AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/ CON/ 737/ 474

FOR

“Design, Engineering, Construction and Commissioning of 43.60MLD capacity Water treatment plant including all civil & Electromechanical works and its O & M for 10 years including supply of chemicals, performance by maintaining water quality as per requirement & running the Plant complete at Singrauli –Waidhen (M.P.)

VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT (ACC), TECHNICAL SPECIFICATIONS & SCHEMATIC DRAWING
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

The following Additional Conditions of Contract shall be read in conjunction with General Conditions & Special Condition of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions/Special Condition of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

1.0 INTRODUCTION

Singrauli is situated in the north-east border of Madhya Pradesh, on Katni-Garwa road broad gauge railway line & 262km from Katni south station. The work site is situated at Waidhen, Which is district Headquarter of Singrauli & is about 25km away from Singrauli Railway Station. The Singrauli has thermal Power Plants of NTPC, Reliance & other major companies and also headquarters of NCL (Northern Coal Field Ltd.)

This work consist of Design, Engineering, Construction and Commissioning of 43.60MLD capacity Water treatment plant including all civil & Electromechanical works (including raw water sump) and its O & M for 10 years including supply of chemicals, performance by maintaining water quality as per requirement & running the Plant complete at Singrauli – Waidhen (M.P.)

2.0 SCOPE OF WORK INCLUDED IN THE CONTRACT

DETAIL SCOPE OF WORK:-

(1) Water treatment Plant ;- Design, Engineering, Construction and Commissioning of 43.60MLD capacity Water treatment plant (including raw water sump) including all civil & Electromechanical works and its O & M for 10 years including supply of chemicals, performance by maintaining water quality as per requirement & running the Plant complete at Singrauli –Waidhen (M.P.)

(2) This work shall comprise of the following items:

1. Chemical house and chemical feeding equipments
2. Flash mixer
3. Clarifiocculator
4. Rapid sand gravity filters
5. Disinfections arrangements
6. Laboratory & laboratory equipments
7. Clear Water Pump House and sump well of 1000 KL capacity etc.
8. Peripheral boundry wall/Chain link fencing, gate, staff quarters and internal roads, drains, area lighting etc. complete
9. Connecting pipes and all other related works required for commissioning of WTP.

(3) Repairs and replacements in all project components including Pipeline, Treatment plant, Electrical installations, valves, specials etc. during O&M Period complete shall also be within the scope. The contractor shall ensure that the
required quality & quantity of water reaches to the farthest end point consumer. (The clear water pumping machineries are not in the scope of Contractor.)

(4) Any other work not included above but required for complete the work of the water treatment plant within the battery limit.

(5) Operation and maintenance of above complete system for a period of 10 years after the date of Handing Over.

(6) EPI shall get checked all designs submitted by contractor from any reputed institute. The cost of which shall be borne by contractor. The pre dispatch inspection of all the major supply items shall be carried out by EPI at suppliers premises.

(7) The Repairs and replacements in all project components including Pipeline, Electrical installations, valves, specials etc. during O&M Period complete shall also be within the scope of the contractor. The contractor shall ensure that the required quantity with specified quality of water reaches to the farthest end point consumer. EPI will not supply any pipe/any material required for O & M. The cost of the all items, including pipes etc., which needed replacement /repair during O&M shall be borne by the contractor.

3.0 QUALIFICATION OF TENDERERS

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Cl 19.0 of ITT & NIT of the Tender.

The Tenderers are required to fulfill all the eligibility criteria as stipulated in NIT and elsewhere in the Tender documents. The price bid of tenderers who fulfill the eligibility criteria as per evaluation of EPI shall only be opened. The decision of EPI in this regard shall be final & binding on the tenderers.

3.1 Order of Precedence: - In the event of any ambiguity or conflict between the contract documents, the order of precedence shall be in the following order.

(i) NIT, Memorandum, BOQ

(ii) Additional Condition Of contract (ACC).

(iii) Special Condition of Contract (SCC), Technical Specifications & Drawings

(iv) General Condition of Contract (GCC)

4.0 CONTRACTOR confirms that they have read and understood and have copies of the ‘Tender Documents’ and have visited the site and their offer is based on the ‘tender Documents’ and caters to all the works, requirements, etc. thereof.

5.0 DISQUALIFICATION

The tenderers may note that they are liable to be disqualified and not considered for the opening of Price Bid if;
a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 years such as abandoning the work, rescinding of contract for which the reasons are attributable to the nonperformance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the Tender.

d) If the tenderers attempt to influence any member of the committee. EPI reserves its right to take appropriate action including disqualification of tenderer(s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the Tenderers.

6.0 SPECIFICATIONS

6.1 The works detail specifications are as per Bill of quantities & enclosed technical specifications provided in tender documents. The work is to be carried out as per Specifications. The Technical Specifications for the work can be seen at Vol-II technical specifications.

6.2 The reinforcement steel used shall be corrosion resistant (CRS Steel). Thermo mechanically Treated bars conforming to IS: 1786, Fe 500 grade as required, from approved manufacturers viz. SAIL/RINL/TISCO/ equivalent as approved by client shall be used.

6.3 Ordinary Portland cement/ Blast furnace slag cement/ PPC of Grade43/ Grade53 as per design, manufactured by major & reputed plant shall only be used.

Inc case contractor uses PPC/slag cement instead of OPC than the cost difference of amount of Rs. 400 per MT shall be recovered from contractor.

7.0 Taxes and Duties:

The contractor shall be responsible for the payment of all Taxes, Duties Statutory levies such as VAT, WCT, Labour Cess, Other Cess, Octroi, Entry Tax, Royalties, Turn over Tax, Service Tax, and other expenses etc. shall be applicable as per clause no. 13 of GCC and as per clause 8 of section 6 of SCC. Labour cess @ 1% shall be deducted from each RA bill. TDS shall be deducted as per statutory rates as applicable. Income Tax will also be deducted from bills as per rule.

8.0 All men, materials, machinery, tools and plants, infrastructure etc. as required for execution of “Works” shall be provided and arranged by CONTRACTOR for their portion of work. All transportation charges including for cartage of issue material, electricity and water charges and for all expenses such as site offices expenses, labour camp, bank guarantee charges, EPF/CPF/ Statutory contributions preparation of all required design & detailed engineering and all required drawings etc., facilities and other expenses whatsoever, incurred on execution, completion and maintenance of the “Works” as per ‘Tender Documents’, and their own overheads and profit etc. shall unconditionally
abide by all conditions for execution of “Works” as per terms, conditions specifications, drawings, documents etc. given in the ‘Tender Documents’ for the completion, handing over, maintenance period etc. for the project.

9.0 EPI shall take Contractors All Risk (CAR) Insurance for the main work. The CONTRACTOR shall take insurance cover at its own cost towards Workman Compensation Act for its own workers, employees and for the plant & Equipment deployed by the CONTRACTOR at the project site and shall furnish documentary proof of the same to failing which no payments shall be released to the CONTRACTOR against work done. THE CONTRACTOR shall assist EPI in follow up with insurance company in case of any claim related to CONTRACTOR’s scope of work. EPI is not liable to pay any claim of the CONTRACTOR of it is not paid by insurance company due to any reasons whatsoever. All insurance policies required during the O&M Period shall be in the scope of contractor.

10.0 In the event of award of “works”, CONTRACTOR shall submit to EPI Bank Guarantees from a Scheduled Bank towards performance, retention money, security deposit etc. (if applicable) as required by EPI/Client/local authorities as per conditions of the ‘Tender Documents’ (in the prescribed proforma of EPI) for CONTRACTOR’s portion of work.

11.0 The CONTRACTOR shall be fully responsible to complete the “Works” in workmen like manner to the satisfaction of the Client and EPI by maintaining high standard of quality and precision as per ‘Tender Documents,’ Agreements, Terms & Conditions, Specifications, Drawings etc. within contractual completion period and within their quoted rates/amount.

12.0 In case CONTRACTOR is awarded the “Works”, they will submit detailed work programme in Bar chart/MS Project within 07 days of issuance of LOI/W.O. If they fail to execute as per agreed schedule of progress of work and as per specified quality and/or lags behind in activities required for timely completion of “works”, as determined by EPI/Client, then EPI shall give 15 days written notice to CONTRACTOR to achieve the specified quality and/or to deploy adequate to the satisfaction of EPI for timely completion of “Works”, then EPI shall have option to withdraw the remaining work partly or in full from CONTRACTOR and get the same executed at the risk and cost of the CONTRACTOR from alternative agency/agencies besides encashment of the guarantees submitted by the CONTRACTOR to EPI. The decision of EPI in this regard shall be final and binding on the CONTRACTOR.

13.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Period from the date of Start</th>
<th>Description of work to be completed during the period specified under column no. 2 (Milestone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>From the date of start to end of 2nd month.</td>
<td>Complete survey, Submission of Design &amp; Engineering work and start of civil work in All structures</td>
</tr>
<tr>
<td>2.</td>
<td>From the start of 3rd month upto the end of 4th month</td>
<td>Placement of order on E&amp;M items, continuation of civil works, etc.</td>
</tr>
</tbody>
</table>
3. From the start of 5th month upto the end of 12th month: Completion of Civil works required at site & supply and Installation of Equipment/Materials at site. Testing & commissioning of complete plant.

4. From the start of 13th month: Start the O&M period of 10 years

Entire work should be completed within a period of twelve months from the date of LOI.

14.0 Operation and Maintenance Period shall be for 10 years (120 months) after successful of completion of the works.

An amount of 25% of each RA bill (In addition to retention money of 5%) shall be retained against O&M. The amount retained against O&M shall be released on yearly basis during O&M period @ 2% pa with an increase of 5% in every succeeding year till the 10th year of O&M. The payment against the O&M shall be made every year on satisfactory upkeep and running of the system.

The CONTRACTOR shall post adequate competent engineers and supervisory staff at site for day-to-day execution and supervision of its works, etc. during the entire duration of the contract including maintenance/defect liability period and Operation & Maintenance period (O & M) of 10 Years. The minimum number and level of engineers, supervisors and other personnel at to be deployed by the CONTRACTOR should be as directed by EPI. In case the CONTRACTOR fails to deploy adequate number of personnel at site/office, EPI after giving seven days notice shall engage the required personnel solely at the risk and cost of the PARTY and debit the cost of the same to the account of CONTRACTOR. EPI shall exercise overall management, monitoring and coordination of project. EPI shall not post any staff during maintenance/defect liability period for which the CONTRACTOR shall make suitable arrangement to the satisfaction of EPI/client.

During Construction

I) Project Manager with degree in corresponding discipline of engineering with 10years experience – One No.

II) Graduate Engineer with 5 years experience – 02 nos.

ii) Diploma Engineer with 5 years experience – 03 nos

In case the contractor fails to employ the technical staff as aforesaid during construction period, EPI shall deploy the same & recover the following amounts from Contractors’ Bill in the case of each person.

i) Graduate Engineer with 05 years experience – Rs. 60,000/- p.m.

ii) Diploma Engineer with 05 years experience – Rs. 30,000/- pm.

During O & M

The Bidder shall employ following minimum Manpower for the O&M of the project. (Bidder shall be employing other staff as per requirement following is only the minimum staff).
In case the contractor fails to employ the technical staff as aforesaid during O & M period, EPI shall deploy the same & recover the following amounts from Contractors’ Bill in the case of each person.

i) Project Manager- Rs. 1,00,000/- p.m.

ii) Chemist– Rs. 40,000/- pm.

iii) Electrician –Rs. 25,000/-pm

15.0 In case the project execution is delayed beyond the contractual scheduled completion period due to any reason attributable to the Contractor, the staff and site office expenses of EPI for extended period shall be paid by the CONTRACTOR to EPI at the rate of Rs.2,00,000/- per month. This shall be in addition to the facilities provided by the CONTRACTOR to EPI and the Liquidated Damages/ Compensation for delay/Penalties etc. if any, levied by Client.

16.0 The CONTRACTOR shall be responsible for timely completion of the “Works” within the contractual completion period. The time allowed for carrying out the work, as entered in the TENDER shall be strictly observed by the contractor and shall be deemed to be essence of the contract. The period will be reckoned immediately from the date of issue of LOI to the contractor to commence the work.

The work shall throughout the stipulated period of contract be proceeded with all due diligence keeping in view that time is the essence of the contract. The contractor shall be bound to complete 1/8th of the whole work before 1/4th of the whole time allowed under the contract has elapsed, 3/8th of the work before 1/2 of such time has elapsed and 3/4th of the work before 3/4 of such time has elapsed. In the event of the contractor failing to comply with the above conditions, the Engineer shall levy on the contractor, a compensation of amount equal to 1/16 percent of the value of work per week.

The total amount of compensation under the provision of the clause shall be limited to 5 percent of the estimated value of whole work & liquidated damages for each default and not by way of penalty and the sum of Rs. 20000 per day for every complete day of such default.

In the event of unsatisfactory progress penalty upto ½% of the cost of balance work shall be imposed in addition to LD and penalty.

The above compensation shall be kept in deposit and shall be refunded if the contractor subsequently makes up the progress for the lost time within the period of contract including extension granted.

The amount of compensation may be adjusted or set-off against any sum payable to the contractor under this or any other contract with EPI even after completion of the work.
17.0 The CONTRACTOR shall have EPF Code number, CST-TIN, Service Tax, VAT –TIN/ Sales tax on Works contract number, Service tax registration number, PAN (Permanent Account Number of Income Tax) etc. and shall be responsible for depositing EPF subscription and contribution for labour and staff employed by it on the “Works” and Service tax, other taxes, duties and dues etc. as per statutory requirements and documentary evidence of same shall be provided to EPI. The CONTRACTOR shall also be responsible for labour welfare and for arranging labour and other licenses/permits/clearance etc. for the project at their own. In case EPI has to take labour license or and other licenses, all expenditure towards the same shall also be borne by the CONTRACTOR. The CONTRACTOR shall comply with all the requirements as per labour laws/acts. All the records in this regard shall be maintained by CONTRACTOR as per statutory requirements and rules and shall be produced by the CONTRACTOR on demand if required.

18.0 The CONTRACTOR shall be responsible for obtaining all approvals from Client with regard to quality of materials & workmanship and measurements etc. for their portion of work. All such approvals shall be in the name and title of EPI. The CONTRACTOR shall be responsible for reconciliation of issued material, if any. Any shortfall in issue materials shall be made good/recovered from CONTRACTOR at actual expenditure plus financing and handling charges @ 10%

19.0 The CONTRACTOR will not deal directly with Client and all the correspondence in matters regarding bills, claims, interpretation of the specifications, conditions and all matters related to the contract with Client, Client’s Consultants, all other agencies including Government and Statutory bodies etc. shall be done through EPI only. CONTRACTOR shall prepare and submit expeditiously all bills, claims, details, clarifications, documents, information, etc. as required by EPI /Client for proper execution and successful completion of the “Works”

20.0 If desired by EPI, CONTRACTOR shall be available/associate with EPI in meetings with Client for its portion of work. CONTRACTOR shall furnish all information and clarifications as and when required by EPI/Client.

21.0 The CONTRACTOR shall plan and execute the “Works’ in his scope of work in such a manner that the other works, connected with the “Works” of the CONTRACTOR, but not included in the CONTRACTOR’s scope of work, do not get affected/delayed.

22.0 The CONTRACTOR shall deploy sufficient plant & equipment of the required and in good working condition for completion of the works in stipulated time with required quality, the equipment should either be owned by the CONTRACTOR or hired/leased. The deployment of equipment by CONTRACTOR shall be as decided by EPI and the same shall not be less than the minimum deployment stipulated by the Client, if any for execution of “Works” and as per schedule agreed with EPI. The CONTRACTOR shall make arrangement for regular maintenance including preventive and breakdown maintenance and maintain stock of essential spares at site/near to site so as to ensure minimum break downtime of equipment. The equipment once brought to site shall not be allowed to be removed without the consent of EPI. In case the CONTRACTOR fails to deploy sufficient equipment to the satisfaction of EPI or in case of prolonged breakdown of equipment, EPI at its sole discretion shall arrange the required equipment and debit all the related costs including ten percent overheads of EPI and shall recover the same from the due payments of CONTRACTOR, including from its bank guarantees available with EPI.
23.0 CONTRACTOR shall ensure compliance with all Central, State and Local Laws, Rules, Regulations etc. as applicable or may be applicable during the course of execution, maintenance etc. of the “Works” and shall indemnify against any claim or damages whatsoever on such accounts. The CONTRACTOR shall keep EPI indemnified at all times against infringement of any Patent or Intellectual Property rights.

24.0 EPI is an ISO: 9001 and ISO: 14001 Company. The conditions of the ISO as applicable should be followed by the CONTRACTOR for implementation & maintaining the established procedures of EPI for this purpose. Following documents have been provided by EPI to CONTRACTOR & CONTRACTOR confirms receipt of the same:-

a. Quality & Environmental Policy
b. Objectives & Targets.
c. Operational control procedures
d. Operational Control Procedures
e. Noise.
f. Wastage

25.0 The work executed by CONTRACTOR shall be subject to audit and quality control checks from Quality Control Division &Technical audit of EPI, Client Inspecting Agency of the Client and Chief Technical Examiner of Central Vigilance Commission, Govt. of India. In the eventuality of any defect/sub standard works as brought out in the report or noticed otherwise at any time during execution, maintenance period etc., the same shall be made good by the CONTRACTOR without any cost to EPI. In case CONTRACTOR fails to rectify the defect/sub- standard work within the time period stipulated by EPI, shall get it rectified at the risk and cost of CONTRACTOR and shall recover the amount from the dues of the CONTRACTOR. All documents required to be submitted to these agencies for the scope of work of contractor will be provided on demand of EPI. The contractor shall properly maintain records of all documents related to approvals, material & test records, labour attendance and all other statutory requirements for any time inspection by the above agencies.

26.0 The work shall also be inspected by third party agency appointed by Singrauli Municipal Corporation (owner) in every quarter at bidders cost. (Please also refer clause no. 6, Vol-II under SCC-II)

27.0 In case, at a later stage, it is found that the CONTRACTOR has submitted incorrect, false details and credentials resulting in apprehensions on the capabilities of CONTRACTOR with regard to quality & timely completion of works, financial capabilities etc. EPI can terminate this agreement solely at its option. In this eventuality the CONTRACTOR shall be liable for the losses suffered by EPI and further CONTRACTOR shall have no claim on EPI, whatsoever.

28.0 All other terms and conditions shall be as per the Tender documents of Client and the same shall be applicable between EPI and the CONTRACTOR on mutatis mutandis basis. The above terms and conditions shall supersede the terms and conditions contained in the Tender Documents of the Client in case of variance in any condition. However, if EPI is granted some concession or exempted from certain obligations by client, by virtue of EPI being a Public Sector Company, the same concessions/exemptions shall
not be applicable to the CONTRACTOR. The decision of EPI in this regard including interpretation of terms & conditions shall be final & binding on CONTRACTOR.

29.0 PRIORITY OF WORK

The contractor has to deploy resources and plan the work accordingly and nothing extra shall be payable to the contractor on this account. The contractor has to ensure safety of the occupants and sufficiently barricade the area so as to avoid any hazard to occupants.

30.0 The relevant and required documents in respect of VAT assessment / service tax assessment for EPI for availing exemption / deductions by EPI are to be submitted along with each RA bill failing which the VAT Tax levied / suffered by EPI is to be borne by the contractor and will be recovered from the forthcoming bills. The bills are to be submitted in the format required under the respective tax acts indicating input tax.

31.0 The final bill payment to the PARTY shall be made when PARTY submits VAT clearance certificates, EPF clearance certificate, all other clearances, approvals, certificates etc. as per agreement of EPI with the client for the “Works” and as per statutory requirement.

32.0 The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents:

a) Completion certificate issued by the Engineer-in-Charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contactor.

d) No claim certificate from the sub-agencies / venders engaged by the contractor.

e) As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handing over of the work as included in scope of Contractor.

j) Manufacture’s guarantee of various machines / equipments installed as part of works.

k) NOC from labour department, PF Department.

33.0 In case of any discrepancy between the downloaded tender and the approved hard copy, the approved hard copy shall hold good for contractual as well as legal purposes.

The tenderer shall furnish a declaration to this effect that no addition/deletion/corrections have been made in the downloaded tender document being submitted by him and it is identical to the tender document appearing on the
Web-Site and with the Standard DRAFT Tender Document available in the office inviting the tenders.

If any tenderer withdraws his tender before the said period or issue of letter of acceptance/intent, whichever is earlier, or makes any modifications in the terms and conditions of the downloaded tender which are not acceptable to the EPIL, then the EPIL shall, without prejudice to any other right or remedy, be at liberty to forfeit entire amount of Earnest Money as aforesaid.

