dia x 6.00 m    | RCC                    |
| 16)    | Dechlorination sump             | 1No   | 2 x 2 x 2.5 m      | RCC                    |
| 17)    | Mv Panel room                   | 1No   | 8 x 5 m            | BW/RCC                 |
| 18)    | Construction of Compound wall   |       | 60 x 60m           | BW/RCC                 |

### **XIII. MINIMUM ENVIRONMENTAL MANAGEMENT MEASURES**

The EIA and EMP is to be adhered during construction and Operation and maintenance period by the Contractor

#### **Environmental Assessment**

##### **1.Objectives and Need**

Objectives of this assignment are to:

establish the environmental baseline in the study area;  
 identify and assess the adverse environmental impacts; and provide requisite measures to address these impacts;  
 identify the opportunities for environmental enhancements in the project area and provide requisite guidance/plans in this regard;  
 wherever relevant integrate the measures (mitigation and enhancement related) in the project planning and design; and  
 develop appropriate management plans and codes of practices for implementing, monitoring and reporting of the environmental mitigation and enhancement measures suggested.

The EA shall be carried out in line with the Government of India (GoI)'s regulations (EIA Notification), the World Bank's EA guidelines and TNUDF's ESF.

The EA comprises: Environmental Screening, Project EA and the Environmental Management Plans (EMPs). The EA shall be carried out in a consultative manner through "Stakeholder Consultations", at various stages, with the affected communities, NGOs, selected government agencies and other stakeholders.

##### **2.Scope of Work**

The following are the tasks to be performed by the contractor while conducting Environmental Assessment for the STP including nature, scale and magnitude of impacts that the project is likely to cause on environment.

###### **Task 1 Description of Project**

A succinct description of the proposed project shall be provided.

###### **Task 2 Review of Earlier Studies**

The contractor shall review various earlier studies such as feasibility and detailed project reports, etc., of the project and understand the project and various aspects associated with the same. This shall provide a base to formulate the environmental surveys necessary for the project and assessing impacts of the same.

###### **Task 3 Legislative and Regulatory Considerations**

A review of the legal and regulatory provisions applicable for the project shall be carried out in this task. The objective of the review is to bring out the legal and policy issues to be addressed in the project at various stages of project development such as design, execution and operation. Also the contractor should review the environmental laws such as EP Act, Water Act, Air Act, as well as the applicable operational policies / directives of The World Bank. Besides, the contractor shall also provide a complete list of regulatory formalities required for the project and various clearances required from different regulatory agencies.

#### Task 4 Preparation of Environmental Profile

An environmental profile of the project influence area shall be prepared, based on appropriate primary & secondary surveys and field investigations. The objective of this profile is to establish existing environmental conditions of the project area, in terms of air, water (surface & ground), noise, soil and other environmental parameters, which should form the basis for prediction of impacts due to proposed project activities. As part of this, the environmentally sensitive land uses (protected natural areas, areas of ecological value, sensitive receptors like schools, hospitals etc.) would also be identified and plotted on a map to scale.

The extent and duration of surveys shall be judiciously decided by the contractor as per requirements of the environmental regulations applicable in India and guidelines of international funding agencies. The profile prepared shall be adequate enough to predict impacts of the project and shall cater to the requirements of obtaining necessary environmental clearances from the authorities.

The profile shall essentially include all physical, ecological and socio-economic components of the project environment and bring out the salient and sensitive features of the same. Important aspects such as reserve forests, national parks, major water bodies, structures of archaeological / historic importance, and other environmental resources (if any) shall be identified and salient features of the same shall be presented.

#### Task 5 Determination of Potential Impacts

Based on the environmental profile of the project area prepared above and the proposed project activities discussed under task 1, the contractor shall carry out environmental screening to determine the nature of impacts and level of Environmental Assessment to be carried out (refer Section 3 for the details to be carried out under Environmental Screening).

In case of low or insignificant level of environmental impacts, where an EMP will suffice, the contractor shall review the recent versions of generic EMPs available with TNUDF and carry out necessary changes to suit the project requirements.

As part of screening, if medium to high impacts, requiring a detailed EA and stand alone EMP is required, the contractor shall carry out detailed impact analysis. The contractor shall predict environmental impacts of the project components, activities and sub-activities on various environmental attributes (bio, geo and physical) through appropriate analytical tools and techniques such as modelling techniques, overlays, etc. Significant or insignificant, permanent or temporary, reversible or irreversible, negative or positive impacts shall be categorised separately and presented for each phase of project development.

All identified impacts shall be summarised in an easily understandable format and the magnitude and significance of each impact shall be explained in detail.

An analysis of various project alternatives, including the 'Project' and 'No Project' scenario shall be analysed and impacts shall be analysed for each scenario. Based on the above analysis the best alternative that causes minimum or no impact shall be recommended for implementation.

#### Task 6 Social Assessment

Magnitude of social impacts due to loss of land, structures, income, livelihood etc shall be assessed .Significant findings of census and social economic survey of PAPs along with a brief account of proposed mitigation measures using the ESF guidelines, budget shall be brought out in the report. Institutional arrangements with resettlement implementation plan shall be provided where required.

#### Task 7. Stakeholder Consultations

The contractor shall carry out consultations with Experts, NGOs, forest department officials (if applicable) and other selected Government Agencies and other stakeholders to (a) collect baseline information, (b) obtain a better understanding of the potential impacts and (c) appreciate the perspectives/concerns of the stakeholders, and (d) secure their active involvement during subsequent stages of the project as appropriate .

Consultations shall be preceded by a systematic stakeholder analysis, which would (a) identify the individual or stakeholder groups relevant to the project and to environmental issues, (b) include expert opinion and inputs, (c) determine the nature and scope of consultation with each type of stakeholders, and (d) determine the tools to be used in contacting and consulting each type of stakeholders. A systematic consultation plan with attendant schedules will be prepared for subsequent stages of project preparation as well as implementation and operation, as required. Where community consensus is required in respect of proposed mitigation measures for impacts on community assets including water bodies, places of worships etc., specific plan for modification/relocation etc have to be disclosed and consensus obtained.

#### Task 8 Environmental Management Plan

The contractor using outputs of the above tasks shall prepare an implementable Environmental Management Plan (EMP) for the project. Preparation of Environmental Management Plan is detailed under Section 4 below.

### 3. Environmental Management Plan

The EMP should suggest ways / options for mitigating negative impacts of the project, the preventive measures necessary. Where required, EMP shall include community consensus for the mitigation measures proposed. The EMP shall identify the means / agency responsible for implementation of the same and recommend suitable monitoring mechanism for the EMP. The EMP shall be implemented fully by the Contractor. The above referred activity shall be applicable for Generic EMPs as well as specific EMPs developed as an outcome of detailed EAs

The contractor shall prepare a detailed EMP covering the measures to mitigate and/or minimize the negative impacts, including the implementation arrangement and a monitoring plan for the same with site specific requirements. EMP shall cover the following details:

Mitigatory measures: For each of the significant negative impact the contractor should recommend measures to eliminate or mitigate the impact. In case any impact is non-mitigable, the cost of damage shall be estimated. The cost (capital and recurring) of all the mitigation measures and the responsible parties for implementation should be clearly identified. The mitigatory measures should necessarily contain conceptual designs wherever necessary. The contractor should also specify neighbourhood committees to supervise effective implementation of the proposed mitigatory measures.

Landscape plan: Wherever necessary (especially STP sites), the Landscaping plan should be prepared considering the project area as a whole and shall meet project specific

requirements. Considering the nature of the project area, the EA should provide a conceptual landscape plan for all the project components while considering the special environmental and social needs.

**Monitoring Plan:** The contractor should specify the types of monitoring needed for potential environmental impacts during construction and operation. As in the case of the mitigation plan, requirements should be specific as to what is to be monitored, how and by whom along with reporting formats and recommendations if any Cost estimates are necessary and where monitoring reports are to be prepared, the recipient responsible for review and any corrective action should be identified. The monitoring plan should be supplemented with a detailed schedule of implementation of EMP measures.

**Institutional Arrangement to Manage Environment Impacts Effectively:** The contractor shall identify institutional/organizational needs to implement the recommendations of the project EA and to propose steps to strengthen or expand, if required. This may extend to new agency functions, inter-sectoral arrangements, management procedures and training, staffing, operation and maintenance, training and budgeting.

#### 4.0 Public Disclosure

The contractor is to provide support and assistance to the Client in meeting the disclosure requirements, which at the minimum shall meet the World Bank's policy on public disclosure. The contractor will prepare a plan for in-country disclosure, specifying the timing and locations; translate the key documents, such as the EA Summary in local language; draft the newspaper announcements for disclosure; and help the client to place all the EA reports in the client's website.

The contractor shall prepare a non-technical EA Summary Report for public disclosure.

#### 5.0 Review Committee

The review committee comprising of representatives from TWAD/CMWSSB, TNPCB, CMA and TNUIFSL will review and clear the EIA report. Payment will be made after approval of the EIA by the review committee.