34.0 Tenderer shall provide ‘Sign Board(s)’ as per given below design approved by EPI and /or Client.
Technical Specifications
BRIEF SPECIFICATIONS

SPECIFICATIONS FOR PIPE LINES

1. **Excavation for Pipe Line Trenches**
   1.1. **Excavation for Pipe Line Trenches**
       The excavation in hard rock will have to be carried out either by controlled blasting or
       chiseling, wedging or by mechanical means and the TENDERed rate is supposed to
       cover cost of all such means.

1.2. **Site Clearance**
   The pipe line alignment shall be cleared of all bushes, shrubs, roots, grass, weeds and if
   required trees, coming in the alignment of pipe line in the trench width portion. The rates
   for excavation shall cover all such site clearance work and no extra payment will be
   allowed on this account.

1.3. **Alignment marking**
   After the work site is cleared as above, pipe line alignment with required trench width
   shall be marked on the ground with apex points, curves etc, as shown on the drawings or
   as directed by the Engineer-in-Charge in charge for the stretch where the work is to be
   started. The contractor shall provide all labour, survey instruments, and materials such
   as strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out
   and establishment of bench marks. The contractor shall be responsible for the
   maintenance of bench marks and other marks and stakes as long as they are required
   for the work in the opinion of the Engineer-in-Charge.

1.4. **Working survey**
   Working survey of the pipeline alignment shall be carried out by the contractor before
   start of the excavation work. The contractor shall provide all the instruments such as
   leveling instruments, steel tape, ranging rods, strings, pegs etc for carrying out the
   survey. Based on the working survey, the alignments, L-section (depth of laying), grade,
   and location of specials, valves and chambers shall be finalized and got approved from
   the engineer in charge. The gradient and alignment shall be such that minimum
   horizontal and vertical bends shall be required.

1.5. **Use of Machinery :**
   All excavations shall be carried out by mechanical equipments / machinery unless, in
   the opinion of the Engineer-in-Charge, the work involved and time schedule permit
   manual excavation.

1.6 **Trench Width and Depth :**
   All buried pipelines shall be minimum 1 meter +/- 0.2 mtr below ground level to maintain
   proper grade unless other depths are approved by the engineer in charge. The trench
   width for respective pipe diameters permissible as required under respective IS code for
   Pipeline laying and installation.

   The trench width shall be constant through out the trench depth, which will provide a
   clearance of about 0.30 m on either side of the pipe line.
   The contractor may, for the facility of work or similar other reasons, excavate and also
   backfill later, if so approved by the Engineer-in-Charges, at his own cost, outside the
   allowable trench width specified above. Should any excavation be taken below the
   specified trench bottom, contractor shall fill it up to required level, at his own cost, with
   the same material available at the trench bottom including watering and compaction.
   The excavation shall be taken down to such depths as shown in drawings. Excavation
   for extra depth equal to the thickness of proposed pipe bedding shall be done below
   pipe soffit level for providing bedding below pipe line wherever bedding is required. The
   trench bottom shall be excavated to proper grade as shown on drawings. The contractor
   shall provide site rails and leveling instruments required for checking the grade during
   excavation, bottom bedding and pipe laying Projections in rock excavation shall be
   removed by chipping.
The contractor shall carry out extra excavation at the pipeline joints to be welded in the trench, as required (minimum 0.6 m deep and 0.9 m lengthwise, all around the pipe), for facilitating proper welding of the bottom joint from out side. The work of trench excavation should be commensurate with laying and jointing of the pipe line. It should not be dug in advance for a length greater than 500 m ahead of work of laying and jointing of pipeline unless otherwise permitted by the Engineer-in-Charge.

The minimum cover on pipe is to be maintained 1 meter +/- 0.2 mtr. However the cover on pipe may be modified to suit gradients and site conditions as per direction of Engineer-in-Charge.

1.7 Barricading and Guarding:
To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of work, till filling of the trenches after pipes are laid and jointed. The lighting, barricading, guarding of the trenches and the maintenance of watchman shall be done by the contractor at his cost.

All precautions shall be taken during excavation and laying operation to guard against possible damage to any existing structures, under ground cables, pipe lines of water, gas, sewage etc. Any damage done to such properties will have to be repaired / rectified by the contractor at his cost. The Contractor has to ensure the following:

- safety protections as mentioned above have to be incorporated in the work process
- hindrances to the public have to be minimized
- the trench must not be eroded before the pipes are laid
- the trench must not be filled with water when the pipes are laid
- the trench must not be refilled before laying of the pipes

The bed for the laying of the pipes has to be prepared according to the L-Section immediately before laying of the pipes.

1.8 Reuse of surface material
All surface materials, which in the opinion of the Engineer-in-Charge, suitable for reuse in restoring the surface shall be kept separate from the general excavation material, as directed by the Engineer-in-Charge.

1.9 Stacking of excavated material
All excavated materials shall be stacked in such a manner that it does not endanger the work and avoids obstructing foot paths and roads. Hydrants under pressure, surface boxes, fire and other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clean or other necessary provisions made for street drainage and natural water courses shall not be obstructed. All the excavated material shall be the property of the Employer and shall be stacked or disposed off as directed by the Engineer-in-Charge.

1.10 Maintenance of traffic
The work of excavation and pipe laying shall be carried in such a manner that it causes the least interruption to traffic and the road / street may be closed in such a manner that it causes the least interruption to the traffic. Where it is necessary for traffic to cross open trenches, suitable bridging arrangement shall be provided. When the street is closed for traffic, suitable signs indicating that street is closed shall be placed and necessary detour signs for proper maintenance of traffic shall be provided.

1.11 Structure protection
Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of work shall be furnished under the direction of the Engineer-in-Charge. The structures which have been disturbed shall be restored upon completion of work.

1.12 Protection of property
Trees, shrubbery fences, poles and all other property shall be protected unless their removal is allowed by the Engineer-in-Charge. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the Engineer-in-Charge.

1.13 Avoidance of existing services
As far as possible, the pipeline shall be laid below existing services, such as water and gas pipes, cables, cable ducts and drains but not below sewers. Excavation of the trenches shall be carried out to the required depth accordingly. If it is unavoidable, the pipeline shall be suitably protected and lesser trench depth in such cases can be allowed. A minimum clearance of 150 mm shall be provided between the pipeline and such other services. When thrust or auger boring is proposed for laying pipeline across roads, railway or other utilities, larger clearance as required shall be provided. Adequate arrangements shall be made to protect and support the other services during excavation and pipe laying operations. The work shall be so carried out as not to obstruct access to the other services for inspection, repair and replacement. When such utilities are met with during excavation, the authority concerned shall be intimated and arrangements made to support the utilities in consultation with them.

1.14. Bailing out of Water
During the excavation if subsoil water is met with, contractor shall provide necessary equipment and labour for dewatering the trenches. If pumping out subsoil water is found necessary, contractor shall provide sufficient number of pumps for the same. The TENDERed rate shall cover all costs for bailing out of water including hire charges of pumps, cost of diesel and labour etc and hence, no extra payment shall be allowed.

1.15. Disposal of loose boulders etc
All loose boulders, semi detached rocks, (along with earthy stuff which might move therewith), not directly in the excavation but close to the area to be excavated, as to be liable, in the opinion of the Engineer-in-Charge, to fall or other wise endanger the workman equipments, or the work etc, shall be stripped off and removed away form the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. The TENDERed rate is supposed to cover this job and no extra payment will be allowed on this account.

1.16. Disposal of Excavated Material
All the excavated surplus material shall be disposed off on low lying Government land or as directed by the engineer in charge.

1.17. Moorum / Sand Bedding below Pipeline
In case of hard rock and black cotton soil, before lowering of the pipes in trenches, a layer of selected moorum, available from excavated material under the same contract shall be provided below the pipe line to act as bedding. The bedding shall be compacted properly including required watering and the thickness of well compacted layer shall not be less than 150 mm. The bedding shall be provided for full trench width with proper grade as shown on drawings.

2. Refilling the trenches

2.1. Use of selected excavated material
Filling of excavated material in trenches shall be commenced as soon as the joints of pipes and specials have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes and the outer coating.

Selected surplus spoils from excavated material shall be used as backfill. Fill material shall be free from clods, salts, sulphate, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixture used for filling.

2.2. Filling zones
For the purpose of back-filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

| Zone A: |
| From the bottom of the pipe (top of bedding) to the level of the centre line of the pipe | Back-filling by hand with selected approved material available from excavation, placed in layers of 150 mm and compacted by tamping. The back-filling material shall be deposited in the trench for its full width on each side of the pipe, specials and appurtenances simultaneously. Special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe. |
| Zone B: | |
| From the level of the centre line of the pipe to a level 300 mm above the top of the pipe | Back-filling and compaction shall be done by hand or approved mechanical methods in layers of 150 mm; special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe. |
| Zone C: | Back-filling shall be done by mechanical methods in 15 cm. |

2.3. All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer-in-Charge in Charge, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof, and the manner of depositing and compacting shall be subject to the approval of the Engineer-in-Charge in Charge, but the Contractor will be held responsible for any displacement of pipe or other structures, any damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

The back filled layers shall be wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content of the surrounding material. Any deficiency in the quantity of material for backfilling the trenches shall be supplied by the Contractor at his expense.

The Contractor shall at his own expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The Contractor shall not use backfilling for disposal as refuse or unsuitable soil.

2.4. **Fillings of the trench excavated in rock**

In case of excavation of trenches in rock, the filling up to a level of 30 cm above the top of the pipe shall be done with fine materials, such as soft soil, murrum etc. The filling up of the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 15 cm, whereas the filling above the centre line of the pipe shall be done by hand compaction or mechanical means in layers not exceeding 15 cm. The filling from a level of 30 cm above the top of the pipe to the top of the trench shall be done by mechanical methods with broken rock filing of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

2.5. **Consolidation**

The consolidation of the filled material shall be done to attain 95 % proctor density. The density of the filled and compacted material shall be tested regularly and record maintained accordingly.

2.6 **Road Restoration**

The contractor shall be restoring the road after laying & jointing of pipe & refilling of trench. The restoration work shall include WBM & Bituminous/cc surface of thickness & design mix as directed by EIC.

3.0 **PIPES** (Pipes shall be procured only from the Manufactures.)

3.1 **Supply, laying and jointing of DI Pipes and fittings.**

The pipe to be supplied and laid under this contract shall be DI K-7/K-9 as per IS 8329-2000 Rubber Gaskets used with push-on joints or mechanical. All fittings
for the pipe shall conform to the provisions of IS 5382-1985, along with DI fittings confirming to IS 9523:1980 complete.

3.2 The laying of pipe shall be as per IS 12288:1987 with up to date amendments.

3.3 The manufacturer and their associates (if any) should have the facility to carry out the internal coating / lining and external coating / painting at factory for pipes and specials confirming to IS 11906:1986.

3.4 The DI pipe manufacturer should have valid BIS license from last 5 years (or valid BIS license from last 2 years with an experience of manufacturing and supplying atleast 500 kms of various diameters of DI pipe to any State/Central govt/ board/organization of repute in last 3 years) and the pipes should be manufactured conforming to IS 8329-2000 specification and further amendment to the code as on date and duty ISI marked.

3.5 The DI pipe manufacturer should have house facility for carry out the following test for size DN 80-DN1000:-
   a) C-value determination arrangement
   b) Type test for leak tightness as per ISO 2531:2009/BS EN 545/IS 8329:200.

3.6 DI pipe manufacturer should have the ISO 9001:2008 & ISO 2531:2009 certification for manufacture of DI pipe.

3.7 A certificate for having supplied DI pipe of size proposed in the project for quantity 1/3 of the TENDER requirement during last 3 years to any state/central govt. department /board to be submitted by pipe manufacturer.

The manufacturer should be able to demonstrate the conformity of the product to the requirement by controlling the manufacturing process and by carrying out the various tests as specified in IS wherever possible, statistical sampling techniques should be used to control the process so that the product is produced within the specified limit. Quality assurance program of the manufacturer shall be enclosed with the Tender.


4.1 Scope
This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of High Density Polyethylene Pipes used for water supply. Use of HDPE Pipes of various diameters shall be as per relevant BIS /other standards marked with Pressure class of PN 6.

4.1.2 Applicable Codes
The manufacturing, testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and 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 standards / Codes, this Specification shall govern.

Others Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Title/Specification</th>
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<tbody>
<tr>
<td>IS 4984</td>
<td>High Density Polyethylene Pipes for Water Supply</td>
</tr>
<tr>
<td>IS 2530</td>
<td>Methods of test for polyethylene moulding materials and polyethylene compounds DI K7 Pipes, Joints and Fittings for use for Potable Water Supply</td>
</tr>
<tr>
<td>IS 5382</td>
<td>Rubber sealing rings for gas mains, water mains and sewers.</td>
</tr>
<tr>
<td>IS 4905</td>
<td>Methods for random sampling</td>
</tr>
<tr>
<td>IS 7328</td>
<td>High density polyethylene materials for moulding and extrusion</td>
</tr>
<tr>
<td>IS 7634</td>
<td>Laying &amp; Jointing of Polyethylene (PE) Pipes</td>
</tr>
<tr>
<td>IS 9845</td>
<td>Method of analysis for the determination of specific and/or overall migration of constituents of plastics material and articles intended to come into contact with foodstuffs</td>
</tr>
</tbody>
</table>
4.1.3 Designation
4.1.3.1 Pipes shall be designated as per IS 4984, according to the grade of material, followed by pressure rating and nominal diameter, for example, PE 100 PN 10 DN 200 indicates a pipe pertaining to material grade 100 having a pressure rating 1.0 MPa and outside nominal diameter 200 mm.

4.1.4 Colour
The color of the pipe shall be black.

4.1.5 Materials
The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any internationally reputed organization as per the satisfaction of the Engineer-in-Charge in charge.

4.1.6 Raw Material
(a) Raw material used to manufacture the HDPE pipes shall be PE 100, pre-compounded PE resin confirming to IS: 4984, IS: 7328 and ISO: 4427-2007. For this a certification has to be given by the resin manufacturer as per clause 3.2.3 of IS: 4984. The resin proposed to be used for manufacturing of the pipes should also comply with the following norms as per ISO 9080-2003.

(b) The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10 MPa for PE 100 resin. Internal certificate of any resin manufacturer will not be acceptable.

(c) Certificate from reputed organization OR Raw material supplier for having passed the full scale rapid crack propagation test as per ISO 13478. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-50-T-003 of IS 7328. HDPE conforming to designation PEEWA-50- T-003 of IS 7328 may also be used with the exception that melt flow rate (MFR) shall not exceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.

(d) The specified base density shall be between 940 kg/ m³ and 958 kg/ m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS 7328 The value of the density shall also not differ from the nominal value by more than 3 kg/ m³ as per 5.2.1.1 of IS 7328. The MFR of the material shall be between 0.20 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in IS 2530. The MFR of the material shall also be within ± 20 percent of the value declared by the manufacturer.

(d) The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ±0.5% and the dispersion of carbon black shall be satisfactory when tested as per IS 2530.

4.1.7 Anti-oxidant
The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS 10141

4.1.8 Reworked Material
No addition of Reworked/ Recycled Material from the manufacturer’s own rework material resulting from the manufacture of pipes is permissible and the vendor is required to use only 100% virgin resin compound.

4.1.9 Maximum Quality of Pipe
The outside diameter of pipes, tolerance on the same and quality of pipe shall be as given in table 2 of IS 4984. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross.
section of the pipe, at 300 mm away from the cut end. For pipes to be coiled the quality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of quality.

4.1.9.1. Detectability
HDPE Pipes should be detectable when buried underground, by providing a copper wire of 1.50 sq.mm +/- 0.2 sq. mm, co-extruded or fixed on to the pipe with the help of superior quality adhesive tape on the outer surface as provided in IS 7634 part II in such a way that in no way it affects the pipes’ conformity to relevant BIS codes.

4.1.10 Length of Straight Pipe
The length of straight pipe used shall be minimum 6 mtr or as agreed by Engineer-in-Charge. Short lengths of 3 meter (minimum) up to a maximum of 10% of the total supply may be permitted.

4.1.11 Coiling
The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipe beyond 110mm dia shall be supplied in straight length not less than 6m.

4.1.12 Workmanship / Appearance
Pipes shall be free from all defects including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe. IS 4984 :1995 will be followed for visual appearance.

4.1.13 Handling, Transportation Storage and Lowering of pipes
During handling, transportation, storage and lowering, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole.

The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

- Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.
- Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.
- Scores or scratches to a depth of greater than 10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.
- PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.
- Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.
- During coiling care should be taken to maintain the coil diameter at or above the specified minimum to prevent kinks. Coiling shall be done when the pipe attains the ambient temperature from the extruder. In uncoiling or recoiling care should be taken that sharp objects do not scour the pipe.
- When releasing coils, it must be remembered that the coil is under tension and must be released in a controlled manner. The end of the coil should be retained at all times, then the straps released steadily, one at a time. If the coil has bands at different layers of the coil, then they should be released sequentially starting from
the outer layers. The amount of the energy locked up in the coil will depend on the size of the pipe, the SDR of the pipe, and the size of the coil.

- Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.
- Bare coils shall be wrapped with hessian cloth for long distance (> 300Kms) transportation. The truck used for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded – especially no metallic, glass and wooden items. The truck shall not have sharp edges that can damage the Pipe.
- Pipes manufactured at factory are to be carried to the site of work directly or stacked suitably and neatly along the alignment/road side/elsewhere near by the work site or as directed by the Engineer-in-Charge.
- Damages during transit, handling, storage will be to the Contractor's account and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Engineer-in-Charge.

4.1.14 Lowering, Laying of Pipes

- Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer-in-Charge shall be laid.
- While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same as backfill material. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M15, 15 cm or 20cm thick sand bed as approved by the Engineer-in-Charge may be provided.
- As PE pipes are flexible, long lengths of Electro/Butt-fusion jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.
- During the pipe laying of continuous Electro/Butt-fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)
- For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.
- The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.
- The Installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.
- Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.
- PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done.
- When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs
full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

- However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.
- Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

4.1.15 The pipe ends shall be suitable for Electro-fusion/ Butt- Fusion jointing system that shall provide for fluid tightness for the intended service conditions.

4.1.16 Bedding, Backfilling and Compaction

4.1.17 Bedding
In case of sandy strata no separate bedding is required. However the bottom face / trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95% of maximum dry density. The pipe bedding should be placed so as to give complete contact between the bottom of the trench and the pipe. The minimum cover over buried pipe should be 1 m.

4.1.18 Back Filling
Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earthfill on each side should not be more to cause lateral movement of pipe.

Most coarse grained soil are acceptable. This may comprise of gravel or sand. However silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.

It is very important that the pipe zone backfill material does not wash away or migrate into the native soil. Like wise, potential migration of the native soil into the pipe zone backfill must also be prevented.

Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

4.1.19 Compaction
Vibratory methods should be used for compaction. Compaction within distances of 15 cm to 45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95% of maximum dry density.

4.1.20 Thrust Block
RCC thrust blocks, if required, should be suitably designed & provided at bends and at places of reduction in cross section to take care of thrust as required as per the provisions of relevant standards/codes.

4.1.21 Fittings & Specials
All HDPE fittings/ specials shall be of minimum PN 6 or above Pressure class, fabricated in accordance with IS: 8360 (Part I & III). PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the Engineer-in-Charge. Fittings will be Butt welded on to the pipes or other fittings by use of Electro/Butt fusion process. Recommended makes for PE / PP fittings / specials are Georg-Fischer / Glynwed / Frialen / Durafuse if purchased or should be manufactured by the manufacturer himself to have consistency with pipe material/grade.

4.1.22 Bends
HDPE bends shall be plain square ended conforming to IS: 8360 Part I & III Specifications. Bends shall be moulded.
4.1.23 Tees
HDPE Tees shall be plain square ended conforming to IS: 8360 Part I & II Specifications. Tees may be equal tees or reduced take off tees. Tees shall be moulded or fabricated from pipe elements.

4.1.24 Reducers
HDPE Reducers shall be plain square ended conforming to IS: 8008 Part I & VII Specifications. Reducer must be moulded.

4.1.25 Flanges/ HDPE Pipe Ends
HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VI Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below.

4.1.26 Slip-On Flanges
Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure rating of flanges will be PN10.

4.1.27 Welding Procedure
Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with Electro or Butt-fusion welding using automatic or semi automatic, hydraulically operated, superior quality Electro/Butt-fusion machines which will ensure good quality welding of HDPE pipes.

Normally Electro/Butt fusion welding shall include following activities:
- Aligning of pipe on welding M/C
- Surface preparation for welding.
- Heating of pipes/ ends
- Holding pipes for welding
- Cooling etc.

4.1.28 Hydraulic Testing
Pipes shall be given different hydraulic tests for ensuring quality of manufacture as per clause 16.9.5.6.2 of Standard Specification.

4.1.29 Site Fabrication of PE Fittings
Two or more PE specials coming at one place (like PE Tee, Reducer, Flanged end etc.) shall be jointed at contractor’s workshop and transported to the site of works for final installation with proposed PE pipelines. In no case, jointing of three or more welds in one place, at site will be allowed.

4.1.30 Training
The Contractor shall provide on-site training on PE pipe laying, jointing, testing and maintenance etc., to the personnel authorized by EMPLOYER.

4.1.31 Manuals
Technical Manual on PE pipes including precautions to be taken during operation of the pipeline shall be prepared and submitted by the contractor immediately on completion of work.

4.1.32 Flanges
All flanges employed in the project must be compatible whatever material used.

4.1.33 Marking
All pipes shall be marked at maximum interval of 1 m. The marking shall indicate at least the following information.
1) Manufacturer’s name & / or trade mark.
2) The dimensions (nominal outside diameter X nominal wall thickness)
3) The outside diameter tolerance (A or B)
4) The designation of pipes material (PE 100, PE 80 etc)
5) The nominal pressure (PN)
6) The production period (date or code)
7) The number of the International standard.
8) The word “Water” shall also be included.
9) Lot number/Batch Number

4.1.34 Packing & Transport

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

4.1.35 Summary of quality Tests :

1. **Quality Mark** : Pipe: IS 4984
2. **Material** : As per IS 4984. However only virgin resin is allowed, reworked material is not allowed.
3. **Grade of Material** : PE 100 as per IS 4984 (Certificate from raw material manufacturer is required).
4. **Pressure Rating** : Minimum PN 6 or above as per requirement.
5. **Colour** : as per IS 4984
6. **Dimensions** :
   - **Diameter** : The nominal diameter (outside)
   - **Wall thickness** : As per IS 4984.
   - **Length** :
     - For diameter up to 110 mm : min 6 mtr max. 100 meter
     - For diameter more than 110 mm : minimum 6 meter.
     (Tolerance as per IS 4984)
7. **Visual Appearance** : as per IS 4984.
8. **Test and sampling** : as per IS 4984.
9. **Special Test** :
   Notch hydraulic Test for the HDPE pipe made from PE-100 grade raw material as per ASTM 1474 OR ISO 13479 at manufacturers laboratory or independent laboratory and should pass the Hydraulic test as per IS:4984:1995 for a minimum 165 Hours. The test reports shall not be more than three months old.
   Pipe shall convey water under variable temperature conditions ranging from 4 degree centigrade to 45 degree centigrade.
10. **Jointing of pipes (pipe end)** :
    - For diameters up and more than 110 mm diameter: Butt or Electro-fusion Process
11. **Quality Assurance** :
    Quality Assurance Plan shall be got approved from the employer before production start.

**BIS License**

The pipe manufacturer who is going to supply the pipes for the project has to have a valid BIS license. The Bidders shall include this valid license along with the Tender from the proposed pipe/ Fittings manufacturer.

**Performance requirements**

The pipe supplied should have passed the acceptance tests as per clause given in specified standards. The manufacturer should provide the test certificates for the tests conducted, as required in specified standards along with the supply of pipes. These acceptance tests can be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute one person to be positioned at the pipe manufacturing facility of the successful Contractor. This deputed person will check and approve each lot of the pipes manufactured before they leave the factory after ensuring that they are meeting the required specifications.

**Note:** All remaining parameters / specifications shall be as per respective IS.
5. **Field Hydraulic testing of the pipelines**
   
a. **Sectional tests**
   
   After laying and jointing the pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections approved by the Engineer-in-Charge in Charge. The length of the sections depends on the topographical conditions. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). At the beginning, the Contractor shall test stretches not exceeding 1 km. After successful organization and execution of tests the length may be extended to more than 1 km after approval of the Engineer-in-Charge in Charge. The hydraulic testing shall have to be commenced immediately after laying and jointing of 1 km reach is completed.

   The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. The Contractor shall provide and maintain all requisite facilities, instruments, etc. for the field testing of the pipelines. The testing of the pipelines generally consists in three phases: preparation, pre-test/saturation and test, immediately following the pre-test.

6. **Flushing and disinfecting of pipelines**
   
   After testing and commissioning the contractor shall flush the pipes with a velocity not less than 1 m/s or as approved by the Engineer-in-Charge in Charge. Disinfection of drinking water pipelines should be done by Contractor.

7. **Above ground pipeline**
   
   DI K9 pipe of appropriate size, conforming to IS: 8329 or MS pipes of appropriate size and thickness, conforming to IS: 3589 will be used wherever the pipeline is laid above ground. MS pipes will be in-lined and out-coated with 15 mm thick Cement concrete mortar or Epoxy coating of 400 Micron DFT.

8. **Flow measuring devices:**
   
   Electromagnetic Flow Meter of appropriate size shall be provided along with 8 hour Battery back-up, at inlet and outlet of the Raw water and Clear water pipeline and Feeder pipeline outlet at RCC Over head tanks; to check losses and measure the quantity of water. Reading display of all the Flow meters, along with data logging instruments should be made available at single point, wherever decided by the Engineer-in-charge.

   All the Electromagnetic Flow meters shall have the same make and salient features as under.

   Coil housing of the Electromagnetic flow meters of fully welded SS-316 and Flow-tube lining of PTFE / EPDM / Neoprene.

   Recommended make: Krohne-Marshall / Yokogawa / Emerson- Rosemount.

9. **Technical Qualifications for procurement of pipes during construction:**
   
   9.2. **H.D.P.E. Pipe:**

   9.2.1. The Pipe manufacturer should have an annual installed production capacity of quantity equal to this TENDER.

   9.2.2 The manufacturer should hold valid IS license under IS:4984 consecutively for last five years to manufacture ISI marked pipes.

   9.2.3 The Pipe manufacturer should have manufactured and supplied in India at least HDPE Pipe of minimum 110 mm or above dia. More than required in this TENDER during past 3 years ending 2012. Self certified document from HDPE Pipe Manufacturer to be attached alongside with technical Tender.

10. **Technical Qualifications for Bidder:**

   10.1 The Bidder should have successfully executed one job of Supply, laying and commissioning of ISI marked HDPE Pipeline, complete in all respects on Turn-key basis having cost 50% of the proposed works.

11. **Installation and Commissioning of HDPE pipes**

   a. Installation

   Supplying, laying, jointing, testing and commissioning of pipes shall conform to relevant IS codes, as applicable.
b. The alignment of pipelines shown in drawings of the TENDER documents is only indicative and the exact alignment will be as per drawings and/or as directed by the Engineer or his representative.
c. The HDPE Pipes shall be laid in accordance with the latest IS 7634 Part-2

12.0 Field Hydraulic Test

a. The Sectional Hydraulic Test shall be carried out after the pipeline section to be tested has been laid jointed and backfilled to a depth sufficient to prevent floatation
b. Each length of the pipeline to be tested shall be capped or blanked off at each end and securely strutted or restrained to withstand the forces which will be exerted when the test pressure is applied.
c. Proposals for testing where thrusts on structures are involved, even where thrust flanges on the piping are installed, shall be with the prior approval of the Engineer.
d. The proper method of filling the pipeline with water shall be used. The length under test shall be filled making certain that all air is displaced through an air valve or any other appropriate mechanism. The test length shall then remain under constant moderate pressure as per testing method given in the IS 7634.
e. As per IS code water required to built up allowable drop in pressure during test will be treated as a make up water.
f. The maximum allowable test pressure shall be 1.5 times the system design pressure or pipe rating which ever is higher
g. Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint, the Contractor shall, at his own cost, replace the pipe, repair the pipe or re-make the joint and repeat the hydraulic test with cost including the cost of water.
h. Test pressures are to be measured in kg/cm² at the centre of the blank flange situated at the lowest end of the pipeline under test. Unless otherwise specified the test pressure shall be as stated below.

13.0 INSTALLATION OF VALVES

General
The installation of valves shall be made according to the instructions of the manufacturer and the Engineer.

Installation of valves
Butterfly/Sluice valves shall be installed between flanges according to the instructions of the manufacturer.

Valves shall be placed on a support of concrete so that no shear stress is in the flanges. In case of axial thrust due to closure of a valve against pressure the valve shall be anchored in the support in a suitable manner to transfer the thrust into the floor slab of the chamber.

Air valves shall be installed on top of air valve tees.

SLUICE VALVES

DESIGN REQUIREMENT

A. Sluice valves shall generally conform to IS 14846/BS EN 1171/DIN 3352. Additionally, they should also meet specific requirement as stated.

B. Spindle, thrust collar and operating arrangement including hand wheel should be designed in such a way that one adult male is able to operate the valve against full differential pressure by exerting no more than 8 kgf effort (pull and push) on the hand wheel.

FEATURES OF CONSTRUCTION

a. Valves shall have inside screw, non rising spindle.
b. Valves shall be with appropriate bushing arrangement for replacement of packing without leakage (350 mm ø and above), up to 350 mm ø valves shall be glanduss.
c. Valves 450 mm ø & above shall be provided with an antifriction device / ball thrust bearing arrangement to minimize friction between spindle collar and casting. These should be housed away from wet chamber and should have facility for periodic greasing.

d. Valves of size 450 mm ø and above shall be provided with enclosed, grease packed spur gear box.

e. Valves 450 mm ø and above shall be provided with a drain and air plug.

f. All valve doors when fully closed would ensure door faces are riding on body seat ring by at least 50% of the width of seat ring and there is sufficient room for wear travel. Applicable for valves 350 mm and above. up to 300 mm valves shall be resilient seated.

g. All face and seat rings will be force/press fitted and additionally riveted (300 ø & above) to the recess in the CI casting. No screws are allowed.

h. Spindle, thrust collar and operating arrangement including hand wheel should be designed in such a way that one adult male is able to operate the valve against full differential pressure by exerting no more than 80 N effort (pull and push) on the hand wheel. Only single start, square threads with a pitch not exceeding 12 mm in the spindle be used.

i. Manufacturer to give details of gear box proposed – no. of spur pair, ratio, efficiency etc.

j. Manufacturer to justify with calculation that the valve proposed is operable within the effort parameters specified and no. of turns to ensure the time required to operate the valve from full open to full close is within reasonable limits. This is a vital requirement.

k. Nominal size of the valve shall be cast on the body of the valve.

DATA :

1. Size : 300 mm to 1000 mm

2. Rating (Kg/sq.cm) : PN 1.0

3. Drilling : IS 1538 Table 4 & 6 / relevant ISO with latest amendments/ BS EN 1092-2

4. Material of construction :
   - Body : DI IS 1865 Gr. 500/7 ; 400/15 or CI IS 210 Gr. FG 200 for PN 1.0 (all sizes)
   - Wedge : DI IS 1865 Gr. 500/7 ; 400/15 ( fully rubber lived EPDM, upto 300 mm) or CI IS 210 Gr. FG 200 for PN 1.0
   - Spindle : St. St. AISI 410 / 316 / relevant ISO with latest amendments
   - Seat & face rings : Bronze IS 318 LTB II 6 / relevant ISO with latest amendments ( for 350 mm above)
   - Drain & air plug : Bronze IS 318 LTB II 6 / relevant ISO with latest amendments
   - Ball thrust bearing : SKF or equivalent
   - Bushing arrangement : Halprene on bronze
   - Rivets : Soft annealed brass
   - Gland packing : Teflon coated / graphited asbestos / hemp
   - Fasteners : Carbon Steel
SHOP TESTING:

HYDROTEST:

- Seat leakage: 10 Kg/cm² (5 min) – for PN 1.0
- Back seat leakage: 5 Kg/cm² (2 min) – for PN 1.0
- Body: 15 Kg/cm² (5 min) – for PN 1.0

APPROVED MAKE: IVC / KIRLOSKAR / VAG / FOURESS/IVI

BUTTERFLY VALVES:

a. Butterfly valves shall be of double eccentric and resilient sealed type generally as per BS EN 593, BS 5155 and IS 13095. Valves shall be installed in valve chambers. Valves shall be provided with stainless steel extension spindle so that valves can be operated from ground level and without entering the chamber.
b. Material of construction of butterfly valves shall comply with following requirements:

<table>
<thead>
<tr>
<th>Item</th>
<th>PN 1.0 Valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Ductile IRON DIN 1693 – GGG40/spheriodal graphite icon IS 1865 Gr 400/12</td>
</tr>
<tr>
<td>Disk</td>
<td>Ductile IRON DIN 1693 – GGG40/spheriodal graphite icon IS 1865 Gr 400/12</td>
</tr>
<tr>
<td>Shaft</td>
<td>Stainless steel BS 970 Grade 431 S 29</td>
</tr>
<tr>
<td>Body Seat</td>
<td>Nickel weld overlay micro finished</td>
</tr>
<tr>
<td>Disc Seal</td>
<td>EPDM</td>
</tr>
<tr>
<td>Seal retaining ring</td>
<td>Ductile icon DIN 1693 – GGG40</td>
</tr>
<tr>
<td>Shaft bearing</td>
<td>Bronze with EPDM ‘O’ ring seal</td>
</tr>
<tr>
<td>Internal Fasteners</td>
<td>Stainless steel SS 316</td>
</tr>
<tr>
<td>Nuts, Bolts &amp; washers for</td>
<td>High Tensile steel hot dip galvanized for valve in chamber. Stainless steel SS 316 for buried valves</td>
</tr>
<tr>
<td>pipe flanges</td>
<td></td>
</tr>
<tr>
<td>Coating</td>
<td>Internal and external with power of liquid epoxy coating with minimum dry film thickness of 250 microns</td>
</tr>
</tbody>
</table>

c. Butterfly valves shall be suitable for mounting in any position. The valve shall be free from induced vibration.
d. Butterfly valve shall be suitable for bi directional pressure testing with dead tight shut off even after long period of operation of 5 years. The valves shall be of double flanged long type.
e. The valve seal shall be of replaceable design. When the valve is fully closed, the seal shall seat firmly. The seat surfaces shall be machined smooth to provide a long life for the seal. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
f. The shaft shall be stainless steel with bronze or equivalent seal with self lubricating bearings. Disc pin shall be stainless steel. Ring shall be Tenderirectional seal adjusting suitable for pressure and vacuum service. Removal and replacement of steel shall be possible without removing the operating mechanism, valve shaft and without removing the
valve from the pipeline. Valve shaft shall be of one piece unit extending completely through
the valve disc hubs.

g. All valve spindle and head wheels shall be positioned to give access for operational
personnel. Valves shall be provided with enclosed gear arrangement for ease of operation.
The gear box shall be worm and worm wheel design type totally enclosed grease filled and
weather proof. The operation with gearing shall be such that they can be opened and
closed by one man against an unbalanced head of 1.15 times the specified ratings. Valves
and gearing shall be such as to permit manual operation in a reasonable time and not
exceed a required rim pull of 200 N. The valve disc shall be 90 deg turn.
h. The disc shall be designed to withstand the maximum pressure differential across the valve
in either direction of flow. The disc shall be contoured to ensure the lowest possible
resistance to flow and shall be suitable for throttling operation.

i. It should be possible to open the valve with upstream pipe fully filled and down stream pipe
fully empty. The shaft shall be designed to withstand the maximum torque that will be
imposed by the operator. It shall be secured to the disc by tapered stainless steel cotter
pins.
j. Valve shall be provided with mechanism position indicator to show the position of the disc
mounted on the driven shaft end.
k. Rigid adjustable stop mechanism shall be provided within the gear box or elsewhere on the
valve to prevent movement of the disc beyond the fully opened or closed position (i.e. set
points).
l. Valve shall be capable of closing against the maximum flow that can occur in practice. The
break way torque against maximum differential head conditions shall be within the
manufacturer}s limits.
m. All hand wheels shall be arranged to turn in a clock wise direction to close the valve, the
direction of rotation for opening and closing being indicated on the hand wheels.
n. All hand wheels shall be provided with an internal locking device to prevent operation
device by unauthorized person.

AIR VALVES

A SCOPE AND GENERAL DESIGN FEATURE
This section covers the requirements of double orifice type air valves with tamper proof
cover to be used for evacuation of accumulation of air in water mains under pressure, for
the exhaust of air when such mains are being charged with water and for inlet of air when
they are emptied of water.
The working pressure of the air valves shall be 10 kg/cm² (PN 1).

B FUNCTION
Automatic air valves generally conforming to IS 14845 / relevant ISO with latest
amendments are to be used for evacuation of accumulated air in water mains under
pressure, for the exhaust of air when such mains are being charged with water and for
ventilating the mains when they are being emptied of water.

C DESIGN FEATURES
a) Air valves shall be double orifice type and tamper proof unless otherwise directed
by Engineer. A buoyant rigid float shall seal the large orifice and the chamber
housing shall be designed to avoid premature closing of the valve by the air whilst
being discharged. Small orifice shall discharge small air volume during operation
under full internal pressures. All air valves shall be provided with isolating sluice
valves and flanged end connection.
b) The valve shall be capable of exhausting air from pipe work automatically when
being filled, the air being released at a sufficiently high rate to prevent the
restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipe
work automatically when being emptied or under water hammer condition, the air
inflow rate being sufficiently high to prevent the development of a vacuum in the
pipelines. The valve shall also automatically release air accumulating in pipe work
during normal working conditions.
c) The valves shall be designed to prevent premature closure prior to all air having
been discharges from the line. The orifice shall be positively sealed in the closed
position with the float only raised by the liquid and not by a mixture of air and liquid spray. The seating shall be so designed to prevent the float sticking after a long period in the closed position.

d) Air valves shall thus be designed to automatically operate so that they will;
   • Positively open under internal pressure less than atmospheric pressure to admit air in bulk during pipeline draining operation;
   • Exhaust air in bulk and positively close as water, under low head, fills the body of the valve during filling operation;
   • Not blow shut under high velocity air discharge; and
   • Exhaust accumulated air under pressure while the pipe is flowing full of water.

D CONSTRUCTION FEATURES

Material of construction of air valves shall comply with following requirements:

a) All air valves shall be constructed so that internal working parts which may become necessary for repairs shall be readily accessible, removable, and replaceable without used special tools and removing the valve from the line.

b) Valves with air intake or exhaust facilities shall have an integral protecting cover top shall be supplied to prevent dirt and debris from entering the outlet of the valve.

c) The contractor shall verify with the supplier of the valves that the valves have the capacity to sustain the pipeline test pressure prior to testing. In the event that the valves do not sustain the pressure they shall be removed and the stub pipes from the main pipeline blanked off before pressure testing the pipeline.

E DATA

a) Valve size : 300 to 1000 mm dia
b) Suitable for max. differential pressure (kg/cm²) : 10

c) Material of construction
   Body and cover : CI IS 210 Gr FG 200 or SG iron 1865 Gr 400/12 or grade GGG40
   Float : Rubber coated timber or Polycarbonate up to 50 NB/ SS 304 above 50 NB
   Internal Linkages : SS 304
   Seat Ring : Dexine (Nitrile Rubber) or bronze seat
   Isolating Sluice Valve : Generally conforming to IS 14846/relevant ISO with latest amendments
   Spindle for Sluice Valve : St. St. AISI 410
   Bolts & Nuts : M.S.

TESTING AND PERFORMANCE

a) When tested as per clauses 11.6.d.1, the air passage and the function of ball floats in a valve shall be satisfactory, and the valve shall work smoothly.

b) Hydrostatic test of valve body, when tested in accordance with 11.6.d.4 there shall be no leakage through pressure sustaining components and joints. There shall be no permanent deformation of any part.

c) Valve seat and cock, when tested in accordance with 11.6.d.2 and 11.6.d.3 shall not show any leakage.

d) Function and Performance Test
   d.1 The valve shall be fitted on a test bench. The pressure of the water in pipe shall be developed to working pressure, and the main valve shall be gradually opened to check the air release and float function. Compressed air shall then be slowly put into the valve through underside of the valve, and check the function of floats.
   d.2 High Pressure Orifice Seat Test
Subsequent to high pressure orifice performance test, hydraulic pressure shall be reduced up to half of the working pressure to check leakage of orifice seat for a duration of three minutes.

d.3 Low Pressure Orifice Seat Test

Subsequent to high pressure orifice performance test, hydraulic pressure shall be reduced up to half of the working pressure to check leakage of orifice seat for a duration of three minutes.

d.4 Body Test

The valve body (without cover and ball floats) shall be covered by a blank flange, keeping isolating valve open. Hydrostatic pressure of 1.5 times the pressure class of the valve shall be applied for duration of 5 minutes to check the water tightness of the body.