#### 6.0 Pre Construction Phase Impacts

**Table 4 :**

|   | Potential Negative Impacts    | Mitigation Measures  | Time frame                            | Responsible agencies                                    |
|---|-------------------------------|--|---------------------------------------|---|
|   | <b>PRE-CONSTRUCTION STAGE</b> |  |                                       |   |
| 1 | Clearances                    | All clearance required for Environmental aspects during construction shall be ensured and made available before start of work.   | Before construction                   | ULB / TWAD/ Concerned Departments & agency / Contractor |
| 2 | Tree Cutting                  | i) Try to save the trees by adjusting the plant layout or the alignment of sewage intake structures, sewer mains, pumping stations, etc<br>ii) Provide adequate protection to the trees to be retained with tree guards (e.g. Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars) as required. | Pre-construction & construction phase | Contractor / TWAD                                       |

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|   |                       |   |  |                               |
|---|-----------------------|---|--|-------------------------------|
|   |                       | <p>ii) Identify the number of trees that will be affected with girth size &amp; species type along the sewer mains, pumping / lifting station sites and sewerage treatment plant site. The details to be indicated on map to scale and/or a strip map as may be appropriate. Prepare tree cutting schedule to facilitate clearance requirements</p> <p>iii) Trees identified for cutting shall be removed from the construction sites before commencement of construction with prior permission from the concerned department.</p> <p>iv) Undertake tree plantation (not less than three rows inside and along the boundary of STP, and compensatory plantation as per the tree cutting clearances).</p> <p>v) Compensatory plantation by way of Re-plantation of at least twice the number of trees cut should be carried out in the project area.</p> |  |                               |
| 3 | Utility Relocation    | <p>i) Identify the common utilities to be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc</p> <p>ii) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.</p> <p>iii) provide advance notice (not less than 10 working days) to affected parties. The advance notice shall be in the form of written notice and a grievance redressal cell shall be established for timely addressing of grievances</p>   | Pre-construction & construction phase                      | TWAD/ Concerned departments   |
| 4 | Baseline parameters   | Adequate measures shall be taken and checked to control the Baseline parameters of Air, Water and Noise pollution. Base line parameters shall be recorded and ensured conformance till the completion of the project. The monitoring requirements, at minimum shall comply with consent conditions by the pollution control board   | Pre-construction, construction and post-construction phase | Prospective contractor / TWAD |
| 5 | Planning of temporary | i) Temporary diversion will be provided with the approval of the  | Pre-construction &   | Prospective contractor /      |

|   |                                  |   |                                       |                               |
|---|----------------------------------|---|---------------------------------------|-------------------------------|
|   | Traffic arrangements             | <p>engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, at least two weeks prior to commencement of works.</p> <p>ii) The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen.</p> <p>iii) Any accidents and/or risk of inconveniences caused to the community shall be borne by the contractor</p>                                    | construction phase                    | TWAD                          |
| 6 | Disposal of treated waste water. | <p>i) The construction activities at STP shall be initiated only after consent to establish certificate is secured from the TNPCB</p> <p>ii) STP operations shall take place only after Consent to Operate certificate is accorded by the TNPCB and the treated water quality shall comply with the consent conditions stipulated by TNPCB or at minimum shall meet the discharge standards depending on the type of receiving waterbody (stream / nullah /open land /irrigation purposes, etc.)</p> <p>iii) performance standards shall always be maintained, Ensuring efficient working condition of treatment plant.</p> | Pre-construction & construction phase | ULB/TWAD                      |
| 7 | Storage of materials             | The contractor shall identify the site for temporary use of land for construction sites /storage of construction materials, etc. These sites shall be operated only after prior approval of the engineer.   | Pre-construction & construction phase | Prospective contractor / TWAD |
| 8 | Construction of labour camps     | <p>Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp.</p> <p>The location, layout and basic facility provision of each labour camp will be submitted to Engineer</p>  | During the construction               | Prospective contractor        |

|  |  |   |  |  |
|--|--|---|--|--|
|  |  | <p>prior to their construction.</p> <p>The construction will commence only upon the written approval of the Engineer.</p> <p>The contractor shall maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer.</p> <p>All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be planned. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided should be prepared and shall be approved by the engineer. The construction camp shall not be located within 1000m from the nearest water stream, residential areas and/or any sensitive land uses like schools, hospitals, etc.</p> |  |  |
|--|--|---|--|--|

|     |  |   |                                   |                                   |
|-----|--|---|-----------------------------------|-----------------------------------|
| 3.  | CONSTRUCTION STAGE                                       |   |                                   |                                   |
|     | Construction of Sewerage Treatment Plant                 |   |                                   |                                   |
| 3.1 | Compensatory plantation of trees                         | Compensatory plantation of atleast twice the number of trees felled should be done in line with competent authority guidelines.   | Pre-construction and Construction | Prospective contractor / ULB/TWAD |
| 3.2 | Protection of top soil & Environmental enhancing         | The top soil to be protected and compacted after completion of work. Top soil from the STP area should be stored in stock piles and that can be used for gardening purposes at WTP site which will be an environmental enhancing measure.   | During construction               | Prospective contractor / TWAD     |
| 3.3 | Disposal of construction debris and excavated materials. | A suitable site should be identified for safe disposal, in relatively low lying areas, away from the water bodies, residential and agricultural fields etc., and got approved by the Engineer. Care should be taken that dumped material does not affect natural drainage system. | During construction               | Prospective contractor / TWAD     |

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|-----|--|---|-----------------------------------|-------------------------------|
| 3.4 | Pollution from Fuel and Lubricants       | <p>i) The contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from rivers and irrigation canal/ponds.</p> <p>ii) All location and lay-out plans of such sites shall be submitted by the Contractor prior to their establishment and will be approved by the Engineer.</p> <p>iii) Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground.</p> <p>iv) Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines.</p> <p>v) Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.</p> | Construction and operation.       | Prospective contractor / TWAD |
| 3.5 | Contamination of ground water quality    | <p>i) Groundwater quality may get contaminated due to leaching of waste water. So, the treated water quality shall comply with the standards laid down by the PCB for disposal onto land, water body or for irrigation use.</p> <p>ii) Regular monitoring is required for the treated sewage quality and also the ground water quality in the near by areas and ensures compliance with PCB standards.</p>  | During construction and operation | Prospective contractor / TWAD |
| 3.6 | Water Pollution from Construction Wastes | The Contractor shall take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system.   | During Construction               | Prospective contractor / TWAD |

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|------|-----------------------------------|---|--|------------------------------------|
|      |                                   | All waste arising from the project is to be disposed off in the manner that is acceptable by the Engineer.  |  |                                    |
| 3.7  | Impact of surrounding areas       | To avoid the problems of foul smell polluted air, insects, noise pollution and other problems buffer zones to be provided in the form of green belt around the STP site, this has to be strictly ensured.   | During Construction                                  | Perspective contractor / TWAD      |
| 3.8  | Informatory Signs and Hoardings   | The contractor shall provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required or as suggested by the Engineer.  | During construction                                  | Prospective contractor / TWAD      |
| 3.9  | Risk from Electrical Equipment(s) | The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that -<br>i) No material shall be stacked or placed as to cause danger or inconvenience to any person or the public.<br>ii) All necessary fencing and lights will be provided to protect the public in construction zones.<br>All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer. | During construction                                  | Prospective contractor             |
| 3.10 | Disposal of treated waste water.  | i) The treated water quality shall comply with the standards of TNPCB before let out into the stream / nullah /open land /irrigation purposes, and necessary permission to be obtained from the concerned department.<br>ii) Ensure efficient working condition of treatment plant.<br>iii) Prevent the pollution of stream water and other water bodies receiving STP discharge.   | Pre-construction / construction and operation stage. | TWAD / ULB /Prospective contractor |

|      |                          |   |   |                                 |
|------|--------------------------|---|---|---------------------------------|
| 3.11 | Disposal of sludge       | A suitable site should be identified for the safe disposal of sludge generated at the STP site and got approved by the Engineer. Prepare a sludge disposal plan and adheres to the same.  | Pre-construction, construction and operation. | Prospective contractor ULB/TWAD |
| 3.12 | Labour camp & facilities | <p>Setting up of labour camps needs to be done as per the procedures. Adequate potable water facilities, sanitation and drainage etc., in conformity with the Indian labour laws shall be ensured.</p> <p>The contractor shall also guarantee the following:</p> <p>i) The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction.</p> <p>ii) The construction will commence only upon the written approval of the Engineer.</p> <p>iii) The Contractor shall construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.</p> <p>iv) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities.</p> <p>v) The sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Ensure adequate water supply is to be provided in all toilets and urinals.</p> | During Pre-construction and construction      | Perspective contractor / TWAD   |
| 3.13 | Safety Aspects           | <p>i) Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall conform to the relevant Indian standards Code and shall be regularly inspected by the PIA.</p> <p>ii) Where loose soil is met with, shoring and strutting shall be</p>   | During construction                           | Prospective contractor          |

|      |           |   |                     |                        |
|------|-----------|---|---------------------|------------------------|
|      |           | <p>provided to avoid collapse of soil.</p> <p>iii) Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc.</p> <p>iii) Welder's protective eye-shields shall be provided to workers who are engaged in welding works.</p> <p>iv) Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.</p> <p>v) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs.</p> <p>The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract.</p> <p>The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to.</p> <p>The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form.</p> |                     |                        |
| 3.14 | First Aid | <p>The contractor shall arrange for :</p> <p>i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone</p> <p>ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital</p>  | During construction | Prospective contractor |

|     |  |  |                     |                        |
|-----|--|--|---------------------|------------------------|
| 4.0 | Environmental enhancement and special issues |  | Implementing Agency | Location               |
| 4.1 | Flora and Chance found Fauna                 | <p>The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal.</p> <p>If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Engineer and carry out the Engineer's instructions for dealing with the same.</p> <p>The Engineer will report to the near by forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.</p>   | Project area        | Prospective contractor |
| 4.2 | Chance Found Archae-ological Property        | <p>All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation.</p> <p>The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer of such discovery and carry out the SC's instructions for dealing with the same, waiting which all work shall be stopped.</p> <p>The Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.</p> | Project area        | Prospective contractor |
| 4.3 | Monitoring of environment parameters         | The contractor shall undertake seasonal monitoring of air, water, noise and soil quality through an approved monitoring agency. The parameter to be monitored, frequency and duration of monitoring  | Project area        | Prospective contractor |