14 VALVE CHAMBERS

Valve chambers shall be constructed according to the typical drawings suitable for the respective valve and special arrangement if any shall be approved by Engineer. They shall be constructed in brick masonry as shown in the drawing. The chambers shall be constructed after the laying of the pipes and the assembly of specials and valves. The size of the chambers shall be according to the following criteria as per direction of Engineer.

- Minimum distance of flanges from walls : 45 cm
- Minimum distance of sockets from walls : 45 cm
- Minimum distance between highest point of equipment and roof slab : 30 cm
- Maximum distance between highest point of equipment and roof slab : 50 cm

Pipes passing through walls should be coated by two layers of soft material (Hessian felt) to allow for differential settling and longitudinal expansion if directed by Engineer. Only metallic pipes may be cast into the walls for anchoring purposes.

The work shall include excavation, consolidation, leveling, lean concrete as per drawing in foundations, finishing, refilling. It shall include all labour and material required for the complete chamber.

15 DISMANTLING JOINTS

Double flanged Dismantling joints shall be of Cast Iron in such a manner that valves (300 mm and above dia) can be dismantled without stress to the joints. These shall be for working pressures of 10 kg/cm² (1 Mpa) and shall be completely leak proof with proper gasket arrangement. Flange dimensions shall conform to IS 1538 (part I to XXII). Flanged specials shall be supplied with required nuts, bolts and rubber gaskets. The nuts and bolts shall be of best quality carbon steel, machined on the shank and electro-galvanized. Rubber gasket shall be as per IS 5382. Dimensions and drilling of flat gasket will be as per IS 1538 : 1993, suitable for making flanged joint. The dismantling pieces shall provide minimum clearance of + 25 mm (total distance 50 mm. The dismantling joint shall be internally and externally coated with hot applied (dip) bituminous paint.

16 THRUST BLOCKS

The thrust blocks shall be of plain/reinforced cement concrete on site as per design and drawings to be given by the Contractor and approved by the Engineer In Charge. The thrust blocks shall be cast directly against the undisturbed soil.

17 OTHER SERVICES

Contractor shall take the necessary precautions to avoid the damage to other services such as water supply lines, telephone cables, electrical cables, storm water drains etc. In case of any damages to any of the services, contractor shall be responsible for restoring the facilities in bare minimum time at his own cost.

18 REINSTATING THE ROAD SURFACE

Road restoration should be done just after proper backfilling of trenches. About 100 mm thick layer of stone dust/zeera gitti should be filled in trenches and making with adjacent road. Any settlement in trench should be immediately filled with stone dust/zeera gitti. WBM/Bituminous surface shall be made as directed by Engineer In Charge.
SPECIFICATION FOR CONSTRUCTION OF R.C.C. OVER HEAD WATER TANK

1. **PREAMBLE:**
The work of the aforesaid Overhead tank is to be assigned on Lump Sum contract at Turn-key job basis.

2. **Scope of work:**
Nine RCC Overhead tank as mentioned in Description of work is to be designed and tested on Lump sum contract.

The work includes the following sub work:

i. Investigation and testing for foundation.
ii. Design and drawing of the structure.
iii. Construction as per approved designed and drawing.
iv. Providing and fixing of pipes, valves and other appurtenances.
v. Testing of the structure for the water tightness and stability.

All materials required for satisfactory completion of the work such as cement, steel, pipes, specials and valves shall be procured by the contractor himself. The water required for construction shall be arranged by the contractor but that required for testing and handed over to the department within the time period specified in the Notice inviting TENDER.

3. **LOCATION OF WORK:**
Overhead tank site: Nine nos. 18 m staging OHT’s, 9 nos.1000 KL, having cumulative storage capacity 9000 KL at Nine location of Municipal area.

4. **GENERAL REQUIREMENT:**
4.1 The foundation of the structure should be taken down sufficiently below the average ground level for safe transfer of load to undisturbed formation. The strata chart of test pit, taken at this site is enclosed as Drawing. No.3 for general information only. Suitable Soil test should be carried out by the contractor through Govt. Engineering college or any other recognized laboratory to ascertain safe bearing capacity of the soil for design purpose.

4.2 The tank shall have RCC round column staging only circular columns shall be preferred. The specification laid down in the letter TC No. 236 dated 21.05.97 issued by Engineer-in-Chief PHED M.P. Bhopal be strictly followed.

4.3 The type of foundation should be suit to the determined safe bearing capacity of the soil and shall be designed accordingly. The excavation shall be done in all sort of strata and if blasting is required, the contractor shall obtain permission from the competent authority and all rules regarding safety shall be followed.

4.4 The tanks can either be rectangular or circular is shaped supported over column staging but the location plan of the columns should permit utilization of spacing underneath fully for construction of office/staff building.

4.5 The capacity of the tanks specified in para 2.0 above shall be between the outlet level and the full tank level. The maximum depth of water in the tanks should not be more than 6.0 m. The outlet level should be kept minimum 0.15m above the tank floor level. A free board of 0.5m should be provided below the lowest surface of the
roof slab or beam. The inlet level should be 0.10m above the full tank level. The scour level should be kept flush with the floor slab.

4.6 The height of the staging specified in para 2.0 shall be above the general ground level at the tank site of the nearest road level whichever is higher and shall be measured up to tank floor level.

4.7 A RCC doglegged staircase 1.2m wide shall be provided from ground level to gallery on outlet of the tank. The staircase should have straight flights with intermediate landing at bracing levels. The rise of the stairs shall not be more than 25cm. The staircase should have railing on both sides comprising of 1.2m high GI medium class pipe of 80 mm dia posts, 1.5 to 1.6m apart and medium class 20mm dia I pipes in three rows. The GI pipes posts and the railing pipes (class medium) should be secured adequately.

4.8 A RCC gallery 1.2m wide all around the tank at vertical wall ring beam level should be provided to facilitate inspection, cleaning and painting of the tank. A railing comprising of medium class 80m dia GI pipes posts 1.2m high rigidly fixed in the gallery slab at 1.5m maximum spacing with 3 rows of 20mm GI pipes (Class medium) should be provided. The gallery should have access from the staircase, A steel door shall be provided at the entrance to the gallery or at the far end of the RCC staircase to prevent unauthorized entry.

4.9 RCC ladder properly supported from tank wall with hand rails 0.45m in width should be provided outside of the tank from gallery of top of roof slab. The RCC ladder shall have at lest one landing in between gallery and roof top and. Mild steel ladder, from the manhole in the roof slab to floor slab, inside of the tank to facilitate inspection and cleaning. These ladders should be of MS plates 65mmx10mm size with 20mm dia round bars fixed at 0.25 centers by holding and welding to MS plates. The insides ladder should be properly supported in the mid span for rigidity.

4.10 An apron of cement concrete 1:2:4 i.e. M-15 mix should be provided for an area which is 1.5 meter more the dimension of the tank of all sides having 100x100 mm drain in cement concrete 1:2:4 all around shall be constructed and water will be led to the proper disposal point through the drain to be constructed for the purpose. The top of the drain around the apron shall be 100mm above the ground level. Outer edge will be covered with sloping earth the apron will have a slope of 1.60 from centre towards the drawl. The edge of the drain will be flush with the top surface of the apron. The apron will be 100mm thick in cement concrete 1:2:4 laid on sub base of 100mm thick 1:4:8 cement concrete in case of black cotton/cohesive soil the soil will be removed up to 500mm below the ground level and refilled with rammed moorum up to 400mm incase of hard strata like moorum, kopr etc. moorum filling will not be required.

5. PIPES AND FITTINGS:

The inlet, outlet, over flow and scour pipes for the tanks shall be cast iron double flanged class A as per IS : 7181-186 all these pipes shall be independent of each other and shall be fixed in vertical position rigidly by bolting and clamping properly.

The size of these pipes in OHT shall be as given below

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet dia of pipe</td>
<td>250 mm</td>
</tr>
<tr>
<td>Outlet dia of pipe</td>
<td>300 mm</td>
</tr>
<tr>
<td>Overflow dia of pipe</td>
<td>350 mm</td>
</tr>
<tr>
<td>Scour dia of pipe</td>
<td>200 mm</td>
</tr>
</tbody>
</table>

The size of these pipes in Sump well shall be as given below
inlet dia of pipe 250 mm
Outlet dia of pipe 250 mm
Overflow dia of pipe 300mm

Cast iron bell mouths as per Appendix 10.2 of CPHEEO manual conforming to IS 1538-1976 shall be provide on the top end of all pipes. These pipes shall have CI puddle collars properly embedded in the floor slab at the time of concreting to provide monolithic joint. Cast iron strainer shall be provided on the top of outlet and scour pipes,. Cast iron duck foot bends shall be fixed over cement concrete bed block, to support vertical pipes. The bed blocks shall be designed to take the load of pipes and the water column indecently. The double flanged Duck foot shall be provided. 1.2m below average ground level at site.

Cast Iron Double flanged sluice valves with spur gear and hand wheel class PN 1.0 confirming to IS : 14846 with all revision up to date issued of NIT shall be provided and fixed minimum 3.0 m away from the ground level bracing, along with necessary C.I.D.F. pipes. The size of the valves shall be as given below:

Inlet valve Dia (150 mm)
Outlet valve Dia (150 mm)
Scour valve Dia (80 mm)

The overflow pipe shall be left open at minimum 3.00 m distance from bracing CIDF pipes shall be provided between Duck foot bends and D.F. sluice. The contract will limit up to fixing of DF values.

6 APPURTENANCES:

6.1 Water level indicator:
A float operated level indicator comprising of stainless steel float pulleys, steel wire rope and enameled indicator plate calibrated to read depth of water in metre, shall be provided.

The pulleys should provide free movement of rope and they should be easily accessible for repair and maintenance. The indicate plate should be fixed at about 5m. Above ground level on the front side of tank.

Additionally the following arrangement may be provided as optional
(a) Water level indicator, working on physical characteristics.
(b) Pressure gauge, calibrated, to read water depth directly.

6.2 Ventilators :
Mosquito proof ventilators, of suitable design shall be provide on the roof slab of tank to facilitate discharge of dissolved gases of water and to keep the inside of tank odour free.

6.3 Man hole:
An opening of 0.75x0.75m or 0.9m dia size shall be provided in the roof slab fo tank for access inside the tank for inspection and cleaning. The opening shall have CI/MS cover with locking arrangement.

Lightening Arrestor:
Aluminum lightening arrester as per relevant B.I.S. shall be above highest point and 30 mmx4mm size strip connected to earth electrode shall be provided. The earth strip shall be secured rigidly to concrete surface.

7 Finishing and painting

7.1 Form finish:
All external surfaces on the structure shall have form finish. However all uneven surface and small defects shall be made even immediately after removal of forms with 1:1 cement mortar. The inside surface of the tank shall be rendered even and water proof by cement plaster in 1:2 portion.

7.2 Painting of Concrete:
The outside surface of the Over Head Tank shall be painting with 2 coats of IS marked cement colour of approved make. The colour shade shall be decided by the Engineer-in-Charge.

7.3 Painting of pipes etc.
Cast iron pipes, valves and fittings, shall be painted with 2 coats of black bituminous paint.

7.4 Painting of MS Ladders and MH Cover:
As the MS ladder inside of the tank and manhole cover shall be subjected to corrosive action of chlorinates water they shall be coated with epoxy paint.

8. TESTING OF OVER HEAD TANK / SUMPWELL:-
In addition to the structural test as given in IS 456-1978 revised and amended up to date the Over head tanks shall also be tested for water tightness at maximum water level in accordance with clause 10.1.1 of IS 3370 (part-I0 1965. The tanks shall be filled more than 0.25m per day and the settlement of foundation of foundation shall be measured accurately before each filling. Any defect of any sort affecting the strength, durability, appearance of usefulness of the structure noticed during testing shall be completely removed to the satisfaction of executive Engineer with in the specified time for completion of work.

9. COMMISSIONING & HANDING OVER:-
On completion of all works and the successful of the over head tank, it shall be handed over to the department for commissioning as required on completion of work and testing. The contractor shall submit completion drawing in six sets along with foundation investigation, concrete strength water tightness test reports at the time of handing over of work.

Additional Specifications
01 The work of construction of RCC reservoir involves workmanship; hence requirement of higher standard than general concrete work is essential.
02 The TENDERs submitting their . in form F (lump-sum TENDER) submit the drawing and calculation within one month from the date of acceptance of their TENDER for scrutiny and approval of competent authority of Public Health Engg. Department Madhya Pradesh. The responsibility for design, construction, structural stability and water tightness for all water tight structures will however, rest solely with the contractor and the will have to make good at their own const any damage or loss to Government due to defect, if any in the above mentioned work.
03 The TENDER submitting their offer in form "F" (lump-sum TENDER) shall indicate the approximate quantities of various items involved in the work e.g. cement, concrete and steel etc. This information shall be attached with the TENDER itself. The lump sum offer shall include provision for balcony railing, lightening arrester, water level indicator and staircase also.
04 The contractor shall have to arrange his own steel whatever the quantity of steel is required to complete the whole structure in all respect. The department shall not supply any quantity of steel under any circumstances. No extension of time will be granted for late supplies of steel of escalation, if any in future. The steel for reinforcement shall conform IS2266-1962 OR IS 1977-92 (st. 44) only and a certificate shall be required to be produced to the department in support in addition to
random sample at site duty got checked at contractor cost to see whether it confirm to above specification.

05 The tank container shall be designed to take care of corrosive effect of water due to mixing of chlorine in the water for disinfections.

06 The department shall not be responsible for providing water required for construction and other purpose. The contractor shall make his own arrangement for the same at his own cost.

07 Not extra charges for the plastering if required for the finishing of the surface of structure shall be paid under any circumstances.

08. Whenever bailing out of water or dewatering of foundation is required to be done, nothing extra will be paid for it the contractor/firm should quote his rate after taking this factor into consideration.

09. The contractor/firm shall be required to submit the complete drawing in six copies on completion of the work in A3 size only.

10. The contractor shall have to make his own arrangement of electric or telephone connection, if required at his own cost.

11. For blasting if required, in foundation the contractor /firm will make his own arrangement for license/permit and materials from the competent authority.

12. The work shall be treated as complete when the same is completely tested and handed over to the department including site clearance.

DESIGN REQUIREMENT

01. A separate drawing showing only dimension must be given.

02. Details of reinforcement in different components like footing, columns bottom dome, vertical wall rings beams, roof dome and stair case etc.

03. Orientation and shape of each type of bar must be shown against sketch for the component length and total number of bar of each type must be mentioned to avoid confusion.

04. Location of pipes and other fittings and extra reinforcement at opening should be shown separately.

05. Bar bending schedule and location of construction joints also be made clear in the drawings.

06. Contractor shall consider the earthquake zone for design purpose.

REINFORCED CONCRETE WORK

It shall be strictly as per IS 456 & IS 3370 (part (i) to (iv), IS 11682 and other relevant specification revised up to date for RCC structures.

01. Minimum strength of concrete:

Minimum strength of concrete for components of elevated tank shall be as below:

- Columns, staging - M25 (250kg/sqm.cm)
- Tank including roof - M-30 (300kg/sqmc.m)

02 Minimum cement content:

From durability considerations minimum content shall be as below:

- Concrete MK-25 - 350mg/cum
- Concrete M-30 - 400kg/cum

03 The cover of concrete:
The minimum cover shall be 40mm all the reinforcement & for foundation this cover shall be 60mm.

04. Cement Grade:
Grade 43 of cement should be used for columns and grade 53 for the tank portion, including the top dome cover only fresh cement should be used in the tank. It is advisable to use cement, manufactured by major plant and reputed firms OPC or blast furnace slag cement should be used.

05 Water cement ratio
Water cement ratio shall not be more than 0.45. This means 22.5 litres of water per 50kgt beg of cement.

06. Use of Chemicals
When the water cement ratio is less he strength and durability of concrete of concrete is good. It is advisable to use plasticizers in concrete and reduce water cement ratio up to 0.4 plasticizers manufactured by reputed combines are recommended.

(i) Sika Qualcretae 24-B park street, calcutta, 7000 16 CM bauchemie PVT Vardhman chambers sector 17 Vashi new Mumbai 400703
(ii) Rioffe, 12 c Vikas center, S.V. Road Betul, Creuze, West Mumbai 400054.
(iii) Fos Rock India Ltd. Hafeea Chambers 2nd floor 111/74 K.H. Road Bangalore 560027.
(iv) Shallmar tar products, construction Additive division 16 NGN Vaidya Marg, bank street Mumbai. 400023.

Proportion of plasticiser to be used shall be as per the instruction manual supplied by the manufactures.

07 MEASUREING:
The quantity of cement shall be determined by weight. The quantities of fine and coarse aggregates shall be determined either by volume or by weight.

08 Aggregates
It is advisable to use metal derived form igneous rock preferable of basaltic or granitic origin. The coarse sand should be free soil. All aggregates shall conform to all provision and test methods of I.S. specification 388-1963.

01 Fine aggregates when tested by the colorimetric method the color shall of be darker than light amber, fine aggregates shall be capable of developing 30% o the compressive strength.
02 Maximum aggregate size shall not be more than 20mm when the spacing of reinforcement bar is 20mm.
03 Fineness modulus shall be more ten plus or minus 0.20 from that of the approved sample.
04 Water shall be clean & free from oil acids of injurious substances.

09. Storage of material
Cement shall be stored off the ground in a dry ventilated building. Aggregate shall be stored in 0.6 meters layers on planning. reinforced steel shall be stored under cover & protected from rusting oil grease or distortion only steel needed for immediate use shall be removed from storage.

10 Minimum Dimension And shapes:
Minimum Dimension shall be as below:
Circular  400mm
Tank wall 200mm
Bottom slab 150mm
Top slab 125mm

Note: If a dome is provided at the top, the thickness can be limited to 100mm rectangular square columns are not allowed circular shafts are also not allowed. In respect of horizontal braces corners shall be chamfered by 40x40mm

Form
01 The contractor shall provide form that will produce correctly aligned concrete.
02 The centering shall be true and rigid and thoroughly based both horizontally and diagonally. The forms shall be sufficiently strong to carry the dead weight of the concrete without deflection and tight enough to prevent leakage of mortar.
03 For exposed interior or exterior concrete surface of columns and walls, steel or other approved corrosion resistance devices shall be used.
04 Rigid care shall be exercised that all columns are in plum and true & thoroughly cross braced to keep them so.
05 All floor and beam concreting shall be crowned not less than 6mm in all direction for every 4.8 meter span.
06 Beveled strains shall be provided in form, angles and in corners of column and beam boxes for chamfering of corners where shown in drawings or as directed.
07 The inside of forms shall be coated with approved oil thoroughly wetted oil shall be applied before reinforcement is placed.
08. Temporary openings for cleaning and inspections shall be provided at the base of vertical forms and at other places when they are necessary.

11. **FORM WORK:**
Wherever intz type of tanks are adopted or where then is an inclined slab having inclination steeper than one vertical to three horizontals, inside form work must be provided, the procedure for such a form work be

a) Place outer form work.
b) Place inner form work 300 to 450mm wide Then concrete that portion then fix next strip and concrete.
c) In respect of top of bottom domes, place upper form work for lowest circular strip of width equal to 1/4th dia of dome and concrete as stated above, then concrete central half for which top form may not be provided.

12. **REINFORCEMENT STEEL**
01. Bars and rods shall be free from scale oil structural defects and shall be maintained so on the job.
02. Fabrication shall be accurately done to the dimensions shown on the drawings, stirrups and ties shall be bent around a pin having diameter at least twice the bar thickness, other bars shall be bent around a pin having a diameter at least 6 times the bar thickness. All bars shall be bent cold.
03. All steel will be rigidly held in place with approved galvanized wire devices in such a manner that all steel will support the weight of the workman without displacement.
04. On exterior exposed concrete no metal ties charts or spacer shall remain within 40mm of the finished surface.
05. The steel bars used for reinforcement shall be strictly as per IS specifications.
13. **Minimum Steel:**
Design requirements as set out in relevant codes in respect of steel shall be full satisfied. However, following minimum steel should be provided

a) Vertical steel in column 0.8% of cross sectional area actually required & 0.3% when larger section than actually required is provided.

b) Horizontal links in columns not less than 8mm dia at 200mm c/c or 10mm dia not more than 300mm c/c.

c) Exposed RCC Surface On both faces when thickness is 150mm or more.