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|     |   |  |                    |                        |
|-----|---|--|--------------------|------------------------|
|     |   | plan shall be prepared   |                    |                        |
| 4.4 | Sensitive Areas                                   | The sensitive areas like Schools, hospitals to be provided with suitable noise barriers and safety measures, prior to the start of work in order to minimize the dust and noise impacts due to vehicle movement during construction and their effectiveness to be checked during operation phase .   | Project area       | Prospective contractor |
| 4.5 | Clearing of construction of camps and restoration | Contractor to prepare site restoration plans for approval by the engineer. The plan is to be implemented by the contractor prior to demobilization. On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the contractor's expenses, to the entire satisfaction of the engineer.  | Corridor of Impact | Prospective contractor |
| 4.6 | Tree Protection,<br><br>Tree Planting,            | Giving due protection to the trees that fall in the shoulders /corridor of impact shall be the prime focus during Construction/post construction<br>Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars, use of plate compactors near trees may also be considered where necessary<br>Re-plantation of at least twice the number of trees cut should be carried out along the project road. Since the major portion of the project road may pass through open lands, planting of trees along the entire stretch of the road is recommended as an enhancement measure.<br>Growth and survival of trees planted shall be ensured and monitoring done at least for a period of 3 years .Survival status shall be reported on monthly basis to Engineer incharge. | Corridor of Impact | Prospective contractor |

#### 7. Environmental Monitoring Plan

To monitor the extent of environmental impact of the proposed project, the contractor has to periodically monitor the ambient environmental quality along the proposed project area. The monitoring requirement for the different environmental components is presented in table below.

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**Table 5:**

|                                 |  |
|---------------------------------|--|
| <b>Air Quality Monitoring</b>   |  |
| Project stage                   | Pre Construction , Construction & operation period (as agreed)   |
| Parameter                       | SPM, RPM, SO <sub>2</sub> , NO <sub>x</sub> , CO and Pb  |
| Sampling Method                 | Use method specified by CPCB for analysis  |
| Standards                       | Air (Prevention and Control of Pollution) Rules, CPCB, 1994  |
| Frequency                       | Once before start of work & once every season of the year during construction period & upto 18 months (operation Period)   |
| Duration                        | Continuous 24 hours / or for 1 full working day  |
| Location                        | Sensitive locations along the pipe laying work, pumping / lifting station locations, STP site.   |
| Measures                        | Wherever air pollution parameters increase above specified standards, additional measures as decided by the engineer shall be adopted  |
| Implementation                  | Contractor through approved monitoring agencies  |
| Supervision                     | Implementing agency  |
| <b>Water quality Monitoring</b> |  |
| Project stage                   | Pre Construction & Construction  |
| Parameter                       | pH, BOD, COD, DO, TDS, Pb, Oil & Grease and Detergents for Surface water.<br>Water pH, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater.   |
| Sampling Method                 | Grab sample collected from source and analysis as per Standard Methods for Examination of water and Waste water  |
| Standards                       | Indian standards for Inland Surface Water (IS; 2296, 1982) and for Drinking water (IS; 10500, 1991)  |
| Frequency                       | Twice a year (pre monsoon and post monsoon seasons) during the construction period   |
| Duration                        | Grab sampling  |
| Location                        | Locations to represent residential, agricultural, surface water quality and vicinity of the construction site.   |
| Measures                        | At locations of increased in water pollution, all inflow channels shall be checked for pollution loads and channel delivering higher pollution loads and channel delivering higher pollution load shall be terminated from disposal into the water source and other methods of disposal shall be adopted |
| Implementation                  | Contractor through approved monitoring agencies  |
| Supervision                     | Implementing agency  |
| <b>Noise Level Monitoring</b>   |  |
| Project stage                   | Pre Construction , Construction & operation period (as agreed)   |
| Parameter                       | Noise level on dB (A) scale noise levels on dB (A) scale   |
| Special guidance                | Free field at 1 m from the equipments whose noise level are being determined.<br>Equivalent noise levels using an integrated noise level meter kept at a distance of 15m from edge of pavement   |
| Standards                       | MoEF Noise Rulers, 2000  |
| Frequency                       | Once every seasons (except monsoon) for each year of construction  |

|                                |  |
|--------------------------------|--|
| Duration                       | Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged   |
| Location                       | Wherever the contractor decides to locate the equipment yard. At sensitive location such as school, hospitals etc                        |
| Measures                       | Incase of noise levels causing disturbance to the sensitive receptors, management measures as suggested in the EMP shall be carried out. |
| Implementation                 | Contractor through approved monitoring agencies  |
| Supervision                    | Implementing agency  |
| <b>Soil Quality Monitoring</b> |  |
| Project stage                  | Pre Construction & Construction  |
| Parameter                      | Monitoring of Pb, SAR and Oil & Grease   |
| Sampling Method                | Sample of soil collected to be acidified and analysed using absorption spectrophotometer   |
| Standards                      | Threshold for each contaminated set by IRIS database of USEPA until national standards are promulgated                                   |
| Frequency                      | During the pre monsoon post monsoon seasons each year for the entire construction period   |
| Duration                       | Grab sampling  |
| Location                       | At productive agriculture lands abutting traffic detours, pumping / lifting station locations and STP site.                              |
| Measures                       | At location of increased in pollution levels, source shall be identified and shall be diverted from future disposal                      |
| Implementation                 | Contractor through approved monitoring agencies  |
| Supervision                    | Implementing agency  |

Apart from the above mentioned monitoring requirements, any major accidents / spillage during bulk transport of hazardous materials. Depending on the type of spillages / accidents the parameters to be monitored will be decided by the engineer and should be carried out by the contractor through approved monitoring agencies and supervised by the Implementing agency at their own cost.

#### 8. FORMATS FOR REPORTING:

Formats for reporting / monitoring the progress / parameters achieved will be finalized in consultation with the successful bidder.

#### 9. Environmental Compliance Report

The contractor shall submit a monthly progress report as per the reporting format approved by the engineer, on the status of the implementation of the EMP, and get it duly approved by the engineer for its compliance and for proceeding with the work. The Engineer and the Environmental and Social Safeguard (ESS) Manager, who will have access and authority to monitor the status based on the same and for which necessary facilities shall be made by the contractor.

#### 10. Environmental Protection Work

10.1 The Contractor shall have to take following measures during construction and commissioning of works for protection of environment as under to avoid environmental impacts on air, water and land.

## 10.2 Site Clearance

The site clearance shall be done with minimum damage to existing structures flora and fauna, electricity and telephone lines and other infrastructure service.

## 10.3 Earth Work and Excavation

The Contractor shall inform the local authorities / government if any fossils, coins artifacts of value or antiquity, structures and other remains of geological or archaeological interests and excavation shall be stopped until identification of cultural relics by the authorised institution is completed.

The Contractor shall dispose off surplus / waste material at identified sites approved by the Engineer. The Contractor shall ensure that there is minimum hindrance to normal activities and business. The Contractor shall avoid damage to permanent structures and shall avoid loss of standing crops along the road.

## 10.4 Replantation

The Contractor shall carry out Replantation on areas / on the periphery of construction sites to minimize visual impact and soil erosion. The Contractor shall pay special attention to the type of trees to be replanted to prevent fouling of water through falling leaves and bird droppings. A list showing the type of trees to be replanted will be got approved before replanting any trees.

## 10.5 Soil Erosion and Water Quality

The Contractor shall ensure that earth and stone do not silt up existing irrigation /drainage systems.

The Contractor shall take suitable measures to prevent direct discharge of polluted waters form construction activity into lakes/rivers/irrigation channels.

The Contractor shall minimize exposure of soil types susceptible to wind and water erosion.

The Contractor shall control run-off and erosion through proper drainage channels and structures.

## 10.6 Soil Compaction

The Contractor shall restrict traffic movements and use low ground pressure machines.

The Contractor shall preserve topsoil to be replaced after completion of construction activity.

The Contractor shall avoid wet soils.

## 10.7 Social Disruption

The Contractor shall minimize interruptions to utility services through proper planning and scheduling of activities.

The Contractor shall provide temporary roads and diversions as may be necessary for smooth flow of traffic.

The Contractor shall preferably use local labour / Skilled persons during construction.

#### 10.8 Dust / Air Pollution

The Contractor shall provide effective dust control through sprinkling / washing of construction sites and access roads.

The Contractor shall cover / water stockpiles and storage areas to prevent dust pollution.

The Contractor shall cover trucks transporting construction materials to minimize spills.