2 kg/sqm in one direction.

2 kg/sqm in perpendicular direction.

The above requirement is satisfied if.

8mm bars @ 200mm c/c OR

10mm bars @ 300mm c/c are provided.

Even if design steel is less than above, the above minimum shall be provided.

d) Steel in tanks As per provision of IS 3370 subject to minimum as set out in (c) above.

13. **Minimum Spacing of Reinforcement:**
Maximum spacing of main reinforcement in slab or walls shall not be more than 150mm center to center. The spacing of secondary bars, such as distribution steel of vertical bars in columns shall not be more than 300mm center to center.

14. **Type of Steel:**
It is advisable to use corrosion resistant CR steel such steel is now available.

15. **Detailing of Steel:**
Before commencing the work the drawing should be studied. It must be insisted that the designer provides details of the shape of each bar, its diameter, length and numbers of each category in a schedule of reinforcement. This must be incorporated in every working drawing.

16. **Mixing Concretes:**
01 It is extremely essential that the contractors undertaking the work should have concrete mixer with them. No hand mixing shall be allowed.

02. Concrete shall be mixed in the standard batch mixer with a drum speed of 200 to 250 peripheral feet per minute mixing time shall be two minutes for batches of 1 cu. yd or 0.39 cum or under and shall be increased 15 seconds for each additional 1/2 cu. yd or 0.39 cum of fraction there of.

03. Tempered concrete shall not be allowed Air standard or lean concrete shall not be used, the contents of the mixer shall be completely discharged before each new batch is loaded.

04. The concrete shall be, uniform in ingredients, colour and consistency.

17. **Transportation**
Concrete shall be handled from the places of mixing to the place of original deposit as rapidly as practicable by methods which will prevent segregation or loss of any ingredients. If segregation does occur during transport the concrete shall be remixed before begin placed.

18. **PLACING OF CONCRETE**
01. Concrete shall be deposited in its final position without segregation remanding or flowing.

02. When possible concreting shall be continues unit the section in completed.

03. Form shall be clean before concrete is placed.

04. In no case the concrete shall be laid without vibration, it is desirable to keep two concrete vibrators at the construction site so that in case of break down the other vibrator can be used.

05. Concrete shall be shaped & vibrated with approved mechanical vibrator to maximum subsidence without segregation and adjacent to form and joints over vibrating or vibrations of very wet mixes will not be permitted and should be avoided. Reinforcement bars shall be shaken to ensure bond with concrete.

06. Slabs and beams stems shall be placed in one operation.

07. Concrete columns & walls settle at least 2 hours before the floor system supported on is poured.

08. Construction joints be treated in accordance with is 456. The surface of already laid concrete be cleaned by water jet and cement slurry be applied, Cement mortar 10mm thick of the same proportion as in concrete by applied and then fresh concrete of the lift be laid. The form work must overlay 100m on the already laid concrete.

09. Conveying & chatting of concrete shall be done only by approval of the Engineer-in-charge & with equipment to insure a continuous flow with out segregation.

10. Water accumulation during placing shall be removed concrete shall not be deposited in such accumulation.

11. The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed.

12. Converting shall be placed and compacted before setting commences and should not be subsequently disturbed.

19 **EXPOSED SURFACE**

01. Imperfect surfaces where strength is not impaired may be patched and rubbed smooth with carborundum brick.

02. Fins and projection shall be removed and the concrete surface affected there by shall be rubbed smooth.

03. Small voids shall be filled with 1:3 mortar pressed into holes and floated smooth.

04. Plastering and steel trowling of surface shall not be allowed.

05. Honey comb concrete shall be repaired by removal and replacement of member.

06. Forms shall be filled tightly so as to minimize fins joints shall be finished with bevels strips as directed by the Engineer-in-charge.

20. **CURING CONCRETE**

01. It is extremely important to make arrangement for supply of sufficient water at the construction site for curing of the concrete. Continuous and efficient curing is extremely important for development of good compressive strength in any concrete structure.

02. After finishing concreting, curing shall be done by damping concrete at least for one week after placing. Floor & vertical surfaces shall be covered with a layer of old gunny bags or similar absorbent material and kept constantly wet. Curing operations shall begin as soon as the concrete has attained initial set. All materials and facilities for curing concrete shall be on hand and ready for use before concrete is placed.

03. Concrete shall be kept wet and moist for at least two weeks.

21. **FLOOR FINISH**
Tank wall and floor finish shall be monolithic bonded.

22. **REMOVAL OF FORM**

01 In no circumstances forms shall be struck until the concrete reaches strength of at least twice the stress to which the concrete may be subjected at the time of striking.

02. In normal circumstances i.e. at temperature 21 C forms may be removed at the following minimum times which will be subject to the Engineer's requirement.

<table>
<thead>
<tr>
<th>Material</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>02 days</td>
</tr>
<tr>
<td>Columns</td>
<td>03 days</td>
</tr>
<tr>
<td>Beams soffits (sides)</td>
<td>05 days</td>
</tr>
<tr>
<td>Bottom of beams up to 6m span</td>
<td>14 days</td>
</tr>
<tr>
<td>Bottom of beams above 6m span</td>
<td>21 days</td>
</tr>
<tr>
<td>Slabs 125mm thick or less, up to 4.6m span</td>
<td>07 days</td>
</tr>
<tr>
<td>Slabs 125mm thick or less, above 4.6m span</td>
<td>14 days</td>
</tr>
<tr>
<td>Slabs over 125mm thick or, up to 4.6m span</td>
<td>18 days</td>
</tr>
<tr>
<td>Slabs over 125mm thick or above 4.6m span</td>
<td>14 days</td>
</tr>
</tbody>
</table>

04 All concrete shall be inspected for quality before forms are removed.

05. When struck by a carpenter's hammer it shall ring like stone.

06. Upon removal of forms the contractor shall place adequate precautions to prevent injury to the concrete by construction loads.

07. The contractor shall be responsible for safe removal of forms and for placing adequate precaution.

23. **APPROVAL OF MATERIAL**

Before use, samples of all materials shall be got tested from recognized laboratory by the contractor at his won cost and the test certificate shall be furnished to the Engineer-in-charge & no material shall be used until it has been approved.

25. **LABORATORY TEST**

Following laboratory test shall be made by the contractor at his own cost and reports furnished to the Engineer-in-charge.

<table>
<thead>
<tr>
<th>Sn</th>
<th>Material</th>
<th>Lab test</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Cement</td>
<td>Physical &amp; Chemical test</td>
<td>IS 269-445</td>
</tr>
<tr>
<td>02</td>
<td>Coarse &amp; Fine Aggregate</td>
<td>i) Gradation</td>
<td>IS 2386 (part-I)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Deleterious constituents</td>
<td>IS 2386(part-I)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Moisture Content</td>
<td>IS 2386(part-III)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv) Bulking of fine aggregate (for volume batching)</td>
<td>IS 2386(Part-III)</td>
</tr>
<tr>
<td>03</td>
<td>Coarse aggregate</td>
<td>i) Los Angeles abrasive values (aggregate impact valve)</td>
<td>IS 2386(part-IV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Soundness</td>
<td>IS 2386(part-V)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Alkali aggregate reactivity</td>
<td>IS 2386(part-VII)</td>
</tr>
<tr>
<td>04</td>
<td>Water</td>
<td>Chemical test</td>
<td>IS 456</td>
</tr>
<tr>
<td>05</td>
<td>Concrete</td>
<td>i) Workability (Slump or compacting factor test)</td>
<td>IS 1199</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Concrete strength</td>
<td>IS 516</td>
</tr>
</tbody>
</table>
FIELD TEST

01 The contractor shall provide all equipment and make all arrangements for field tests to exercise proper quality control over work specially for test mentions as S.No.2(ii) and S.No. 5 mentioned under para 28.0.

02 Test for compressive strength of concrete.

03 Test specimens cubical in shape shall be 15x15x15cm. If the largest nominal size of the aggregates does not exceed 20mm; 10cm cubes may be used as an alternative. Cylindrical test specimen shall be 15cm in diameter and 30cm long. Smaller test specimen shall have a ratio of diameter of specimen to maximum size of aggregate of not less than 3 to 1 except that the diameter of the specimen shall be not less than 7.5 cm for mixtures containing aggregate more than 5% of which retained on is sieve 480.

04 The mould shall be of metal preferable steel or cast iron and should be strong enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage and shall be so machined that when it is assembled ready for use. The dimensions and internal faces shall be accurate within the permissible limits the mould and base plate shall be coated with a thin film of oil before use in order to prevent adhesion of the concrete.

05 The tamping bar shall be of steel bar 16mm in diameter 0.6 meter long and bullet pointer at the lower end.

06 The test specimen shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 5cm deep in placing each scoop full of concrete. The scoop shall be moved around the top edge of the mould as the concrete slides from it in order to ensure a symmetrical distribution of the concrete within the mould each layer shall be compacted by vibration. After the top layer has been compacted the surface of the concrete shall be finished level with the top of the mould using a travel & covered with a glass or metal plate to prevent evaporation.

07 When compacting by vibration, each layer shall be vibrated by means of an electric or pneumatic hammer or vibrator or by means of a suitable vibrating table until the specific condition is attained.

08 The mode and quantum of vibration of the laboratory specimen shall be as nearly same as those adopted in actual concreting operations.

09 The test specimen shall store in a place free from vibration it should be kept in moist air of at least 90% relative humidity & at a temperature of 2702 C for 24 hours + - 1/2 hours from the time of addition of water to the dry ingredients in the fields, it should be kept under matting racks or other similar material for 24 hours + 1/2 hour from the time of adding water to the other ingredients at a temperature at a temperature range of 22 to 32 C, after this period, the specimen shall be marked and removed from the mould and unless required for test within 24 hours immediately submerged in clean, fresh water or saturated lime solution and kept there until taken out just prior to test. The temperature of water or solution shall be maintained at 27 + - C, the specimen shall not be allowed to become dry at any time until they have been tested.

10 At least 06 test samples on each day concreting should be collected and date mentioned on it subject to minimum samples as described in para 25 (05) above.
11. The contractor shall also provide all equipments and make all arrangements for field test and conduct all test as under and submit the test result to the Engineer-in-charge.
DESIGN AND CONSTRUCTION OF RCC ELEVATED RESERVOIRS

Public Health Engineering Department constructs a large number of elevated service reservoirs in rural areas, well in urban areas. Many cases of failure of these structures have come to the notice of the department. To minimize failures, it is extremely important that a uniform policy with respect to resign and construction specifications of these structures is followed throughout the State so that the quality of construction is ensured keeping in view the above objectives the following instructions are issued for strict compliance in future. the authorities responsible for enforcing these instructions will be the respective Chief Engineer of the Zones, Superintending Engineers of the respective Circles and the Executive Engineers in charge or the works.

GENERAL INSTRUCTIONS

1.0 Elevated Service Reservoirs supported on concrete shaft shall not be constructed henceforth. The .s responsible for approval of the design shall see that tanks are supported on column structure.

1.1 The R.C.C. columns supporting the tank should necessarily be round shape and not square or rectangular. The top shall i.e. water container, could be square or rectangular.

1.2 On the bottom floor of the water container cast iron or stainless steel grate should be provided over the supply outlet and scour outlet. This is essential to prevent any accident for the labour attending to periodical cleaning of the tanks. One such accident occurred at BETUL when two persons in succession were sucked into the scour pipe, the top of which could not be seen because of calcium deposits due to regular use of bleaching powder, Cast iron grates 20x20mm or stainless steel square 20x20mmcan be used with square frames on top of the outlet.

1.3 The over flow outlets should not be connected to the distribution system. Connection of over flow pipe to the distribution system can result in over filling of the elevated service reservoirs in case supply valves of the distribution system are not open. The over flow outlet should always be kept open for draining any excess storage in the tank.

1.4 It is extremely important to make arrangements for supply of sufficient water at the construction site for curing of the concrete. Continuous and efficient curing is extremely important for development of good compressing strength in any concrete structure.

1.5 It is advisable to use metal derived from igneous rock preferably of basaltic of granite origin. The coarse sand should be free from soil. This can be checked easily by half filling a transparent glass with the sand sample and the other half by clean water. Stir the sand vigorously. Silt in the sand can then be easily seen in the top water portion.

1.6 It is extremely essential that the contractors undertaking the work should have a concrete mixer with them. No hand mixing should be allowed.

1.7 In no case the concrete should be laid without vibration. It is describable to keep two concrete vibrators at the construction site so that in case of a break down the other vibrator can be used. It is desirable that the divisions have with them at least two concrete vibratos, which is an essential T & P for laying concrete.

FOLLOWING SPECIFICATIONS SHOULD BE STRICTLY FOLLOWED:

2.0 CEMENT AND CONCRETE:
2.1 Minimum Strength of Concrete:
Minimum strength of concrete for components of elevated tank will be as below:
Column staging \( \text{M} \ 25 \ (250 \text{ kg/sqcm}) \)
Tank including roof \( \text{M-30 (300 kg/sqcm)} \)

2.2 Minimum Cement Content;
From durability considerations minimum cement content shall be as below:
Concrete \( \text{M-25 (350 kg/cum)} \)
Concrete \( \text{M-30 (400 kg/cum)} \)

2.3 Cover of Concrete
The minimum cover shall be 40mm for all the reinforcement. For foundations this cover shall be 60mm.

2.4 Cement Grade:
Grade 43 of cement should be used for columns and grade 53 for the tank portion, including the top dome cover. Only fresh cement should be used in the Tank. It is advisable to use cement manufactured by major plants and reputed firms. OPC or blast furnace slag cement should be used.

2.5 Water Cement Ratio:
Water cement ratio shall not be more than 0.45. This means 22.5 litres of water per 50 kg bag of cement.

2.6 Testing Machines for Concrete:
Compression testing machines should be installed in each rural and project divisions.

2.7 Use of Construction Chemicals:
When the water cement ratio is less, the strength and durability of concrete is good. It is advisable to use plasticizers in concrete and reduce water cement ratio up to 0.4. Plasticizers manufacture red by reputed companies is recommended.
Proportion of plasticizer to be used shall be as per the instruction manual supplied by the manufacturers.

2.8 Construction Joints:
Construction joints are treated in accordance with IS 456. The surface of already laid concrete is cleaned by water jet and cement slurry be applied. Cement mortar 10mm thick of the same proportion as in concrete by applies and then fresh concrete of the lift be laid. The form work must overlay 100mm on the already laid concrete.

Minimum Dimensions and shapes:
Circular Column \( \text{400mm} \)
Tank Wall \( \text{200mm} \)
Bottom Slab \( \text{150mm} \)
Top Slab \( \text{125mm} \)

Rectangular / square columns are not allowed. Circular shafts are also not allowed. In respect of horizontal braces, corners shall be chamfered by 40x40mm.
Footing: The depth of footing on the face of column shall not be less than 1/3rd of the spread of footing from the face.

3.0 STEEL:
3.1 Minimum Steel: Design requirements as set out in relevant codes in respect of steel shall be fully satisfied. However, following minimum steel should be provided.

a) Vertical steel in columns : 0.8% of cross sectional area actually required and 0.3% when larger section than actually required is provided.

b) Horizontal links in columns : Not less than 8mm dia at 200mm c/c or 10mm dia not more than 300mm c/c.

c) Exposed RCC surface : on both faces when thickness is 150mm or more.

2 kg/sqm in one direction

2 kg/sqm in perpendicular direction. The above requirement is satisfied if 8mm bars @ 200mm c/c OR 10mm bars @ 300mm c/c are provided.

3.2 Type of Steel

It is advisable to use corrosion resistant or steel such steel is not available.

3.3 Detailing of Steel

Before commencing the work, Executive Engineer In Charge should study the drawing. It must be misted that the designer provides details of the shape of each bar, its diameter, length and numbers of each category in a schedule of reinforcement. This must be incorporated in every working drawing.

3.4 Form Work:

Wherever inzle type of tanks are adopted or where there is an inclined slab having inclination steeper than one vertical to three horizontals, inside form must be provided. The procedure for such a form work shall be :

a) Place outer form work.

b) Place inner form work 300 to 450mm wide. Then concrete that portion. Then fix next strip and concrete.

c) In respect of top or bottom domes, place upper form work for lowest circular strip of width equal to 1/4th dia of dome and concrete as stated above. Then concrete central half for which top form may not be provided.

4.0 Protection Work Drainage:

At the ground level, stone pavement should be provided for an area which is 1.5 meter more than the dimension of tank on all sides. This should be laid in a slope of 1.60 from the centre and a drain be constructed around for outlet of water. It is advisable to provide fencing around the tank so that the space around the tank is not misused for any purpose. It is advisable that the tanks be white - washed every year.
SPECIFICATIONS FOR TREATMENT PLANT

All the work shall be carried out as per relevant clause of CPHEEO Manual

(1) Construction of Treatment Plant. The Job includes the construction Clariflocculator, Pressure filters, Proper arrangement for dosing of chemicals for pre & post chlorination.

This work shall comprise of the following items:-
1. Chemical house and chemical feeding equipments.
2. Flash mixer.
3. Clariflocculator.
4. Rapid sand gravity filters.
5. Disinfections arrangements.
6. Laboratory & laboratory equipments.
7. Clear water pump house and sumpwell of 1000 KL

(2) TREATMENT:

Specifications of all the treatment units shall be as per CPHEEO Manual and relevant IS standards. Bidder shall require to submit a brief write up on the treatment plant along with the TENDER. On acceptance of TENDER the successful Bidder shall submit a detailed design and drawings of the treatment plant based on CPHEEO Manual and relevant IS specifications for the approval of competent authority.

(3) Pre & post Chlorination shall be done by providing Chlorinator of Siemens / Penwalt make.

The chlorinator shall be 4 kg/hr cabinet mounted vaccum operated, solution feed type designed for wall mounting and shall incorporate following features :

a. V-Notch Control Mechanism with accuracy of +/- 4% of indicated flow
b. Differential Pressure regulating valve Maintains the proper vacuum differential across the V-notch orifice for consistent feed rate, regardless of changes in the operating vacuum
c. Vacuum guage for easy visual functional check.
d. Manual adjustment of dosage rate.
e. Safety vent to be piped to external atmosphere.
f. 10” Glass Rotameter

The required vacuum tubing and the vent tubing should be supplied with the chlorinator.

Injector

The chlorinator shall be driven by a ¾” fixed throat injector which would create the required operating vacuum. The injector shall have following features :
- Built-in double check valve for protection against back flooding
- The main check valves shall consists of a spring-loaded diaphragm with a spherical seat for positive sealing
- A spring-loaded poppet check to provide additional safety
- Anti-syphon arrangement for negative backpressure applications

Vacuum Regulator

The vacuum regulator shall be so designed that it opens when the vaccum is generated by the injector. On failure of water to injector, the vacuum regulator must close automatically. The regulator shall have a maximum nominal capacity of 4kg/hr with built-in internal pressure relief valve. The unit shall be cylinder mounted thereby reducing gas pressure to a vaccum immediately.
**Ton Container Mounting Kit**
The system shall be supplied with mounting kit to adapt to vacuum regulator for ton container mounting. The kit shall include heater, liquid chlorine drip leg and removable strainer.

**Booster Pump**
The system shall be supplied with suitable booster pump to generate the desired vacuum at injector.

**Chlorine Tonners**
Contractor shall provide 2 nos. Chlorine Tonners for proper replacement.

(4) For the testing of incoming Raw water & outgoing Clear water laboratory of suitable Class as per CPHEEO Manual shall be provided by the Contractor. The Laboratory equipments & Chemicals to be provided should be of GLAXO / RANBAXY / MERCK make.
TECHNICAL SPECIFICATION
A. PUMPS, MOTORS AND ALLIED EQUIPMENTS

PART1: SPECIFICATION FOR VERTICAL TURBINE PUMPS FOR RAW WATER PUMPING

Design, manufacturer, supply, erection, testing commissioning of turbine pumping sets for pumping clear water including all electrical, mechanical equipment's accessories and civil works viz., foundation of pump, motor, cable, pipes, fittings for suction, delivery butterfly valves, reflex valve, specials etc., complete as per details given in this NIT.

1.0 DETAILED SPECIFICATIONS OF PUMPS SETS :

The pumps shall be vertical turbine wet pit type and non pull out design with multistage bowl assembly directly coupled with vertical hollow shaft motors.

a. 3 (Three) units of self water lubricated vertical turbine pumps sets each of capacity 275 LPS against approximate total head of 50 meters for pumping raw water at intake well.

The pumps should be KIRLOSKAR/JYOTI/WORTHINGTON/BEACON WEIR/MATHER & PLATT make only.