The Contractor shall have a preventive maintenance program for construction equipment and vehicles to meet emission standards.

#### 10.9 Noise Pollution

The Contractor shall normally undertake construction work during daytime only (between 6.30 to 18.00 hrs) and when authorized to work beyond these hours adopt suitable noise control methods during such works.

The Contractor shall maintain machines and trucks to keep them with low noise.

The Contractor shall install sound barriers and plant tree as appropriate during construction.

#### 10.10 Construction Camps

The Contractor shall take adequate measures such as provision of septic tank/pit latrines at construction site / camps.

The Contractor shall provide crèches to working women labour.

The Contractor shall provide drinking water conforming to IS: 10500

The Contractor shall provide garbage cans at suitable fixed place and have the garbage disposed off regularly.

#### 10.11 Aesthetic Improvement

The Contractor shall through proper house keeping enhance aesthetic appearance of construction sites.

The Contractor shall dispose-off construction wastes at approved disposal sites.

The Contractor shall repair pavements immediately following construction pipeline and appurtenant structures.

The Contractor shall remove after completion of construction, all temporary structures and restore the project and surrounding areas nearest possible to the pre construction condition.

#### 10.12 Conservation of Ecological Resources

The Contractor shall not use farmland and forest belts as materials borrow sites.

The Contractor shall not select arable land as material borrows site. In case excavation in arable land is unavoidable, topsoil layer (30 cms. depth) shall be saved and returned after construction work is completed so as to minimize impacts on ecosystem, agriculture and animal husbandry.

The Contractor shall educate construction workers to protect natural resources, wild plants and animals.

#### 10.13 Risk Of Accidents

The Contractor shall provide efficient lighting equipment and safety signs on temporary roads during construction and shall adopt and implement adequate traffic regulation.

The Contractor shall take effective safety and warning measures to reduce accidents.

The Contractor shall provide suitable temporary crossings to facilitate normal life and business.

#### 10.14 Responsibility For Accidents, Damages Etc.

The care of the whole of the permanent work until their completion and the whole of the temporary work until their removal shall remain with the Contractor who shall be responsible for all accidents or damages from whatever cause arising and chargeable for anything that may be stolen, removed, destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said Works or to any property adjoining or any cause whatever, whether such damage or defects were occasioned by the negligence of the Contractor or not or may be or might have been discovered during the progress of the works or in consequence thereof, or shall appear to be known after the completion whereof or whether payment may wholly or partially have been made or the Works approved as supposed to have been properly done, and no certificate or approval of any works by any officers or members of the Employer shall effect

#### 10.15 Noise Monitoring

##### a. Monitoring Frequency:

- a) During construction period: 12 times a year each time including day and night.
- b) During Commissioning period: 4 times ad hoc monitoring will be taken.
- c.) During construction period: Near construction sites, factory sites and sensitive areas.

## XIV. MAINTENANCE OF SEWERAGE SCHEME

### GENERAL

On completion of the construction, trial operation and commissioning of all the components of the project, **Operation and Maintenance for a period of 12 months as per BOQ will commence.**

It is the sole responsibility of the contractor to successfully operate and maintain the entire project comprising sewage collection system, pumping station, pumping main & STP for the maintenance, period of 12 months.

The following measures are to be taken essentially by the contractor  
Necessary maintenance crew with supervisory staff shall be deployed as specified. The entire strength of maintenance crew with the supervisory personnel should be available from the first day of the maintenance period.

The staff to be deployed shall be adequately qualified for the performance of the job and trained in operation of electrical equipments, pumps, etc and also capable of identifying and managing trouble shooting of faults and attend minor repairs.

The contractor should keep all spares required for replacements at the sewer line, pumping stations, pumping main, sewage treatment plant, etc as recommended by the respective manufactures readily available to ensure proper functioning of the sewerage system.

All the equipments that go out of order during the course of the maintenance period shall be rectified/ replaced within a week's time or such longer time as approved by the employer, to ensure uninterrupted operation of the plant.

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.

On completion of O&M period of 12 months, the contractor shall hand over to the employer in good working condition all the components of the project taken over by him as mentioned in para 1 above.

One set of as laid plans of all the components of the project - Architectural, mechanical, instrumentation, piping drawings, sections details charts etc., with modifications as carried out (with the approval of employer) shall be supplied. Operating and maintenance manuals supplied by manufacturer and Step by step procedures for all operation requirements and adjustments required shall be given.

The contractor shall carry out the works observing all safety precautions. The owner shall be indemnified for any accidents that may occur at the site.

The contractor shall follow all the rules and regulations of statutory authorities Government agencies etc. The owner shall be indemnified against any failure.

The contractor shall take necessary insurances for the property and labour etc., The owner shall be indemnified against any failure.

CONTRACTOR

CHIEF ENGINEER/TNJ

The contractor shall pay all fines, penalties etc., imposed by various agencies for non performance / non adherence to rules in connection with his work. The owner shall be indemnified.

## **DUTIES AND RESPONSIBILITIES**

### **A) SEWER MAINTENANCE**

The total length of sewerage system as per the contract including appurtenances such as Manholes, Drop manholes, pumping mains, Interconnections and HSC. The depth ranges from 1.0 m to 5.0 m. The cost of staff, fuel and other consumables etc shall be borne by the contractor. No other sewer cleaning equipment will be supplied by the employer. The jet rodding machine shall be kept in operating condition always.

No unauthorised connection shall be given to the sewerage system under the control of the O & M contractor.

Sewer inspections and maintenance should be planned. The whole sewerage system should be marked on a plan and divided into sections and areas. The schedule for the preventive maintenance of the sewers shall be submitted by the contractor and got approved from the employer in advance.

#### **Preventive Maintenance**

In order to maintain the sewer system in satisfactory manner, desilting of manholes and sewers to be done by any of the following methods suitable for the purpose.

- a) By manually by ball passing method
- b) By drag bucket machine
- c) By jet rodding machine

A yearly programme should be given for desilting so that each street is covered once in a year.

#### **Breakdown Maintenance**

The work of each sewer maintenance gang would consist of the following:

- a) The house sewer obstruction and main sewer obstruction or any other related complaints has to be attended with in the stipulated period as given in the enclosed table.
- b) The sewer line leaks complaints are to be attended with in the stipulated period as prescribed.
- c) Any silt or mud removed during sewer cleaning operation shall be removed from the roads with in 24 hours to approved location..

Penalties for non compliance of various activities are given in Annexure

It shall be the responsibility of the contractor to arrange for traffic control and to obtain permission from concerned agencies for traffic diversion etc for purpose of maintenance. All necessary precautions shall be taken.

#### **Performance level to be achieved**

1. Collection system shall be maintained without overflows from manholes/sewers on to streets or into side drains.
2. Silt and trash removed from sewers during removal of blockages / routine cleaning of sewers shall be disposed of hygienically within 24 hours.
3. Preventive maintenance shall be carried out as per approved schedule.
4. Duration of breakdown maintenance shall not exceed the specified norms.
5. All records as mentioned in Annexure shall be maintained.

6. All safety precautions shall be taken in sewer maintenance as listed in Annexure to avoid accidents.

## **B) PUMPING STATIONS**

### **General**

The one number of pumping station shall be operated and maintained by the contractor for a period of 12 months.

It comprises of LT installation.

The pumping station with submersible pumpset generally consists of screen well, grit well and wet well/pump well.

### **Maintenance of screen well**

Screening shall be removed at least once per shift and tile removed screening shall be removed from the pumping station campus each day and disposed of hygienically in an approved manner.

### **Grit well**

Degritting shall be done at least once in a day during day shift. The grit shall be removed from the pumping station campus each-day and disposed of hygienically in an approved manner.

### **Facilities for maintenance and Repairs**

Adequate stock of consumable such as me lubricating oil and transformer oil should be maintained.

To avoid downtime, stock of fast moving spares and spares likely to be damaged by short circuit should be maintained. A set of recommended spares for two years of double free operation should be ordered along with the equipments.

Tools such as crimping tools, soluunug, Imizing and usual electrical tools should be available.

Usual test equipment such as megger, AVO-meter (Multi-meter), tong tester, vibration-tester, noise level tester, tachometer should be available.

### **Preventive Maintenance**

The schedule covers recommendations for checks and remedial action to be taken at different periodicities such as daily, monthly, quarterly and annually.

## **DAILY**

### **1. Pump and Motor**

Check for any undue noise or vibration.

### **2. Panel, Circuit-Breaker, Starter**

Check the phase-indicating lamps

Note readings of voltage, current, frequency and others

Note energy-meter readings.

Check the indication lamps functioning

Check the functioning of Interlock switches

### **3. Transformer Substation**

Note voltage and current readings.

## **MONTHLY**

### **Pump and motor**

1. The electrodes/Float switches should be cleaned for smooth working of pump.

2. Panel, Circuit Breaker, Starter Examine contacts of relay and circuit-breaker - Clean, if necessary Check setting of over-current relay, no-volt coil and tripping mechanism and oil in the dash-pot relay. Check the condition of capacitor bank - If oil filled, check for leakage

3. Transformer Substation

Check the level of the transformer oil

Check the operation of the Air Break Isolator

Check contacts of Air Break Isolator

Check temperatures of the oil and windings

Clean radiators to be free of dust or scales

Pour 3 to 4 buckets of water in each earth-pit.

Check the condition / colour of silica gel and reactivate or change

## QUARTERLY

Panel, Circuit-Breaker, Starter and others

Check fixed and moving contacts of the circuit-breakers/switches. Check and smoothen contacts with fine glass-paper or file

Check condition and quantity of oil, auto-transformer starter and rotor-controller.

Check the condition of Air Break Switches; its contacts by taking out from the Panel.

Transformer substation

Check condition of the H.T. bushing

Check the condition of the de-hydrating breather and replace the silica gel, if necessary. Reactivate old for reuse

Check for any plant growth within the yard and remove the same.

## ANNUAL

a) Pump and Motors

The pump portion should be overhauled completely to check the clearance and to replace the worn out parts. Clearance between impeller and casing ring and casing cover are important. If abnormal corrosion or erosion is observed in any component, the same shall be replaced.

Check end – play of bearing and reset by lock-nuts, wherever provided.

b) Panel and others

All indicating meters should be calibrated

c) Transformer substation

Check resistance of earth pit/earth electrode. If earth resistance is below 1 ohm, improve the conditions.

Check dielectric strength oil. It should be 50 kv/min. If not filtration of oil has to be done.

## TROUBLE SHOOTING FOR ELECTRICAL EQUIPMENTS

Trouble-shooting comprises of detecting the trouble, diagnosing the cause and taking remedial action. Detection of the trouble is prompted by noticing symptoms. The trouble-shooting details are hence outlined here below for various symptoms.

Symptom : Starter/Breaker Trips

Check whether the relay is set properly. Correct the setting, if necessary

This can happen also if motor is getting over-loaded for which details are mentioned above  
Tripping can also be due to short-circuiting or single-phasing, which are also discussed above

Oil in dashpot relay may be either inadequate or of low viscosity

Check that there are no loose connections

Check whether the timer setting of star delta or auto transformer starter are proper

## **CABLES**

1. Check the insulation of cables, check in detail the current carried by the cable Cable.
2. When more than one run of cable is provided in any equipment, check the tightness of lug connection in the bus bar and terminals.

## **DIESEL GENERATING SET**

1. Diesel Generating set has been provided in the sewage pump house, for operation in case of failure of power supply from TNEB. As such it is essential that the DG set should be kept always in working condition. The manufacturer's Maintenance Schedule as prescribed shall be followed. Spares recommended by the manufacturer shall be stocked.
2. Check the condition of Battery, voltage and specific gravity of acid weekly.
3. Check the functioning of the battery charger - current and voltage - daily.
4. Check whether sufficient quantity of diesel is in stock - weekly.
5. Check for any leakage in the oil tank.
6. Maintenance after 10 hours of operation - checking of oil level, clutch, air purifier, oil tiller, radiator water and cleaning of diesel injectors.
7. Maintenance after 50 and 100 hours of operation - oiling of clutch.
8. Maintenance after one year or 200 hours operation whichever is earlier.
  - Oil Change
  - Checking of generator gauges and their recalibration where necessary
  - Checking of electrolyte (acid concentration) in the accumulators
9. Maintenance after 6 months.  
A specialist shall on behalf of the Contractor check the generator in accordance with the manufacture's instructions and shall prepare a report on its condition including all its component parts.
10. The Diesel Generating set has to be started once in a week and pumps have to be operated with diesel generator load disconnecting TNEB supply at least for 1½ hours, specially during peak flow period.
11. While the DG set is running following check shall be carried out:
  - a. Engine temperature - oil temperature
  - b. Functioning of lubricating oil system
  - c. Functioning of water cooling or air cooler system as the case may be
  - d. Abnormal sound if any in, the engine or alternator
  - e. Condition of coupling between, diesel engine and generator
  - f. Bearing noise in the Motor
  - g. Voltage generated
  - h. Functioning of other meters (Ammeter, PF Meter), KWH meter, Pressure gauges
  - i. Working of Dynamo for charging the battery(wherever provided)
12. Repainting of metal work shall be carried out as needed, but not less than once every 2 ½ years.
13. General checking - Tightness of foundation bolts and nuts - once in 3 months  
Tightness of alternator Terminal Connection - once in 3 months

- Vibration of the unit while in operation if any.  
 Functioning of protective systems - in Diesel Generator later, etc once in 3 months
14. AMF Panel - Where AMF Panel has been provided functioning of AMF panel.  
 Function of Interlock between mains incoming TNEB supply Circuit Breaker and DG Supply Circuit Breaker once in 3 months.

## **VALVES**

1. Check valves and sluice gates operation - once in 2 months
2. Check non return valve - once in 6 months

## **Performance Level to be achieved**

The pumping plant shall be operated in such a manner that

1. There shall be no backing of sewage in the incoming sewers.
  2. Carrying out preventive maintenance of all equipment as per schedule.
  3. Maintain power factor as prescribed by TNEB. Penalty levied by TNEB for any failures in this regard shall be borne by the contractor. .
  4. Pumping station shall be maintained in clean and hygienic condition.
  5. All equipment shall be in working condition.
- A. Good house keeping - building - and surrounding clean and free of dust, cobwebs and screenings, grit etc.
- B. Electrical consumption to be optimum. The designated pumps, shall be operated for the corresponding levels of discharge.

## **C) Pumping mains**

### **General**

The list of pumping main to be operated and maintained by the contractor is annexed.

### **Preventive Maintenance**

The pumping main shall be inspected once in 3 months and checked for proper functioning of valves (Air valve etc)' and for signs of leakage. Any defects noticed shall be rectified within a period of 3 days.

### **Breakdown maintenance**

Any pipe bursts shall be informed to the employer immediately . It shall be rectified within a period of 3 days.

Penalty for non compliance for various activities are given in Annexure.

## **Performance Level to be achieved**

The pumping main shall function without leakage and bursts. Any leakage/bursts shall be attended to within the stipulated time.

**3) PENALTY FOR DEFICIENCIES IN OPERATION AND MAINTENANCE IS LISTED BELOW:**

**Table 6:**

|          |  | Nature of Deficiency  | Penalty                                  |
|----------|--|---|--|
| <b>1</b> | <b>Deficiency in manpower</b>                                    |   |  |
|          | Maintenance Engineer[AEE]  | Not present on duty   | Rs 200 per day.                          |
|          | Lab Chemist [PG chemistry Holder]                                | Not present on duty   | Rs. 450 per day                          |
|          | Electrician / Operator   | Not present on duty   | Rs.100 per day                           |
|          | watchman/ Mazdoor/ Staff/ Helper/                                | Not present on duty   | Rs.60 per day                            |
| <b>2</b> | <b>Deficiency in Service</b>                                     |   |  |
|          | Overflow from manholes   | Not attended upto 3 days                                      | Rs.5000 per day every day beyond 3 days. |
|          | Sewer leaks  | Not attended upto 3 days                                      | Rs.100 per day beyond 3 days.            |
|          | Clearing of site   | Not attended upto 1 day                                       | Rs.100 per day beyond 1 day.             |
|          | Main Sewer Obstruction   | Not attended upto 3 days                                      | Rs.100 per day beyond 3 days.            |
|          | Not wearing safety belt and adopting safety measures as required | Any time on duty  | Rs.500 per occurrence                    |
|          | Non-observance of Preventive Maintenance Schedule                | Any time on duty  | Rs.500 per occurrence                    |
| <b>3</b> | <b>Pumping Station</b>   |   |  |
|          | Allowing water level to rise up beyond permissible level         | Occurrence any time   | Rs.100 per occurrence                    |
|          | House Keeping  | Not kept up tidy  | Rs.100 per day                           |
|          | Delay in getting the pumps repaired within specified period      | To be specified by the employer considering type of equipment | Rs.500 per day                           |

**4. ENERGY CONSUMPTION**

The electrical energy consumed for the operation of the pumpsets and other pumping station accessories shall be paid by the employer direct to the TNEB.

The Contractor shall ensure strict economy in electricity usage for lighting and as well as for pumping sewage by using high duty pumps only when the rate of flow to the pumping station cannot be handled satisfactorily by low duty pumps. All level controls shall be maintained in operating condition always.

CONTRACTOR

CHIEF ENGINEER/TNJ

Any diversion of electricity from the sewerage project installations for unauthorized purpose will invite severe penal action as directed by the Engineer.

In the pumping stations where the HT supply has been availed, maximum demand in KVA is to be controlled. The operator should ensure that the maximum demand in KVA does not shoot up in any case than the contractual maximum demand, since any excess over the contractual maximum demand invites double the cost per KVA to be paid to TNEB. The maximum demand shall be fixed with reasonable margin by the Employer. The contractor shall train persons in all aspects and post suitable persons. In case of any excess over the fixed KVA as in the electric consumption statement for the maximum point of full designed capacity appended the excess amount to be paid to TNEB has to be borne by the contractor.

The power factor should be maintained at 0.95 and pumpsets shall operate at the efficiency specified by the manufacturer. Any excess consumption of electricity for not adhering to be above, the contractor has to bear the cost. The low power factor compensation charges levied by the TNEB has to be borne by the contractor. Diesel oil required for operation of pumping plants shall be paid for by the contractor.

## **SAFETY PRECAUTIONS**

### **1. Sewer Lines**

#### **Hazards**

Personnel engaged in operation and maintenance of sewerage systems including sewage pumping stations are exposed to different types of occupational hazards like physical injuries, injuries caused by chemicals and radioactive wastes, infections, caused by pathogenic organisms in sewage and dangers inherent with explosive or toxious vapours and oxygen deficiency.