1.1 GENERAL SPECIFICATIONS

The pumps shall be water lubricated complete with bowl assembly, column pipe such floor discharge head, line shaft, oil tubes, foundation plate/sole plate, basket strainer, motor foot stool and all necessary accessories. The pump shall be designed so as to have a maximum flow capacity not less than 110% of the rated flow capacity. The pumps shall also be designed for continuously operation at any point of head capacity curve between 90% and 110% of pump rated flow, without undue vibration or over heating and thrust bearing should be antifriction type point head.

(A) BOWLS:

The bowl shall be made of close grained cast iron smoothly finished and free any casting defects. The bowls shall be capable of with standing hydrostatic pressure equal to twice the pressure at rates capacity or 1.5 times of the shut off head whichever is greater. The water passage in the bowls shall be smooth and shall have the Nitril rubber linked bearing with bronze shall to save bearing for the impeller shaft. Neoprene rubber lined bearing with bronze shall should be provided in the bottom of the bowl assembly also.

(B) IMPELLERS :

Impellers shall be closed type made of zinc free bronze statically and dynamically balanced. Impellers shall be free from any casting defect and shall be properly machined. All the water passage shall be smooth finished. The impellers shall be secured to shaft with tapered lock collect or key & split rings.

(C) IMPELLER SHAFT :

The impeller shaft shall be of stainless steel with renewable stainless steel sleeves at bearing portion. The impeller shaft shall be guided by bearing provided in each bowl. The butting faces of the shaft shall be machined surer to the axis and the shaft shall be chamfered an the edged. The shaft shall have a surface finish of 0.75 micron as per IS : 3078/1967.

(D) LINE SHAFT :

The line shaft shall be made of High grade carbon steel. The shafts shall be furnished with interchangeable suctions having a length of 1.25 M / 2.5 M / 3M. The butting faces of shaft shall be machined square to shaft axis and the shaft ends shall be chamfered on the edges. To ensure to correct alignment of shafts they shall be perfectly straight.

The shaft shall not have the surface roughness more than 0.75 microns as per IS : 3073/1967. The shaft shall have the adequate strength to withstand all the forces at + 10% of the critical speed of shaft.

(E) COLUMN PIPE :


Column pipe shall be manufactured from the heavy class M.S. pipe confirming to relevant India Standard Specification. The column pipe shall not exceed 3.0 meters in length & made of 6mm thick sheet the dia of bolts to be used in flange joints should not be less than 20mm.

(F) LINE SHAFT BEARING:
Line shaft bearings shall be designed to be lubricated by forced water. line shaft bearing shall be cutless Nitrile rubber lined bearing with bronze shell.

(G) LUBRICATION:
The pumps are water lubricated.

(H) DISCHARGE HEAD:
The discharge head shall be of standard construction cast iron as per IS:210 Gr. FG 200 and sufficiently strong to support the weight of the pump. It shall be fitted with a tube tension plate for tighten up. The shaft tubes for the purpose of aligning the shafts.

(I) STUFFING BOX:
A packing gland shall be provided at the top of stuffing box. Shaft sleeves shall be provided on the top shaft. The stuffing box shall be of sufficient depth to permit adequate packing. The space between the pump motor main coupling and the stuffing box shall be sufficient to permit removal of packing gland and insertion of new packing without dismantling the pump.

(J) MOTOR STOOL:
The motor stool shall be of fabricated mild steel shall be designed to take care of all static and dynamic loads on it.

(K) PRESSURE INDICATION DEVICES:
Each pump shall be provided with pressure gauge of best quality makes to give indications of delivery pressure. The pressure gauges shall be of Borden type, dial size 150mm.

(L) LABORATORY TEST:
Laboratory pump test shall be carried out as per IS: 9137 / for each pump to assess the pump discharge V/s head, horse power and efficiency figures. The pump shall be subjected to a test pressure of 1.5 times of the shut of pressure or twice the working (rated) pressure which ever higher.

(O) FIELD TEST:
The field test shall be carried out as per IS : 1710 and 5126.
The successful BIDDER will ensure the Engineer-in-charge of work or any other Senior Engineer nominated by the COMMISSIONER, Municipal Corporation Singrauli will inspect and witness tests conducted on the pumps and motors at manufacturer's place with respect to their characteristic and performance as specified by the department.

1.2 GUARANTEED PERFORMANCE & TECHNICAL PARTICULARS:
The contractor shall submit the details of guaranteed performance & technical particulars as desired in the Performa enclosed vide schedule's with the TENDER along with the preliminary out line drawing indicating principal dimensions & weight of pumping equipments and cross section drawing indicating the assembly of pumps & manor parts thereof with materials of constructions and special features. Complete descriptive and illustrated literature on the equipment and accessories offered.

1.3 SPECIAL NOTES FOR BIDDER:
1.3.1 Pump should be capable of throttling. The throttle point discharge should be quoted. The extent to which pump can be throttle and the corresponding discharge to be mentioned.
1.3.2 Duty point discharge should be specifically mentioned along with the head at which the same will be attained. Efficiency at different operating heads and discharge should be mentioned.
1.3.3 The accessories like surface, discharge head/underground discharge head with elbow, prelub tank with fittings, motor stand with NRR and thrust bearing housing, column assembly bowl,
assembly, basket strainer, as per specifications shall be quoted, individually. The drawing to
the scale showing the proposed arrangements for the pumps and the positions of various
parts with detail drawing must accompany the TENDERs along with detailed specification,
make, guarantee period etc.

1.3.4 Head capacity curve shall be rising type and shut off head must be higher than the maximum
operating head for paralleled operations of pumps. Performance covers for each individual
pump sets and also for the four pump sets working in parallel should be given for full load and
for throttled conditions also. All pumps to be of identical in all respect.

2.0 SPECIFICATIONS FOR 415-V INDUCTION MOTORS :

2.1 TYPE :
The motor shall be vertical hollow shaft squirrel cage type induction motors suitable
to operate on 415 V, 3 Phase, 50 Cycle A.C. Supply at 1500 RPM directly coupled
with vertical turbine pump. The motor shall generally confirm to latest revision of IS :
325/1978 and other relevant ISS. Duly fitted with space heater and RTDs & BTDs.
The motor shall be of KIRLOSKAR, JYOTI, BHEL, CROMPTON, NGEF, make only.

2.2 VARIATION IN SUPPLY VOLTAGE :
The motors shall be capable of delivering rated out put and rated power factor with
following variations :
Voltage : \pm 10%
Frequency : \pm 5%
Combined : As per IS 325

2.3 RATED CAPACITY :
The minimum conditions rated capacity of motors shall be such that it meets the
power requirements of pumps in the complete range of its operation. It shall also
provide on additional power requirement on the motor. By 5% at the maximum power
requirement or by 10% at the duty point of operation whichever is maximum. The
contractor shall ascertain the K.W. requirement and provide the motors of suitable
capacity.

2.4 ACCELERATION CHARACTERISTICS:
The acceleration characteristics of motor shall be matched with the driven equipment
so that acceleration is obtained without over heating of motor.

2.5 METHOD OF STARTING :
The motors shall be designed for star/delta/soft starting at full voltage with starting
current not exceeding four times the rated full load current. The motor shall also be
designed for a minimum pull out torque of 200%.

2.6 CONDITION OF START :
Motor when started with the drive imposing its full starting torque under the specified
supply voltage variation shall be capable of withstanding at least one successive
starts from hot condition to start from cold condition without damage to the winding.

2.7 CLASS OF INSULATION :
The motor winding shall be provided with insulation conforming to thermal class "F".
The maximum temperature rise of the winding shall not exceed the limits specified
from class "B" insulation. The insulation can be given tropical and fungicidal
treatment for successful operation of motor in hot humid tropical climate. It shall of
thermos setting type and shall remain unaffected by heat. The coils shall be highly
uniform with uniform insulation strength and uniform dielectric losses.

2.8 MOTOR CONSTRUCTION :
The motor construction shall be suitable for easy dismantling and reassemble at site with the help of simple overhead crane. The motor shall be of core pack construction attached to the stator frame to facilitate easy removal and replacement of the winding for maintenance purpose. The overhead for winding at both ends of the core shall be accessible for usual inspection without resorting to major dismantling.

2.9 MOTOR FRAME:
Motor frames shall be rigid fabricated steel they shall be suitably annealed to eliminate any residual stress introduced during process of fabrication and machining. Motor frame should be identical with existing Jyoti make motor 260 K.W. to maintain interchangeability.

2.10 STARTOR LAMINATIONS:
Stator laminations shall be made from suitable grade sheet steel varnished on inner side and shall be adequately designed to over heating during starting and running conditions stipulated above.

2.11 ROTOR SHORT CIRCUITING RINGS:
Rotor short circuiting and rings shall be such that it is free to move with expansion of bars without distortion. The connections of the bars to the end rings shall be made by bracing.

2.12 LOCKING ROTOR WITH STAND TIME:
Locked rotor with stand time under hot conditions at 110% voltage shall be more than starting time at minimum permissible voltage by at least two seconds.

2.13 TYPE OF ENCLOSURE & DEGREE OF PROTECTION:
The degree of protection provided by the enclosures of motor shall conform to IS: 4691. The enclosure for the motors shall be screen protected Drip Proof (SPDP) IP 23.

2.14 SHAFT INSULATION:
Suitable insulation shall be provided on shaft/bearing house to prevent shaft current. The insulation provided shall be such that it shall retain its dielectrically properties even after its handled for number of times during dismantling and reassemble.

2.15 BEARING ASSEMBLY:
Bearing assembly shall be such that it prevents dust and water from getting to the bearing. Further, bearing lubricant shall not find access to the motor winding. The bearing assembly shall be provided with proper lubricating nipples.

2.16 EARTHING:
The motor body shall have two separate earthing terminals for earthing in compliance with I.E. Rules.

2.17 DIMENSIONS OF MOTORS:
Motors shall be properly dimensioned to have greater stability and low vibration limit.

2.18 TESTING:
All the motors shall be routine tested at manufacturers workshop and test certificate shall be provided with motors.
PART - 1 : HORIZONTAL SPLIT CASING CENTRIFUGAL PUMPS FOR CLEAR WATER PUMPING

1.1 GENERAL DESIGN CONDITIONS

The pumps shall be high head single stage horizontally split casing type to facilitate easy inspection & maintenance. The pumps shall be designed to operate satisfactorily while handling a minimum suction lift of 4.0 from all causes. [Three] units of pump sets each of capacity of 262 lps against approximate total Head of 105.0 meters for pumping clear water from WTP to Singrauli.

The pump shall be horizontally split with the suction and delivery branches cast INLINE on the bottom half of the casing. The top half should be constructed to allow easy dismantling. There by providing the facility of inspection and repair to the equipment with out any difficulty.

The rotating elements of pumps will be dynamically balanced and over stressing should not occur due to sudden failure of power, Reverse rotation should not damage the pumps.

The pumps shall be so designed as to have a maximum flow capacity of not less than 110% of the rated flow capacity.

The pumps shall be designed for continuous operation at any point of head capacity curve between 50% & 110% of pump rates flow without under vibration or over heating.

The pumps shall be so designed as to have a stable non overloading characteristics, capacity head curve shall be continuously from shut-off point to operating point and shall be suitable for parallel operation of pumps without any haunting possibility. The shut-off head should not exceed 120% of duty point head.

The impeller adjustment shall be designed in such a way that impellers run free in any installed condition.

1.2 GENERAL SPECIFICATION

The pump shall be complete with suction pipe, foundation plate/sole plate and all other necessary accessories.

The pumps should generally comply with the requirement of following standard.

1. IS 1520-1972 : Horizontal Centrifugal Pumps for clear, cold and fresh water.


PUMP MAKE KIRLOSKAR, JYOTI, WORTHINGTON, BEACON AND MATHER & PLATT ONLY.

1.3 PUMP CASING

The casing should be made of closed grain Cast Iron smoothly finished and smooth surface finish inside free from any casting defects capable of with standing twice the hydrostatic pressure at rated capacity or 1.5 time the shut off head. Which ever is greater. The water passage shall be completely smooth.

1.4 IMPELLERS

The pump impellers shall be of double suction type and of non-ferrous materials, preferably zinc free phosphorus, bronze,(LTBR IS318 –LTB2 ) designed to inherently provide dynamic-static axial balance. Design of impeller should be such as to prevent cavitations during the working condition specified. The impeller shall be statically and dynamically balanced depending on design considerations to minimum vibration at the pump bearings, thereby prolonging their working life.

1.5 PUMP SHAFT

The pump shaft shall be manufactured from high tensile carbon steel and provided with renewable zinc free bronze sleeves to protect the spindle from the water being pumped.

1.6 INTERNAL PARTS
The pump internal shall be constructed of bronze materials of suitable composition so as to provide compatibility with regard to rubbing surface. Hardness of wearing surface shall be so adjusted as to provide maximum economy in terms of replacement of wearing component i.e. casing neck rings shall be more soft than the impeller neck.

Facilities for gland drainage shall be provided and gland lubrication shall suitably arranged by means of providing connection from the discharge volutes.

1.7 PUMP BEARING

The pump is to be provided with suitably white metal lined split bush bearing and a deep grove ball thrust bearing to take up residual axial balance. These bearing should be oil lubricated.

1.8 PUMP COUPLING

This shall be of flexible pin type equipped with a suitable coupling guard.

1.9 SOLE PLATE

Each pump shall be provided with a heavy structural steel sole plate. Sole plate shall be provided and grouted with foundation. The sole plates shall be designed to permit removal of entire pump without disturbing sole plate.

1.10 PRESSURE INDICATION DEVICE

Each pump shall be provided with pressure gauges of good quality make to give indications of delivery pressure & vacuum pressure separately. The pressure gauges should be designed in such a way that the readings shall not be affected due to mechanical vibrations. The connections sizes shall be 12mm and diameter size 150m. In addition to above each pump shall be fitted with electronic pressure transducer with electronic digital display type indicator in control panel to indicate the delivery vacuum pressure of the pumps.

1.11 BOLTS, NUTS & WASHERS

All bolts, nuts and washers shall be of superior quality conforming to relevant Indian Standard Specification.

1.12 MATERIAL OF CONSTRUCTION

MATERIAL OF CONSTRUCTION OF PUMP SHALL BE SUCH AS TO RESIST EROSION & CORROSION. MATERIALS OF CONSTRUCTION OF VARIOUS COMPONENTS SHALL BE AS UNDER

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump casing</td>
<td>CI</td>
</tr>
<tr>
<td>Impellers</td>
<td>Zinc free Bronze conforming to relevant IS.</td>
</tr>
<tr>
<td>Pump shaft</td>
<td>High Tensile Carbon Steel with renewable Zinc free Bronze sleeves conforming to relevant IS.</td>
</tr>
<tr>
<td>Pump Internal</td>
<td>Bronze materials of suitable composition as per relevant IS.</td>
</tr>
<tr>
<td>Sole Plate</td>
<td>Fabricated as per IS 226.</td>
</tr>
<tr>
<td>Nuts, Bolts &amp; Washers</td>
<td>High Tensile Mild Steel conforming to relevant I.S.</td>
</tr>
</tbody>
</table>

1.13 INSPECTION & TESTING

All the inspection, examination and testing shall be carried out in accordance with relevant Indian Standard Specification.

1. LABORATORY TEST

Laboratory pump test shall be carried out as per IS : 5120-1968 each pump to assess the pump discharge Vs head, horse power and efficiency figure. The pump casing shall be subjected to a pressure test of 1.5 times the working pressure at duty point.

2. FIELD TEST
The field test shall be carried out as per IS : 1520-1972 & IS : 5120-1968. These tests may be witnessed by the Engineer-in-charge or his authorized representative. If they desire. The tolerance as specified in relevant IS code of practice shall not be applied on the efficiency & KW output. The contractor shall have to demonstrate the quoted efficiency of pump during testing.

1.14 GUARANTEES PERFORMANCE & TECHNICAL PARTICULARS

The contractor shall submit the details of guaranteed performance and technical particulars as desired in the proforma enclosed vide schedule 'B' along with the TENDER & the preliminary outline drawing indicating principal dimension and weight of pumping equipment and cross-section, drawing indicating the assembly of pumps & major parts thereof with materials of construction and special features, complete descriptive and illustrated literature on the equipment and accessories offered.
PART - II
SPECIFICATION FOR 415 V INDUCTION MOTORS

2.1 TYPE
The motor shall be horizontal SOLID shaft squirrel cage type for clear water pumps suitable to operate on 415 V, 3 phase, 50 Hz. AC supply (with allowable variation of 10%) directly coupled with pumps. The rotations of clear water pumps shall be 1500 RPM. The motor rating generally conform to latest revision of IS 325-1971 and other relevant I.S.S.

2.2 VARIATION IN SUPPLY VOLTAGE
The motors shall be capable of deliver integrated output and rated power factor with following variations:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>±10%</td>
</tr>
<tr>
<td>Frequency</td>
<td>±5%</td>
</tr>
<tr>
<td>Combined</td>
<td>±10%</td>
</tr>
<tr>
<td>Phase In Balance</td>
<td>±5%</td>
</tr>
</tbody>
</table>

2.3 RATES CAPACITY
The minimum continuous rated capacity of motors shall be such that it meets the power requirements of pumps in the complete range of its operations. It shall also provide additional power requirement in the motor by 5% at the maximum power requirement or by 10% at the duty point of operation whichever is maximum. The contractor shall ascertain the KW requirement and provide the motors of suitable capacity.

2.4 ACCELERATION CHARACTERISTICS
The accelerating characteristics of motor shall be matched with the driven equipment so that acceleration is obtained without over heating of motors.

2.5 METHOD OF STARTING
The motors shall be designed for star/delta/soft/starting at full voltage with starting current not exceeding 2 times the rated full load current. The motor shall also be designed for a minimum pull out torque of 200%.

2.6 NUMBER OF START
Motors when started with the drive imposing its full starting torque under the specified supply voltage variation shall be capable of withstanding at least two successive starts from hot condition and one start from cold condition without damage to the winding.

2.7 CLASS OF INSULATION
The motor winding shall be provided with insulation conforming to thermal class F. The maximum temperature rise of the winding shall not exceed the limits specified for class 'B' insulation. The insulation shall be given tropical and fungicidal treatment for successful operation of motor in hot, humid tropical climate. It shall be of thermo-setting type and shall remain unaffected by heat. The coils shall be highly uniform with uniform insulation strength and uniform dielectric lose. The dielectric losses shall be low and the star delta measurement should be not exceed 1% at 440V.

MAKE OF MOTOR CROMPTON, KEC, ABB AND SEIMENS ONLY.

2.8 MOTOR CONSTRUCTION
The motor construction shall be suitable for easy dismantling and reassembly at site with the help of simple over head crane. The motor shall be of core pack construction attached to the stator frame to facilitate easy removal and replacement of the winding for maintenance purpose. The over head for winding at both ends of the core shall be accessible for usual inspection without resorting to major dismantling.

2.9 MOTOR FRAME
Motor frame shall be of rigid casted steel. They shall be suitably annealed to eliminate up any residual stresses introduced during process of fabrication and machining.

2.10 STATOR LAMINATIONS

Stator laminations shall be made of suitable grade sheet varnished on either side and shall be adequately designed to avoid over heating during the starting and running conditions stipulated above.

2.11 ROTOR

Rotor should be desisted dynamically balanced and having carbon steel shaft hydraulically fitted.

2.12 LOCKED ROTOR WITH STAND TIME

Locked rotor with stand time under hot conditions at 110% voltage shall be more than starting time at minimum permissible voltage by at least two seconds.

2.13 TYPE OF ENCLOSURE & DEGREE OF PROTECTIONS

The degree of protection provided by the enclosures of motor shall conform to IS : 4691. The enclosure for the motors shall be closed air circuit air cooled (CMUIDSSMT) type, having of protection I.P. 55.

2.14 SHAFT INSULATION

Suitable insulation shall be provided on shaft bearing housing to prevent shaft current. The insulation provided shall be such that it shall retain its dialectical properties even after its handling for number of times during dismantling and reassembly.

2.15 BEARING ASSEMBLY

Bearing assembly shall be such that it prevents dust and water from getting into the bearing. Further, bearing lubricant shall not find access to the motor winding. The bearing assembly shall be provided with proper lubricating nipples.

2.16 EARTHING

The motor body shall have two separate earthing terminals for earthing in compliance with I.E. RULES.

2.17 TERMINAL BOXES

Separate terminal boxes shall be provided for main-Terminals of the motors and for R.T.D. and for space heaters. The terminals box for main terminals of motor shall be segregated type suitable for 3 core. 440 V. Aluminum conductor PVC insulated armored cables. The terminal boxes shall be spacious, dust & house proof designed and properly insulated. Adequate clearance should be given between live motor terminals and covers.