Appropriate safety equipments are to be used. The workers should be trained in their jobs and should know all the possible hazards and the preventive measure to be taken.

#### **Traffic Control**

- a. Place easily readable and clear warning signs well ahead of work area.
- b. Barricade the space around the manhole for placing equipment and deposition of silt removed.
- c. Place barricades or signs to channelise the traffic, if possible.
- d. Use a flagman at the two ends for controlling flow of traffic from each , direction and to avoid a traffic jam, if the road is narrow and only one lane of traffic is possible.

#### **Manhole Safety**

- a. Ventilate the sewer line by opening two or three manholes on both the sides where work is to be carried out. This is more important when adequate blowers for ventilating sewers are not available. The manholes should be opened at least one hour before start of operations. The opened manholes should be properly barricaded to prevent any person especially children, accidentally falling into the sewer. Dummy covers with BRC welded fabric can be used.
- b. Where it is desirable to use the blowers, operate these for atleast 30 minutes before start and during cleaning operations to ventilate the lowest working levels.
- c. Use safety life line before entering the sewer line. Two helpers at the top should be provided for each person. The person standing at the top must send signals at every few minutes interval to the person in the manhole to ensure safety,
- d. Test for hazardous gases before entry of a person into the sewer line and also in between if the operations are for a longer time.

- e. Test manhole rungs or steps for structural safety before using.
- f. Ensure that where portable ladders are used, they are properly sealed or fixed.
- g. Ensure that no material or tools are located near the edge which can fall into the manhole and injure the workman.
- h. Lower all tools to the workman in a bucket.
- i. Use lighting equipment which must be explosion and fire proof.
- j. Use Gas masks when men have to enter into the sewer line.

### **Infection**

The personnel working in sewerage maintenance systems are prone to infections and hence the following precautions should be taken.

- i. Emergency first aid treatment kits shall be provided to take care of all , minor injuries like cuts and bumps.
- ii. A physician's services should be available for emergencies.
- iii. The workers should be educated about the hazards of waterborne diseases which as typhoid and cholera through sewage and tetanus through cuts and wounds, preventive inoculations should be given periodically to the workers.
- iv. The importance of personal hygiene should be emphasized and the workers should be instructed to keep finger nails short and well trimmed, wash hands with soap and hot water before taking food and to keep fingers out of nose, mouth and eyes, because the hands carry most infections.
- v. Use of rubber gloves should be insisted so that sewage or sludge does not come in direct contact with the hands.
- vi. The workers should be provided with a complete change of work clothes to be worn during working hours. Gum boots should also be provided for the workers.
- vii. In laboratory work, only pipettes with rubber teats should be used to prevent contamination of the mouth. Laboratory glassware should not be used for drinking purposes. In no event food should be prepared in the laboratory.

### **Safety Equipment**

The various safety equipments that are normally required in sewer maintenance work are gas masks, oxygen breathing apparatus, portable lighting equipment, non-sparking tools, portable air blowers, safety belts, inhalators and diver's suit.

The use of the particular safety equipment is governed by the detection of various gases and oxygen deficiency.

A knowledge of the type of gases, in the atmosphere and of the working location becomes essential for the selection of the right type of safety equipment. Simple tests for detection of various gases and oxygen deficiency Should be furnished to the workmen.

#### **a. Gas Masks**

General purpose gas masks are used for respiratory protection from low and moderately high concentrations of all types of toxic gases and vapours present in the atmosphere, in which there is sufficient oxygen to support life.

Persons using gas masks should practise regularly with them in order to become proficient in putting them on quickly and breathing through them.

Gas masks cannot be used in Oxygen deficient atmosphere, in unventilated locations or areas where large concentrations of poisonous gases exist.

#### **b. Breathing Apparatus**

This is designed for respiratory protection from atmosphere that contains very high concentrations of toxic gases and vapours or that are deficient in oxygen.

**c. AirHose Respirator**

This is used where a source of fresh air is available within a distance of 50 m from the working location. It is essential that the supply of air is obtained from an uncontaminated source.

Purified air is used where a source of fresh air is not available within 50 m to permit the use of an air hose respirator or in situations where an air hose would encumber the worker.

**d. Portable Lighting Equipment**

The equipment normally used are portable electric hand lamps of either 24 V or 110 V grade or permissible types, electrical cap lamps and explosion proof flash lights.

**e. Nonsparking Lighting Equipment**

These are made of an alloy (containing at least 80 percent of copper) that will not spark when struck against other objects and metals and yet retains the necessary strength and resistance to wear.

**f. Portable Air Blowers**

Forced ventilation of manholes, pits and tanks can be provided by portable air blowers. Special precautions should be taken to ensure that the blowers do not serve as a source of ignition for inflammable gases.

**g. Safety Belt**

This consists of a body belt with a bucket and a shoulder harness. The life line is of high grade spliced manila rope, nylon rope or a steel cable anchored with rings on each side of the belt and provided with safety straps for anchoring or securing to a stable support. The life line should be about 15 m in length and the overall assembly should be capable of withstanding a tensile load of 2000 kg. The safety belt and the life line should be tested by lifting the wearer clear of ground before each day's use.

**h. Inhalators**

Approved inhalators employing a mixture of oxygen and carbon dioxide are used for resuscitating victims of gas collapse, drowning or electric shock.

**i. Diver's Suit**

A good quality diver suit should be provided to the diver whose services are very necessary while plugging the sewer line or removal of some hard blockage due to stone etc at the mouth of the pipe in the manholes. Depending upon the site condition, the suit should have provision to connect an air line with compressor or oxygen cylinder.

**II. Pumping Station****Precautions to be taken at Pumping Stations**

When dealing with equipment:

- i. Always stop the machine before removing any guard.
- ii. See that power supply to the equipment is cut off. Place a warning board on the switch so that some body does not accidentally put it on.
- iii. Hoisting equipment should be able to lift the required load. Temporary support should be given to any machine or equipment jacked or hoisted up before going under it.
- iv. Keep tools in a bag or in a belt and not in the floor.
- v. When lubricating a machine in operation, fittings should be at least 30 cms from any moving part.
- vi. If oil or grease is spilt, clean up at once.

### **Precautions against Electrical Shocks**

- a. Only qualified and specially trained personnel should be allowed to operate and maintain electrical equipment at the pumping stations.
- b. All electrical controls should be kept dry and in good condition.
- c. No metal ladders or metal tapes should be used around electrical equipment.
- d. Insulated rubber mats should be provided before all electrical control panels and they should be kept dry.
- e. Always test wires for current before working on any electrical item.  
Use tools with insulated handles and rubber gloves.
- f. All precautions to be taken as per statutory regulations are to be adhered to.

### **III. Sewage Treatment Plant**

- a. Where chemicals are used, the required precautions as prescribed during storage and handling of chemicals are to be taken.
- b. Safety measure like using of safety helmets, safety belts, gum boots safety slices, goggles, gloves, etc are to be ensured depending on the operations performed.
- c. All safety precautions connected with work on electrical and mechanical installations to be followed.

### **RECORDS TO BE MAINTAINED BY CONTRACTOR**

The following record are to be maintained by the Contractor. The format for the records are to be approved by the Engineer/employer.

#### **1. Collection System**

- Attendance Register for staff
- Record of complaints received and action taken
- Log Books for Jet rodding machine
- Record of routine silt removal programme and compliance
- Order Book
- Register of H S connections given to be updated
- Register of Major Breakdown and Action Taken

#### **2. Pumping Stations and Pumping Mains**

- Details of installation
- Attendance Register
- Log book of Pump Operation including energy consumption
- Maintenance schedule for Electrical and Mechanical Equipments and Compliance Register
- Order Book
- Special Maintenance carried out during each shift if any
- Log Book for Diesel Generating Set including Diesel Consumed
- Log Book for screen and grit removal operation
- Register of Tools

#### **3. Pumping Main**

- Details of Installation
- Record of Inspection - leaks noticed, bursts and action taken

### **INSURANCE**

The contractor shall without limiting his or the employer obligation and responsibilities insure the works together with materials and plant for incorporation therein to the full replacement cost (term cost in this context shall include profit)

The contractor's Equipment and other things brought on to the site by the contractor for a sum sufficient to provide for their replacement at the site.

CONTRACTOR

CHIEF ENGINEER/TNJ

The firm/contractor shall provide risk insurance at their/his cost against loss or damages to the construction and to their workmen to cover from the start date to the end of the Defects liability period, for the following events.

- Personal injury or death
- Loss of or damage to the works, plant, material
- Loss of or damage to Equipment
- Loss of or damage of property (except the works, plant, materials, and equipment) in connection with the contract.

policies and certificates for insurance shall be delivered by the contractor to the Engineer for the Engineer's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred. The contractor will not be eligible for any payment on this account.

If the contractor does not provide any of the policies and certificates required, the Employer shall effect the insurance which the contractor should have provided and recover the premiums the Employer has paid from payments other wise due to the contractor or, if no payment is due, the payments of premiums shall be a debt due.

Alterations to the terms of an insurance shall not be made without the approval of the Engineer.

## **10) TERMINATION**

For the following reasons attributable to the contractor, (unless arising as a result of force majeure event or employer's default)

Non performance of material obligations or failure to perform material obligation under this contract.