2.18 TEMPERATURE DETECTORS

Motors shall be provided with embedded temperature detectors, two for each phase winding at the location where the high temperatures may be expected in the stator winding. The temperature detectors shall also be provided in bearing assembly for monitoring the bearing temperature. The temperature detectors shall be connected with digital temperature scanners with alarm and trip points in the control panel.

2.19 ANTI-CONDENSATION HEATERS

Motors shall be have space heaters suitable for 240 V. single phase 50 Hz. A.C. supply, space heaters shall have adequate capacity to maintain motor internal temperature above due point to prevent moisture condensation on insulation during shut down periods.

2.20 DIMENSIONS OF MOTORS

Motors shall be properly dimensioned to have greater stability and low vibration limits. Mounting dimensions should confirm to IS : 2254.

2.21 COUPLING TO PUMPS
The motors shall be coupled to the pumps by means of polished steel shaft and flexible coupling. The size of line shaft and flexible coupling shall be calculated on the basis of maximum combined shear stress as per the relevant IS and shall not exceed 30% of the elastic limit in tension or 10% of ultimate tensile stress, shaft shall be designed taking into consideration that critical speed of the shaft which shall be higher than the operating or runaway speed.

2.22 DETAILS OF MOTORS TO BE FURNISHED
The TENDERs shall furnish along with their offer, the details of efficiency, total losses and power at different loads etc. as required in the form of guaranteed performance and technical particulars of motors in schedule 'B'.

2.23 TESTING
All the motors shall be routine an type tested at the supplier's workshop in the presence of Engineer-in-charge of work or his authorized representative or a third party inspection directed by Municipal approve the design.
PART-III  CABLING AND MOTOR CONTROL PANNEL

3.1 CABLE CLEAR WATER PUMP HOUSE

In case of clear water pump house the soft starter panel of each motor of clear water centrifugal pump shall be connected in L.T. panel in the pump house, through 300sqmm 3-1/2 core armored cable. Thus in all 2 Nos. of 300sqmm 3-1/2 core armored cable shall be laid in suitable duct and as per I.E.RULE. And a loop of about 1m should be given in each cable.

3.2 REACTOR TYPE MOTOR SOFT STARTER  [MOTOR CONTROL PANEL]

TECHNICAL SPECIFICATIONS:

<table>
<thead>
<tr>
<th>TYPE OF SOFT STARTER</th>
<th>NEUTRAL/LINE REACTOR SOFT STARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRINCIPAL</td>
<td>SRSS[SERIES REACTOR SOFT STARTER]</td>
</tr>
<tr>
<td>APPLICABLE STANDARD</td>
<td>IS 3914 [MOTOR STARTER STANDARD GUIDELINE]</td>
</tr>
<tr>
<td>REACTOR</td>
<td>AIR CORE TYPE 100% COPPER WINDING</td>
</tr>
<tr>
<td>REACTOR CONNECTION</td>
<td>REACTOR TO BE IN SERIES ON LINE OF MOTORS</td>
</tr>
<tr>
<td>STARTING CURRENT LIMIT</td>
<td>2-3 TIMES OF FLSC IN STEPS [DEPENDING UPON LOAD TORQUE REQUIREMENT AND SETTABLE AT SITE]</td>
</tr>
</tbody>
</table>

HARMONIC

REACTORS USED IN SOFT STARTERS CIRCUITS OF AIR CORE SHOULD NOT DEVELOP HARMONIES IN THE CIRCUITS.

DUTY CYCLE

6 NO EQUAL SPACED STARTS /PER HOUR

METHOD OF COOLING

AIR COOLED

SPECIFICATIONS FOR OTHER ITEMS SHOULD BE EQUIPPED WITH REQUIRED SWITCH GEAR PROTECTIONS AND INDICATIONS

3.3 PUMP WELL WATER LEVEL INDICATOR

One No. electrical water level indicator with alarming system shall be provided for the pump well near which the pump house of clear water has been constructed.

3.4 CIVIL WORK

1. Construction of covered cable trenches / tray from L.T. panel to panel board in pump house. The cable trenches should be covered with sand and type should be broken type connected to bridge with bolts etc. by suitable civil work and shall be covered with chequered plates of minimum thickness 7mm.

2. Construction of all other civil works required for erection of pump and motor with all foundation bolts, washers including all work pertaining to it.
PART - IV - BUTTER - FLY VALVE

4.1 GENERAL REQUIREMENT
Each pump shall be provided with a butterfly valve in the delivery pipe, and in addition one no common butterfly valve shall be also required in manifolds of each pump house. The butterfly valve shall be flanged, water works pattern eccentrically pivoted.
The valve shall have head stock, extension rod & wheel for operation and gearing system if the size is 300mm diameter or above. The valve shall generally confirm to relevant I.S.: 51450.

4.2 CONSTRUCTION
Butterfly valve having diameter equal to the diameter of delivery line suitable for individual flange bolting of flanges of pipe, with the disc to form a section cut through a sphere, working in conjunction with a cone shaped seating in body and synthetic rubber seal ring fitted to the disc with the help of a retaining ring & stainless steel screws, shall be provided, confirming to relevant I.S. STANDARDS. The disc shaft bearing shall be off set along the pipe axis from the place of the seating so as to get an unbroken position in full closed position.

4.3 MATERIALS OF CONSTRUCTION
1. Body : Close grained homogenous cast steel construction tested to 40 kg/cm²
2. Disc : Same as body tested to 20 kg/cm2
3. End housing and : Cast steel to grade 20 to 25 IS 210 or Cast Iron.
   cover gear box
   housing for manual
   operation
4. Bearing : P.T.F.E. (Glass filled or carbon filled) having friction coefficient 0.04 (Note : Water itself acts as a lubricant for PTFE bearings).
5. Stub Shaft : 18/8 quality stainless steel AIST 304/ASTMA351 Gr. CF.
6. Rubber Seal Ring: For standard water works valve precision moulded nitrite rubber ring (shore hardness 55 to 65).
7. Hardware used : Stainless steel.

4.4 TESTING
The valves shall be subjected to closed ends tests as per relevant IS standard. Test certificate in triplicate shall be furnished. If necessary, test shall be witnessed by the Engineer's representative.

<table>
<thead>
<tr>
<th>Working Pressure</th>
<th>:</th>
<th>20 kg/sq.cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Pressure</td>
<td>Body</td>
<td>40 kg/sq.cm</td>
</tr>
<tr>
<td></td>
<td>Seating</td>
<td>20 kg/sq.cm</td>
</tr>
<tr>
<td>Gear Box Outside</td>
<td>:</td>
<td>1 kg/sq.cm.</td>
</tr>
</tbody>
</table>
PART - V - NON RETURN VALVE

5.1 GENERAL

The non-return valves shall be single door type, free acting quick opening, giving rapid non-clam closure & with low head loss characteristics when in open position. The valves shall be provided with by passes and isolating valves conforming to relevant Indian Standard.

Specification of the valves shall generally conform to IS : 5321 (Part-II)

5.2 MATERIALS OF CONSTRUCTION

Body, Cover, Door and Hinges : Cast steel construction
Hinge pins, Door pins & Door : 12% Chromium steel conforming to IS:1570

**Suspension pins**

Bearing Bushes : Leaded Gun Metal Gr. 2, Conforming to IS:318

Body rings and door faces : Leaded Gun Metal Gr.2, conforming to IS:318

5.3 TESTING

The valves shall be subjected to closed ends tests as per relevant IS standard. Test certificate in triplicate shall be furnished. If necessary, test shall be witnessed by the Engineer's representative.

WORKING PRESSURE : 20 KG/SQ.CM.
TEST PRESSURE BODY : 40 KG/SQ.CM.
SEATING : 20 KG/SQ.CM.
PART - VI  DELIVERY PIPES

6.1 GENERAL
The scope of the work is providing, laying & jointing of all delivery pipes, specials valves of all the pump and their connection to the common manifold as shown in drawing inclusive of the jointing of the manifolds to the respective conveyance mains fixing with one main butterfly valve.

1. The contractor shall design and fabricate the common manifold which would be made out of MS 6mm thick plates conforming to IS : 226 in such a way that it gives minimum frictional loss of head to the flow of water and also avoid cavitations or vortices in the manifold. The manifolds should be in line and coated with suitable material to protect it from corrosion in case of clear water ultimate carrying capacity shall be 59.60 MLD.

2. The contractor shall provide an expansion joint of his own design duly approved by the Engineer-in-charge.

3. Flanged joints shall be adopted for valves and butt welding joints or flanged joints in jointing of delivery pipe with dismantling joints.

4. Concrete saddles for valves and thrust blocks shall be provided by the contractor as per the design and drawings to be furnished by the contractor and subsequently approved by Engineer-in-charge.

6.2 MATERIAL OF CONSTRUCTION
All the pipes of works shall be fabricated out of steel plates conforming to IS:226-1962. The fabrication of pipes shall generally conform to IS : 3589-1966.

6.3 TESTING
The pipes and common manifold shall be hydraulically tested to a pressure of 2 times the working pressure. Test certificate to that effect shall be furnished by the contractor.

The Engineer-in-charge witness the above test if so desired, the contractor shall arrange for such test in presence of Engineer-in-charge.
PART - VII  RATING AND NAME PLATES

7.1 RATING PLATE

Each main and auxiliary item of plate shall have permanently attached to it a rating plate in a conspicuous position. This shall be a non-corrodible material preferably chromium plates steel. The inscription shall be engraved in black on the plate.

7.2 NAME PLATE

1. Each item of plant shall be provided with a name plate or label designating the service of the particular equipment. The shape and size of the plate and inscription shall be approved by the Engineer-in-charge.

2. Such name plate shall be non-corrodible material preferably chromium plated steel having engraved black lettering.

3. In case of indoor equipment like circuit breakers, starters etc. the plate shall be of transparent plastic material with black lettering engraved on the back.

4. The name plate shall be screwed to the body of the equipment.
DETAILED TECHNICAL SPECIFICATION FOR 695 KVA /suitable ELECTRIC SUB STATION (1 nos. for Raw water)

1. LOCATION OF WORK:-
Providing, supplying, erection and commissioning of Transformer of 695 KVA or suitable rating to be installed in an electric sub-station of 33KV/695 KVA located at Intake well at near Rihind Dam.

2. SCOPE OF WORK
The Scope of works includes design, supply erection construction commissioning and testing of 695 KVA, 33 KV/695 KVA electric sub station (as per I.E. rules and specification) which mainly includes supply of transformer, outdoor, sub station structure, cables, other electrical equipment, accessories, and other allied required civil work etc. complete.

The details specifications of the proposed work are given below. However specifications laid down in relevant in diameter standards shall be strictly followed.

2.1 SUB STATION STRUCTURE AND ASESSORIES. :-
33/3.3KV outdoor substation comprising of 1 pole substation structure made of Double M.S. Girders & channels of adequate section (not less than ISHC 200x10 and ISMB 100x50) and length, with provision, of 33 KV lightening arrester, A.B. switch, D.I. set, disc and post insulators with hardware sub station premises as per I.e. rules. Structure shall be complete with necessary painting of primary red oxide and finished with two coat of aluminum paint.

2.2 TRANSFORMER
One number transformer of rating 695 KVA, 33/0.44 KV 3 phase, double, would Dy 11, ONAN cooled out door distribution transformer with off load top changer as per IS 2026 (with all standard fitting and bi directional rollers and accessories as per I.E. rules) and as per other detailed specification. The transformer shall be fixed on suitable plinth as per I.E. rules.

2.3 EARTHING SYSTEM: -
Double earthing of entire electrical system connected to earthing plates buried in ground and surrounded in charcoal and salt up to adequate depth. The contractor shall have to carry out earth continuity tests earth resistance measurement and all other required test in the presence o the Engineer-in-charge, which are necessary to prove that complete job. If earthing system is

Already in working conditions then rectifications if required is to be done only

2.4 CIVIL WORK:
All related civil works such as construction of transformer plinth, foundation of sub station structure, partition wall between transformer, earth pits, cable trenches/cable trays, cable markers, foundation of Fencing pole structure, providing and spreading 40mm B.T. metal as per I.E. Rules complete job.

2.5 FENCING FOR 33 KV SUBSTATION YARD.
Industrial yard fencing arrangement using 65 mm x 6mm angle iron post complete as per I.E. rules complete job if require at site

2.6 LIGHTING :-
Sub station yard lighting provision in panel.

2.7 SUPPLY OF SAFETY DEVICES:-
Supply of safety devices like rubber mating, hand gloves, first Aid box, danger boards, first Aid, charts, 0.5 Kg. Capacity Co2 type fire extinguishers and sand buckets etc. complete required as per specification and I.E. rules One set.

2.8 OPERATION OF SUBSTATION : 

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The contract include as operation and maintenance of the contract includes substation after commissioning and training to departmental staff for 7 days complete job.

2.9 ANY WORKS  Equipment not specified in particular but considered necessary to complete the work as per specification and I.E. Rules are also include in this TENDER and scope of works.

2.10 PANEL INSTALLATIONS:
Panel is to be installed in substation or at place specified by the department.

3.0 IMPORTANT CONDITIONS:

3.1 The BIDDER shall submit the brand names, & efficiencies at various at various points and design calculation for each and every equipment so as to assess and decide suitable offer.

3.2 A licensed class A electrical contractor authorized under I.E. Rules shall only carry out the work.

3.3 The Successful BIDDER on award of contract shall have to prepare and submit the detailed drawing of the work duly approved by the COMMISSIONER Electrical Inspector and Electrical Adviser, Govt. of M.P. After completion of work the representative of the COMMISSIONER Electrical Inspector and Electrical Adviser shall inspect the same. The inspection fee shall be born by the contractor and electrical sub station shall be charged only after approval and permission of the competent authority as per I.E. Rules.

3.4 Supply and inspection of all the equipments shall be as per relevant BIS/ I.S. Specification and latest I.E. Rules.

3.5 Make, Materials, Technical specification, Circuit diameter grams and connection details of each and every equipment and its major parts offered should be clearly specified in the TENDER.

3.6 Test certificates guarantee, certificate and operation manual shall be submitted along with the supply of equipment.

3.7 After commissioning of all the equipment successful trial will have to be given for at least 72 Hours.

3.8 Maintenance and training of department staff:
After installation, commission and official testing of electric sub station and other equipment satisfactorily, the contractor shall have to run and maintain and electric sub station to the complete satisfaction of the Engineer in charge for a period of at least 7 days round the clock through his experienced and competent staff under supervision of his experienced and qualified engineer.

3.9 Any work equipment not specified in particular but considered necessary to complete the works as per specification and I.E. Rules are also included in this TENDER.

4. DESIGN DATA:

4.1 All the equipment shall be designed for operation in tropical humid climate subject to heavy rainfall and frequent thunderstorms with ambient air temperature of 50 deg. c (max)

4.2 The single line diameter gram of proposed 33 KV sub station, main electric panel board bus bar is shown in the enclosed drawing. The proposed site plan showing the relative location of sub station with respect to pump house are shown in separate drawing, which can be seen in office. The above drawing is enclosed only for the guidance of the BIDDER.
4.3 The rating and specification of transformers and other electrical equipment shown in the drawing and specification are indicative only. The BIDDER shall check up the rating of the equipment and satisfy thoroughly regarding their adequacy.

4.4 All the materials used in this work must be strictly in accordance with the relevant I.S. specification and I.E. rulers.

4.5.1 On completion of work, the contractor shall submit the completion drawing. Circuit diameter grams and detailed electrical mechanical drawing of the equipments and the maintenance manuals in form as desired by the engineer-in-charge.

5. DETAILED TECHNICAL SPECIFICATION:

5.1 TRANSFORMER :

(a) **695 KVA 33/3.3 KV** 3 phase, 50 Hz Oil immersed, Natural self cooled type Onan, core type with class "A" insulation, double wound with off load tape changer outdoor distribution transformer with accessories designed and manufactured with particular reference to tropical condition conforming to IS 1026: 1981 as per IE rules and as per detailed specification.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
<td>695 KVA OR OF SUITABLE RATING</td>
</tr>
<tr>
<td>No load voltage ratio</td>
<td>(HV/LV 33 KVA/3.3 KV)</td>
</tr>
<tr>
<td>Winding materials</td>
<td>copper</td>
</tr>
<tr>
<td>No of phases</td>
<td>Three</td>
</tr>
<tr>
<td>Vector</td>
<td>Dy 11</td>
</tr>
<tr>
<td>Connection On (HV/LV)</td>
<td>Delta Star</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Installation</td>
<td>Outdoor</td>
</tr>
<tr>
<td>Type of cooling</td>
<td>Onan</td>
</tr>
<tr>
<td>Temperature rise in oil by thermometer</td>
<td>45 Deg. C</td>
</tr>
<tr>
<td>In winding of resistance</td>
<td>55 Deg. C</td>
</tr>
<tr>
<td>Terminal Arrangement</td>
<td>*</td>
</tr>
<tr>
<td>*(a) Primary</td>
<td>Bare</td>
</tr>
<tr>
<td>*(b) Secondary</td>
<td>Weather proof bare bushing</td>
</tr>
<tr>
<td>Type of tap changer</td>
<td>Off load top changer</td>
</tr>
<tr>
<td>Tapes step on HV</td>
<td>+5% - 5% in steps of 2.50%</td>
</tr>
<tr>
<td>Fitting and accessories</td>
<td>shall be provided as per IS 2026: 1981</td>
</tr>
</tbody>
</table>

5.2 CONSTRUCTION:

**CORE**

The core shall be of C.R.G.I.O. annealed steel materials having low losses and good grain properties, bolted, together to the frames firmly to prevent vibration and noise,

**WINDING:-**

Winding shall be made out of electrolytic grade copper paper covered wire strips. Generally H.V. winding shall be cross order of disc type with paper covered conductor and the L.V. winding, shall be cylindrical type disc or helical type depending upon the voltage currents.
TANK :-
Transformer tank shall be robust construction and shall be fabricated with M.S. plate proper enforcement shall be provided so as to ensure that no building occurs during service.

FITTING AND ACCESSORIES:--
All the fitting and accessories as mentioned below shall be of the good quality and confirming to Relevant IS specification.

1. Rating and diameter gram plate.
2. Earthing terminals
3. Lifting lugs
4. Off load tape changing switch
5. Drain cum sampling valve wit plug.
6. Conservator with oil level gauge
7. Thermometer
8. Air release plug.
11. Radiametertor.

PAINTING:--
Thank in side, core clamp and other fitting exposed to the oil shall be painted by heat and oil resistant paint. the exterior of the transformer and other ferrous fitting shall be first thoroughly cleaned, scraped and ten given two coats of zinc chromate, red oxide, primer following by two finishing coats of synthetic enamel paints as per shade No.631, of IS 5/1978.

DRAWING :--
Three copies of GA drawing showing details dimension and position of fitting and accessories shall be submitted with equipment.

v. Indicating lamps for breaker ON/OFF Spring charge trip circuit healthy.

vii. Push button for test /reset/acknowledge.

7 PANEL BOARD
The LT AC Switch Board shall be of volts, 3 phase and neutral 50 Hz Distribution board, indoor type, sheet clad by 1.5mm thick CRC sheet over S channel structure frame, floor mounted free standing type, cubical pattern, dust & vermin proof having protection group IP 53, and shall comprise of following.

1 Nos. of incoming ACB OF suitable rating make L&T siemens, Alsthan C&S and Schinder
1Nos. SFU OF suitable rating
- 1Nos. off 144 sq. mm flush tie ampere meter with selector switch.
- 1Nos. set of Indication Lamps for all three phase, On OFF auto Trip .
- 1 Nos. set of CT for protection and metering.
- 1 Nos. of solid state Triple pole on directional IDMTL over load and earth fault relay.
- The bus bar shall be suitable for 3 Phase and applicable amps,. the bus bar shall be with colored insulated sleeves. The supports shall be suitable spaced to give mechanical rigidity for with standing stress due to system fault,. The panel compartments shall have adequate space for termination of incoming and outgoing feeder cables equipped with gland, lugs etc.

8 CABLES:-
Power cable of PVC, aluminum armored cable of size 3x400mmx3.5 with require lugs gland. Total to be considered for lump sum offer is 20 meter. each from transformer to panel.

Control cable of PVC, copper cable of size 1 x 2.5 sq.mm x 3 and 6 core with required lugs, glands. Total length to be considered for lump sum offer is 50mtr, for various connections.

Units rates of cable to be quoted for any addition as required at time of execution.