Sustained inability for a continuous period of two weeks to meet alternative output standards following resumption of suspended operations at the facility :-

Sustained inability (for a continuous period of two weeks) to meet the minimum output standards.

If the cumulative liquidated damages in year exceeded the maximum liquidated damages.

Repudiation of this contract by the contractor or the evidencing of an intention by the contractor not to be bound by the terms of this contract.

The contractor ordered to be wound, up by a court or files a petition for voluntary winding up except for the purpose of amalgamation or reconstruction provided that such amalgamation or reconstruction does not adversely affect the ability of the amalgamated or reconstructed entity to perform its obligations under this contract, the successor has assumed in writing unconditional responsibility for the performance of the contractor's obligations and the technical financial and operating capability of the successor is satisfactory to the employer.

The contractor abandons the operation of the facility for a continuous period of 7 days.

### **Employers default**

The contractor shall be entitled to terminate this contract due to the following reasons attributable to the employer (unless arising as a result of a force majeure event or contractors default)

Commission of a material breach of material provision of this contract

Not with standing the provision above any event for which specific redressal has been provided elsewhere in this contract shall not constitute employers default.

**Termination due to force majeure**

Either party shall be entitled to terminate this contract if a force Majeure event is continuously in effect for a period of more than six months.

**Termination due to suspension**

The contractor is entitle to terminate this contract if a suspension of operations at the facility is in effect for a continuous period of six months provided that such suspension is not due to the default of the contractor.

**Exercising the right to terminate**

Any right to terminate this contract shall be exercised by either party within three months from the dale on which the right arises.

**Consequence of termination**

In the event of a contractors default or employer default (Even of Default) the termination procedures as set out in this; section shall apply.

**Notice of intent to terminate**

On the occurrence of an event of default, the non defaulting party may infinite termination of this contract by delivering a notice to the defaulting, party of intention to terminate this contract (Noticc of intent to terminate)

The notice of intent to, terminate shall specify with reasonable detail the defaults committed by the defaulting party.

**Remedy period**

Following (he service of the notice of intent to terminate, the defaulting party shall have a period of 30 days (Remedy period) to cure the Event of Default pursuant to which the notice of intent of terminate was issued.

During the remedy period the defaulting party may continue to undertake efforts to cure me default and me non defaulting party shall not by any act or omission, impede or otherwise interfere with the defaulting party endeavours to remedy the event of default. During the remedy period both the parties shall save as otherwise provided herein continue to perform their respective obligations.

**Withdrawal of notice of intent to terminate**

If during the remedy period the defaulting party rectifies or remedies the default to the satisfaction of the non defaulting party or the non defaulting parly is satisfied with steps taken or proposed to be taken by the defaulting party or the event of default giving rise to the notice of intent to terminate has ceased to exist, the non defaulting party shall withdraw the notice of intent to terminate in writing.

**Termination notice**

Upon the expiry of the Remedy period, unless the parties have otherwise agreed to or the event of Default giving rise to the Notice of intent to terminate has ceased to exist of the default has been rectified or remedied by the defaulting party, the non defaulting party may terminate this contract by giving a 30 days written notice (Termination Notice) to the. defaulting party.

Upon the expiry of such notice period (Termination Notice) this contract shall stand terminated.

### **Normal termination**

Unless otherwise provided for tills contract shall subject to termination under the provision of this contract expire five years from the date of issue of taking over certificate or after any extension mutually negotiated (Normal Termination)

### **Procedure for Normal Termination**

The employer shall issue a Normal Termination Notice atleast 6 months before the Normal Terminate Date.

### **Effects upon termination/normal termination**

Successor to the contractor upon the issue of the termination Notice by the non defaulting party (or) the receipt of the normal termination notice, the contractor shall use its best efforts to facilitate the appointment and commencement of duties of any person to be appointed by the employer to operate the facility and shall provide full access to the facility and all relevant information, data and records relating thereto by the Successor operator and its representatives and accede to all reasonable requests made by such persons in connection with preparing for taking over the operation and maintenance of the facility.

Promptly after termination/normal termination, the contractor shall deliver to and shall with effect from termination date hold on trust for and to me order of me employer (if so required by the employer by written notice) to the successor operator all property in its possession or under its control owned by the employer or leased or licensed to the employer.

The contractor if required so by the employer and to the extent allowed by such contracts, shall transfer to the successor operator as from the termination date its right as the contractor under all contracts entered into by it in the performance of its obligations under the contract relating to the operations and maintenance of the facility. Pending such transfer the contractor shall hold its rights and interest there under for the account and to the order of the successor operator provided that the employer shall indemnify the contractor for all liabilities incurred by the contractor under these contract as a. result of their continuation and performance by the Employer or as the case maybe by the successor operator Immediately upon the receipt of termination notice by either party (or) normal termination notice the designated key personnel of the employer shall be associated with the operations and shall be trained by relevant personnel of the contractor at me facility to facilitate smooth transfer to the employer/successor operator.

### **Cooperation following termination**

The contractor will upon termination / normal termination of this contract co-operate with the employer and the successor operator and comply with reasonable requests thereof, including the execution of documents and other actions.

### **Passing of risk**

Until the termination date the facility shall remain at the sole risk of the contractor and the contractor shall be solely responsible for any loss of or damage caused to or suffered by the contractor for any reasons whatsoever to whole or any part of the leased premises. Unless such loss or damage caused to or suffered by the contractor is due to any act of default or omission or negligence on the part of the employer.

### XV. UNDERTAKING

1. I/We ..... (Name, Age, Father's name and address of the contractor) are aware of the directions of the Hon'ble High Court of Madras in its order-dated 20.11.2008 in W.P.No. 24403/2008, and the orders of the government of Tamil Nadu in G.O (MS) No. 293, M.A & W.S (MW) Department, dated 26.11.2010, regarding the ban on manual scavenging and on the entry of sanitary workers into the sewerage system or septic tank. I/ We undertake to abide by the said directions of the High Court and Government order in this regard.
  
2. I/We shall not allow sanitary workers to enter into the sewerage system/septic tank for cleaning or maintenance operations except in the 4 circumstances permitted in the orders of the High Court in W.P.No. 24403, dated 20.11.2008. I/ we am/are aware that even in these 4 circumstances. I/ we should allow the workers to enter only with adequate safety gadgets and under the supervision of a qualified staff, and only after duly observing all safety precautions including testing for the presence of toxic gases.
  
3. I/We are aware that violation of the said directions of the Hon'ble High Court and the G.O will attract punishment under section 14 of the Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act 1993.
  
4. I/We should follow the orders given in the G.O..Ms.No.293/MA&WS(MW), Dept/dated.26.11.2010.
  
5. I /We would be responsible to pay a compensation of Rs.10.00 lakhs in the event of death of Workmen in the manhole/sewer system while cleaning it without safety gear and devices.

Signature of the Contractor  
with date and seal.

CONTRACTOR

CHIEF ENGINEER/TNJ

### **Annexure**

#### **Additional Conditions with the contractor in cases where the cleaning and maintenance of sewerage system (Including Septic Tanks) is outsourced.**

a. The Contractor shall strictly abide by the directions of the Hon'ble High Court of Madras in its order dated 20.11.2008 in W.P.No. 24403/2008, and the orders of the Government of Tamilnadu in G.O.(MS) No. 293, M.A & W.S (MW) Department, dated 26.11.2010, regarding the ban on manual scavenging and on the entry of sanitary workers into the sewerage system or septic tank. All cleaning and maintenance operations shall be done only through mechanical devices.

b. The Contractor shall not allow sanitary workers to enter into the sewerage system/septic tank for cleaning or maintenance operations except in the 4 circumstances permitted in the orders of the High Court in W.P.No. 24403, dated 20.11.2008 namely.

i. For the removal of concrete/ FRP manhole door which gets damaged due to the heavy vehicular traffic and often falls inside the manhole causing obstructions/blocks in the sewer and which results in the blockage of sewerage system and where mechanical equipments cannot be put into operation.

ii. For the purpose of inter-linking the newly laid sewer main with the existing sewer main, where it will be wholly necessary too block the main sewer main in the servicing manhole. Entry of sanitary workers on such occasions has to be necessarily permitted in as much as it is stated that large size sewer i.e., where the diameter is more than 300mm blocking the sewer main from the top of the manhole is not possible and only the sanitary worker has to enter the main hole and that too with necessary safety gadgets for blocking the sewer temporarily.

iii. For the removal of submersible pump sets fixed at the bottom of the suction wells, which goes out of order, for which the sanitary worker has to enter the well again with necessary safety gadgets after emptying the sewage from the well in order to remove the pump set. It is made clear that before allowing any sanitary worker to enter on such occasions, steps should be taken to see that the sewage is totally emptied and thereby further ensure that no poisonous gas remains in the sewage line.

iv. For the reconstruction of the man hole of rectification of the sewer min due to any damage caused by sinking of man hole covers/sewer line when the sewage pipe line gets blocked or gets obstructed, which results in the system getting surcharged. Here again, before allowing any sanitary worker to enter the sewer line, it is essential that sewage line is emptied by blocking the main holes in the system on either side of the sinking man holes/damaged man holes.

Even in the above four instances, the contractor should allow the workers to enter only with adequate safely gadgets and under the supervision of a qualified staff and only after duly observing all safety precautions including testing for the presence of toxic gases with a gas detector. Naked flame method of testing the presence of poisonous gases is hazardous and should be strictly avoided.

• Even in the non-exceptional circumstances, consideration of safety of the workers shall be paramount and the contractor shall ensure the same.

- The Contractor should indemnify the employer for any loss or damage caused by his negligence or by his non-observance/violations of any labour laws.
- The contractor should take out insurance policies under the Workmen's Compensation Act. 1923 for all the workers engaged by him and a photocopy of the insurance policy should be furnished to the employer. The policy should be kept alive till completion of the contract.
- The Contractor should impart safety education to all his workers and train them in the use of safety gadgets.

### **XVI. Reference to Specifications/ Code of Practice**

| Description   | BIS No.                          |
|---|----------------------------------|
| Ordinary Portland Cement (33 Grade)   | 269-1989                         |
| 43 Grade Ordinary Portland Cement   | 8112-1989                        |
| 53 Grade Ordinary Portland Cement   | 12269-1987                       |
| Pozzolona Portland Cement   | 1489-1991                        |
| Sulphate Resistance Cement  | 12330 / 1988                     |
| Hydrophobic Portland Cement   | 8043-1991                        |
| Rapid Hardening port land Cement  | 8041-1990                        |
| Low Heat Portland Cement  | 12600-1989                       |
| Standard sand for testing of cement   | 650-1991                         |
| Methods of Test for Pozzolona Materials   | 1727-1967                        |
| Methods of sampling and test for water & waste water (Physical & chemical)  | 3025-1983 to 2003 (Part 1 to 56) |
| Methods of Sampling hydraulic Cement  | 3535-1986                        |
| Methods of Physical tests for hydraulic cement  | 4031-1988 to 1996 (Part 1 to 15) |
| Methods of chemical analysis of hydraulic Cement  | 4032-1985                        |
| Aggregates coarse & Fine from Natural resources For concrete.   | 383-1970<br>4082 /1996           |
| Sand for Masonry Mortar   | 2116 - 1985<br>1542/1992         |
| 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<br>Part-I-Wire cloth test Sieves   | 460 -1985 (Part-I)               |
| Common Burnt clay building bricks   | 1077-1992                        |
| Mild Steel and Medium tensile steel bars and hard Drawn steel wire, concrete reinforcement.<br>Part-I-Mild Steel & Medium tensile steel Bars<br>Part -II- Hard drawn steel wire | 432-1982                         |
| High Strength deformed steel bars and wires for Concrete reinforcement  | 1786-1985                        |
| Bending and flexing of bars for concrete reinforcement  | 2502-1963                        |
| 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 elasticity  | 2854-1990                        |
| Glossary of terms relating to cement concrete   | 6461-1972 & 1973                 |

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|---|---|
|   | (Part 1 to 12)  |
| Methods of test for strength of concrete  | 516-1959  |
| Methods of sampling and analysis of concrete  | 1199 - 1959   |
| Methods of testing bond in reinforced concrete<br>Pull out test   | 2770 -1967  |
| Methods of test for permeability of cement<br>Mortar and concrete   | 3085-1965   |
| Methods of test for splitting tensile strength<br>Of concrete cylinders   | 5816-1999   |
| Methods of tests for determining setting time of<br>Concrete by penetration resistance  | 8142 -1976  |
| Code of practice for construction of<br>Pile foundations (concrete piles)<br>Driven cast-in-situ concrete piles<br>Bored cast -in-situ piles<br>Driven pre-cast concrete piles<br>Bored pre-cast concrete piles | 2911 (Part I)<br>Sec-1-1979<br>Sec-2-1979<br>Sec-3-1979<br>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<br>Engineering   | SP 22-1982  |
| Explanatory Hand Book on IS Code 456-2000   | SP 24-1983  |
| Hand Book on causes and prevention of cracks<br>In buildings  | SP 25-1984  |
| Hand Book on concrete reinforcement & detailing   | SP 34-1987  |
| Brick Masonry   | 2212 - 1991   |
| Construction of Stone Masonry   | 1597 Part I , II -1992  |
| Concrete pipes with and without reinforcement   | 458-1988  |
| P..S.C. Pipes (including fittings)  | 784 – 2001  |
| Methods of tests for concrete pipes   | 458-1998<br>3597-1985   |
| Materials for M.S.Specials  | 226-1976 &<br>2062-1999   |
| Specifications for M.S.Specials for P.S.C.Pipes.  |   |
| Specifications for Steel cylinders reinforced<br>Concrete pipes.  | 1916-1989   |
| Specials for steel cylinders reinforced concrete pipes  | 3597-1998   |
| Methods of test for asbestos cement products  | 5913-1998   |
| Centrifugally Cast (Spun) Iron pressure pipes for<br>Water, gas and sewage Including fittings.  | 1536- 2001  |
| Specifications for Centrifugally Cast (Spun) D.I. Pipes<br>for Water, Gas and Sewage.   | 8329- 2000  |
| D.I.Fittings for pipes for water, gas & sewage  | 9523- 2000  |
| Dimensional requirements of rubber gaskets for<br>Mechanical joints and push on joints for the use<br>With C.I.D.I.Pipes.   | 5382 / 1985   |
| C.I. Specials for Mechanical and push on flexible joints<br>for pressure pipe lines for water, gas & sewage   | 13382-1992  |

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|--|---|
| Horizontally cast iron double flanged pipes for water, Gas and sewage                | 7181-1986                               |
| Cast iron fittings for pressure pipes for water, gas And sewage                      | 1538-1993                               |
| Rubber rings for jointing C.I.Pipes, R.C.C. Pipes & AC. Pipes                        | 5382-1985                               |
| Rubber rings for jointing P.S.C. pipes   | 5382-1985                               |
| Hemp yarn  | 6587-1987                               |
| Rubber Insertion to be used in jointing CIDF pipes                                   | 638 -1979                               |
| Bolts & Nuts to be used in jointing CIDF Pipes                                       | 1363 Part I, II – 2002, Part III - 1992 |
| Unplasticized PVC Pipes for potable water supplies                                   | 4985-2000                               |
| Injection moulded PVC socket fittings with Solvent cement joints for water supplies. | 7834-1987<br>(Part 1 to 8)              |
| Fabricated PVC fittings for potable water supplies                                   | 10124-1988<br>(Part 1 to 13)            |
| Methods of test for unplasticized PVC pipes for potable water supplies               | 12235-1986<br>(Part 1 to 11)            |
| Sluice valves for water works purposes(50 to 300 mm Dia size)                        | 14846 / 2000 PN 1                       |
| Sluice valves for water works purposes (300 to 1200 mm Dia size)                     | 14846 / 2000 PN 1                       |
| Surface boxes for sluice valves  | 3950-1979                               |
| Manhole covers for sluice valves   | 1726 -1991                              |
| Laying of Concrete pipes.  | 783-1985                                |
| Laying of Cast-Iron Pipes  | 3114 -1994                              |
| Laying of PSC Pipes  | 126 of APSS & 783-1985                  |
| Laying of DI Pipes   | 12288-1987                              |
| Laying and jointing of unplasticized PVC pipes                                       | 7634 - 2003<br>(Part 3)                 |
| Stoneware pipes  | IS:651-1992                             |
| Code of Practice for Ancillary Stonewares in sewerage system                         | IS:4111-1986 Part I & II                |
| Precast Manhole covers and frames  | IS:12592-1998 Part I& II                |
| Code of Practice for plain and reinforcement concrete                                | IS:456:2000                             |
| Batch type concrete mixer  | 1791-1985                               |
| Sheep foot roller  | 4616-1968                               |
| Safety code for excavation works   | 3764-1992                               |
| Safety code for scaffolds and ladders<br>Part-I Scaffolds<br>Part II- Ladders        | 3696-1987(Part I)<br>3696-1991(Part-II) |
| Safety code for piling and other deep foundations                                    | 5121-1969                               |
| Safety code for working with construction machinery                                  | 7293-1974                               |

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| Tamil Nadu Building Practice                             | Volume – I<br>Volume – II       |
| Government of India Manual on Water Supply and Treatment | May 1999<br>( Revised )         |
| Gravel for packing                                       | 4091 –1967                      |
| Hard drawn Steel Wire                                    | 1785 – 1983<br>( Part I and II) |
| Structural Steel   | 2062 – 1999                     |
| Hard rolled mils steel for concrete                      | 1139 – 1966                     |
| Hard drawn Steel Wire                                    | 1566 – 1982                     |
| American Society for Testing of Materials                |                                 |
| British Standard   | 2494 – 1955 Part I              |
| Welding Electrodes                                       | 814 – 1991                      |
| Steel Sheets   | 2062 – 1999                     |
| Guniting   | 7322 – 1994                     |
| MS Pipes & Welded Joints                                 | 3589 – 2001 and<br>2041 – 1995  |
| Tensile Test   | 223 – 1950                      |
| Mechanical and Electrical Works                          |                                 |
| Earthing   | 3043 – 1987                     |
| Transformer  | 1180 – 1989                     |
| Generator  | 2253 – 1974<br>4722 – 2001      |
| Laying of HDPE pipes                                     | 4984 – 1995                     |
| DI Pipes   | 8329-2000                       |
| Laying of MS pipes                                       | 5822-2000                       |