9 SUB STATION STRUCTURE ADN ACCESSORIES.

9.1 33/0.44 KVA outdoor substation comprising of suitable substation structure and other required sub station material as given below:

9.2 SUB STATION STRUCTURE :-

Sub station structure extension made of 1 Nos. of two pole structure made out Two Nos. of 200xc 100mm M.S. channels fabricated and welded using 33 x 5 mm. M.S flat to make one pole of substation total substructure have our poles MS channels shall be not less than 100x 50mm and length as required to complete the sub station structure, clamps, nut bolts and other necessary MS Material as required for construction of sub station structure. These structures shall be made as per detailed drawing enclosed.

9.3 3 KV Lightning arrester:

Station class 1- KA rating, single pole lightning arrester for use of 33 KV solidly ground natural system and suitable for pedestal mounting complete with bolts and nuts. One SET of three numbers.

9.4 AIR BREAK SWITCHES:-

Air break switches 33 KV 400 amp. Triple pole with earth blades, gang operated, double break isolators suitable for horizontal mounting, complete with locking arrangement in both On/Off position post type insulators operating pipe arcing horns, hand operated machismo. The isolators will be complete with fixing bolts and nuts. all hardware parts shall be hot dip Galvanized.

9.5 DROP OUT FUSES:-

Drop out fuses 33 KV out doors drop out fuse cut out of expulsion type compete with insulators mounted on bas channels and suitable for cross arm mounting for a working current up to 400 amps. complete with fuse holders, fuse elements and operating rod. All hardware pa5rts shall be hot dip galvanized Each set comprise for 3 Mps single pole drops fuses. The drop out fuse set shall be for control of 500 KVA Transformer Primary One set.

9.6 Post pin and Disc insulators

33 KV disc insulator complete with hardware.

33 KV pin post complete with GI pin

9.7 ALUMINUM TUBULAR BUSBAR:-

Aluminum tabular bus bar required for internal connection of 33 KV equipment such as transformer Isolator, DO fuse etc. Jumpers, Terminal connectors connection supports. insulators bolts nuts etc complete

9.8 PAINTING

Structure shall be complete with necessary painting of primary red oxide and finished with two coat of aluminum paint.

10 SHIFTING OF TRANSFORMER

There is no work of shifting of old transformer.

11 CIVIL WORK
All related civil work such as construction of transformer plinth foundation of substation structure earth pits cable trenches/ cable trays, cable markers, providing and spreading 40 mm BT metal as per IE rules complete job.

12 EARTHING SYSTEM:-
Double earthing of entire electrical system connected to earthing plates buried in ground and surrounded in charcoal and salt up to adequate depth, where damaged earth is encountered at a distance of 2 meters from any permanent structure shall be provided. It shall also included digging of pits earth plates as per latest IS, watering pipe with funnel of required length and diameter earth strip per without kinks lugs and clamps, salt and charcoal earth chamber etc as per EI rules the contractor shall have to carry out earth continuity tests, earth resistance measurement and all other required test in the presence of the Engineer in charge which in his opinion are necessary to prove that the system is in accordance with design specification and as per IE rules complete.

12.1 EARTHING MATERIAL
Copper earthing plate of size 3.15 x 600x 600mm 6 nos
Copper earthing strip 50x 5 mm as required
GI earthing plate of size 6.3 x 600x600mm
GI earthing strip 50 x 5mm as required for earthing arrangement
CI main hole cover for earthing pits.
GI pipe for earthing pits 50 mm diameter of length 1.5 meter
Funnel and other required earthing materials as per IE rules & IS

13 FENCING FOR 33 KV SUBSTATION YARD
Industrial type fencing arrangement using 65 mm x 6mm angle iron post each of 3 meter height fixed as required at a spacing of 2 meter with 2 meter high GI chain link wire mesh fencing of minimum opening of 75mm x 75mm 2 meter wide main gate with locking arrangement and etc complete as per IE rules complete job.

14 LIGHTING
Sub station lighting provision in pasnel is to be done.

15 SUPPLY OF SPARES
Supply of essential spares like DO fuses, HRC fuses indication lamps cable lugs for maintenance one set

16 Supply of essential tools
Supply of essential tools and equipment like DO operating rod earthing rod sets, required for operation of sub station helmet HD one set of each item.

17. SUPPLY OF SAFETY DEVICES :
Supply of safety devices like rubber mating gloves, first Aid box leather apron danger boards, first and charge 0.5 kg capacity CO2 type fire extinguisher and sand buckets etc complete required as per specification and IE rules one set.

Note : The quantities given in annexure E&F are approximate. However the contractor shall have to execute the complete works as per specification and IE rules.
The equipment of following brand shall be required & accepted.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Equipment</th>
<th>Acceptable makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Transformer</td>
<td>NGEF cromptom Alsthom Kirlosker Voltemp btcl TESLA</td>
</tr>
<tr>
<td>2.</td>
<td>3 KV VCB</td>
<td>CROMPTON ALSTHOM AB JYOTI SIEMENS BHEL NIEPE-BANGLORE</td>
</tr>
<tr>
<td>3.</td>
<td>AIR CIRCUIT BREAKER</td>
<td>L &amp; T SIEMENCE ABB JYOTI CROMPTON C &amp; S</td>
</tr>
<tr>
<td>4.</td>
<td>CTS PTS</td>
<td>CROMPTON ALSTHOM UNIVERSAL JYOTI C&amp;S</td>
</tr>
<tr>
<td>5.</td>
<td>44 KV LIGHTING ARRESTER</td>
<td>IGE OBLUM ALPRO CROMPTON</td>
</tr>
<tr>
<td>6.</td>
<td>RELAYS</td>
<td>L &amp; T SIEMENCE ABB JYOTI C&amp;S</td>
</tr>
<tr>
<td>7.</td>
<td>AIR BREAKS SWITCHES</td>
<td>SIL WSL KIRON TEXTILE</td>
</tr>
<tr>
<td>8.</td>
<td>POST AND DIS INSULATORS</td>
<td>SIL WSI KIRON TEXTILE ATLAS JAIPURIA JYOTI</td>
</tr>
<tr>
<td>9.</td>
<td>ALUMINUM TUBULAR BUSBAR</td>
<td>AS PER IE RULE AND AS PER RELATIVE STANDERD</td>
</tr>
<tr>
<td>10.</td>
<td>CABLES</td>
<td>FINOLEX UNIVERSAL HAVELLS NICCO CCI</td>
</tr>
<tr>
<td>11.</td>
<td>DROP OUT FUSES</td>
<td>SIL WSI KRON TEXTILE ATLAS JAIPURIA</td>
</tr>
<tr>
<td>12.</td>
<td>EARTHING MATERIAL</td>
<td>AS PER IE RULES AND AS PER RELATIVE STANDARD D</td>
</tr>
<tr>
<td>13.</td>
<td>SAFETY DEVICE</td>
<td>AS PER IE RULE AND AS PER RELATIVE STANDARD</td>
</tr>
<tr>
<td>14.</td>
<td>METERS</td>
<td>AE MECO.</td>
</tr>
</tbody>
</table>
The following manufacturers are recommended to be used for the proposed work. The Bidders may substitute alternative brand names with prior approval of Engineer in charge.

<table>
<thead>
<tr>
<th>Item / Component</th>
<th>Recommended makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT and Centrifugal Pump</td>
<td>Kirloskar / Jyoti / Mather+Platt / WPIL</td>
</tr>
<tr>
<td>Pump motor</td>
<td>Kirloskar / Jyoti / Crompton / ABB / Elsthom / Siemens</td>
</tr>
<tr>
<td>Sluice Valve / Scour Valve</td>
<td>Kirloskar / IVC / VAG / IVI</td>
</tr>
<tr>
<td>Non-return / Check Valve</td>
<td>Kirloskar / IVC / VAG / IVI</td>
</tr>
<tr>
<td>Kinetic Air Valve</td>
<td>Kirloskar / IVC / VAG / IVI</td>
</tr>
<tr>
<td>Butterfly Valve</td>
<td>Fouress / IVC / VAG / L&amp;T (Audco)</td>
</tr>
<tr>
<td>Valve Actuator</td>
<td>Auma / Rotork / Limitork</td>
</tr>
<tr>
<td>Single faced Sluice Gate / Stop-log</td>
<td>Kirloskar / JASH / VAG</td>
</tr>
<tr>
<td>Flow &amp; Pressure regulating Valve</td>
<td>Darling Muesco / VAG / Keystone</td>
</tr>
<tr>
<td>Electro-magnetic Flow meters – Battery operated</td>
<td>Emerson / Krohne Marshall / Yokogawa</td>
</tr>
<tr>
<td>Water Hammer Control</td>
<td>Sureseal or equivalent</td>
</tr>
<tr>
<td>D.I. pipe Specials &amp; Fittings</td>
<td>Electrosteel / KISWOK / Jindal / Kejariwal</td>
</tr>
<tr>
<td>Electro-fusion &amp; Compression fittings</td>
<td>Glynwed / Georg Fisher/Astore/Magnum</td>
</tr>
<tr>
<td>Chlorinators</td>
<td>Pennwalt (W&amp;T), SIEMENS, Alldos</td>
</tr>
<tr>
<td>Chlorine leakage detectors</td>
<td>Pennwalt (W&amp;T), Capital Control(US), Alldos</td>
</tr>
<tr>
<td>WTP Equipments:</td>
<td>V(203,621),(849,680)ltas / Shivpad / Triveni / Hindustan Dorr-Oliver</td>
</tr>
<tr>
<td>(Bar Screen, Flash mixer, Clariflocculator, Clarifier, Pressure Sand filter, Activated Carbon filter, Chemical dosing system etc.)</td>
<td></td>
</tr>
<tr>
<td>Power Transformers</td>
<td>ABB / Crompton / Emco / Siemens / Alstom</td>
</tr>
<tr>
<td>HT Switch Gear</td>
<td>Alstom / Jyoti / Crompton / Siemens</td>
</tr>
<tr>
<td>Vacuum Circuit Breaker (VCB)</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Air Circuit Breaker (ACB)</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Moulded Case Circuit Breaker MCCB</td>
<td>Siemens / Schneider M.G. / Jyoti / L &amp; T</td>
</tr>
<tr>
<td>Soft starters</td>
<td>Siemens / Alstom / Jyoti / ABB</td>
</tr>
<tr>
<td>Relay and Contactors</td>
<td>Siemens / Alstom / Jyoti / ABB / L&amp;T</td>
</tr>
<tr>
<td>Cables</td>
<td>Tropodur / Finolex / Asian / Gloster / Incab / Universal / Polycab</td>
</tr>
<tr>
<td>EOT crane</td>
<td>Hitech / Indef / Hiking / Ambika</td>
</tr>
<tr>
<td>Product Category</td>
<td>Brands/Models</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Programmable Logic Controllers (PLC)</td>
<td>Rockwell (Allen Bradly) / Siemens / Honeywell</td>
</tr>
<tr>
<td>Panel Enclosures and Consoles</td>
<td>Rittal / MAYOR / Cutler Hammer</td>
</tr>
<tr>
<td>Ultrasonic Type Level Measurement Device</td>
<td>Endress+Hauser / Krohne Marshall / Hycontrol UK.</td>
</tr>
<tr>
<td>Float &amp; Board Type Level Measuring system</td>
<td>Nivo (Toshniwal), Endress + Hauser, Pune Techtrol</td>
</tr>
<tr>
<td>Switch fuse Disconnector</td>
<td>L &amp; T, FN Type, Siemens, GEPC</td>
</tr>
<tr>
<td>Multi-Function Energy Meters</td>
<td>Enercon, L &amp; T, SOCOMEC</td>
</tr>
<tr>
<td>Capacitor bank</td>
<td>Crompton Greaves, Khatau Junker, Malde, L &amp;T</td>
</tr>
<tr>
<td>Cable Termination kit</td>
<td>Raychem, Denson, M- Seal</td>
</tr>
<tr>
<td>Battery</td>
<td>HBL NIFE, Exide, Amco</td>
</tr>
<tr>
<td>Battery Charger</td>
<td>Chaabi Electrical, Masstech</td>
</tr>
<tr>
<td>Tacho Meter on line</td>
<td>Kana Electric, Proton, Jay Shree Electronics</td>
</tr>
<tr>
<td>Pressure switch</td>
<td>Indfoss, Switzer, Tag Process Instruments</td>
</tr>
<tr>
<td>Flow switch</td>
<td>Switzer, General Instrument, Forbes Marshall</td>
</tr>
<tr>
<td>Pressure gauge</td>
<td>WAREE, WIKA, AN Instruments, Guru, Hitek</td>
</tr>
<tr>
<td>Pressure Transmitter</td>
<td>Emerson, Foxbro, Druck, Endress – Hauser, ABB, Honeywell Automation</td>
</tr>
<tr>
<td>Engineering cum Operator work Station</td>
<td>IBM, Compaq, Dell</td>
</tr>
<tr>
<td>Printer</td>
<td>EPSON, HP, CANNON, WIPRO</td>
</tr>
<tr>
<td>Local Supervisory Station</td>
<td>IBM, Compaq, Dell</td>
</tr>
<tr>
<td>HMI Software</td>
<td>Wincc, Rs View, Monitorpro, Intellution, Indusoft</td>
</tr>
<tr>
<td>Alarm Annunciator</td>
<td>Minilec, Peacon, ICA, APLAB</td>
</tr>
<tr>
<td>Uninterruptible Power Supply</td>
<td>HI-Real, Pulse, Tata Libert, APC, APLAB</td>
</tr>
<tr>
<td>Instruments &amp; Control Cables</td>
<td>Delton, Asian, Servel, TCL, Thermopad</td>
</tr>
<tr>
<td>Receiver Indicator/Digital panel meter</td>
<td>Masibus, Yokogawa, Lectrotek, NISHKO, SaiTech, MTL INSTS</td>
</tr>
<tr>
<td>Intercom system</td>
<td>Betel, Samsung, Tata, Panasonic, Matrix</td>
</tr>
<tr>
<td>Conductivity level switch</td>
<td>Pune techtrol, Krohne Marshall, E+H</td>
</tr>
<tr>
<td>Multifunction power monitor</td>
<td>MASIBUS, L&amp;T, ENERCON, SOCOMECH, SECURE, DAE</td>
</tr>
<tr>
<td>Temperature Scanner</td>
<td>SaiTech, Masibus, Nishko, Lectrotek</td>
</tr>
<tr>
<td>Analog Signal Multiplier</td>
<td>MASIBUS, Sai Tech, MTL INSTS, NISHKO</td>
</tr>
<tr>
<td>Portable vibration measuring equipment</td>
<td>Shrenk Every, IRD, STM Instrument, TIME</td>
</tr>
<tr>
<td>Portable sound measuring equipment</td>
<td>CENTER, MECORD, CYNGET</td>
</tr>
</tbody>
</table>

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**Specification of Operation and Maintenance:**

The successful bidder shall carry out the operation and maintenance of the project facilities for 10 years after the successful commissioning of the project. The Lumpsum offer submitted by the Bidder shall include the operation and maintenance cost of the project for a period of 10 years from the date of successful completion of the work. During O&M the scope of Contractor shall be,

1.0 Repairs and replacements in all project components including Pipeline, Treatment plant, Pumps, Electrical installations, valves, specials, OHTs, Intakewell etc. complete.
2.0 Consumables in the form of chemicals for running the Water treatment plant.
3.0 Electrical expenditure shall be borne by Municipal Council as per actual.
4.0 It shall be the responsibility of Bidder that the system runs at desired capacity and at efficiency not less than 90% during the O&M period.
5.0 Bidder shall ensure that all metering equipments (Consumer meter, Bulk meter, Sensors etc.) shall be working efficiently and effectively.
6.0 Bidder shall be responsible for reading the consumer meter and distributing the Bills in every 1st week of month.

ULB shall extend all the necessary support to the Bidder for fulfilling the Obligations for operating and maintaining the system successfully. Also it shall be the responsibility of ULB to enforce suitable water tariff and also ensure effective collection of water bills distributed by the bidder.

The Bidder shall employ following minimum Manpower for the O&M of the project. (Bidder shall be employing other staff as per requirement following is only the minimum staff).

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Particulars</th>
<th>Minimum Qualification</th>
<th>Experience</th>
<th>No. of personnel</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Project Manager</td>
<td>B.E.</td>
<td>5 years</td>
<td>01</td>
</tr>
<tr>
<td>2.0</td>
<td>Dy. Project Manager</td>
<td>Diploma</td>
<td>5 years</td>
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<td>2.0</td>
<td>Electrician</td>
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<td>3 years</td>
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<td>3.0</td>
<td>Fitter</td>
<td>ITI</td>
<td>3 years</td>
<td>03</td>
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</tbody>
</table>

ULB shall release 25% of the total contract price during O&M period @ 2% pa with an increase of 5% in every succeeding year till the 10th year of O&M. The payment against the O&M shall be made every year on satisfactory upkeep and running of the system.

**Note -**

In case of any increase/decrease in length of distribution pipes for 100% coverage of the Municipal area the payment will be adjusted as per the latest SOR issued by Department of Urban Administration and Development, Madhya Pradesh without any escalation.
IS Code (with latest Amendments as per BIS) of practices shall be used are

<table>
<thead>
<tr>
<th>S. No.</th>
<th>IS Code No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS 269:1989</td>
<td>33 grade ordinary Portland cement</td>
</tr>
<tr>
<td>2.</td>
<td>IS 8112:1989</td>
<td>43 grade ordinary Portland cement</td>
</tr>
<tr>
<td>3.</td>
<td>IS 12269:1987</td>
<td>53 grade Ordinary Portland cement</td>
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<tr>
<td>4.</td>
<td>IS 1489:1991</td>
<td>Portland pozzolana cement</td>
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<td></td>
<td>Part I:1991</td>
<td>Fly ash based</td>
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<td></td>
<td>Part II:1991</td>
<td>Calcined clay based</td>
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<tr>
<td>5.</td>
<td>IS 1786:1985</td>
<td>High strength deformed steel bars and wires for concrete reinforcement</td>
</tr>
<tr>
<td>6.</td>
<td>IS 875:1987</td>
<td>Code of practice for design loads for building structure</td>
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<tr>
<td></td>
<td>Part I:1987</td>
<td>Dead loads</td>
</tr>
<tr>
<td></td>
<td>Part II:1987</td>
<td>Imposed loads</td>
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<tr>
<td></td>
<td>Part III:1987</td>
<td>Wind loads</td>
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<td></td>
<td>Part IV:1987</td>
<td>Snow loads</td>
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<tr>
<td></td>
<td>Part V:1987</td>
<td>Special loads and load combinations</td>
</tr>
<tr>
<td>7.</td>
<td>IS 13920:1993</td>
<td>Ductile detailing of reinforcement concrete structures subjected to seismic forces</td>
</tr>
<tr>
<td>8.</td>
<td>IS 1893:2002</td>
<td>Criteria for earthquake resistant design of structures</td>
</tr>
<tr>
<td>11.</td>
<td>IS 1343:1980</td>
<td>Code of practice for pre-stressed concrete (first revision)</td>
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<tr>
<td>13.</td>
<td>Part 1:1965</td>
<td>General requirement</td>
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<tr>
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<td>Part 2:1965</td>
<td>Reinforced concrete structure</td>
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<td></td>
<td>Part 3:1967</td>
<td>Pre-stressed concrete structures</td>
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<td>Part 4:1967</td>
<td>Design tables</td>
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<td>15.</td>
<td>IS 5330:1984</td>
<td>Criteria for design of anchor block for penstock with joints (first revision)</td>
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<tr>
<td>17.</td>
<td>IS 3913:1966</td>
<td>Suspended sediment load samplers</td>
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<td>18.</td>
<td>IS 3917:1966</td>
<td>Scoop type bed material samplers.</td>
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<tr>
<td>20.</td>
<td>IS 4926:1976</td>
<td>Ready mix concrete (first revision)</td>
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<td>21.</td>
<td>IS 6295:1986</td>
<td>Code of practice for water supply and drainage high altitude and/or sub-zero temperature regions(first revision)</td>
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<td>22.</td>
<td>IS 5477</td>
<td>Method for fixing the capacities of reservoir</td>
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<td>Part 1:1969</td>
<td>General Requirement</td>
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<td></td>
<td>Part2:1969</td>
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<td>Part4:1971</td>
<td>Flood storage</td>
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<td>23.</td>
<td>IS 9668:1980</td>
<td>Code of practice for provision and maintenance of water supply for fire fighting</td>
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<tr>
<td>24.</td>
<td>IS 8062</td>
<td>Code of practice for cathodic protection for steel structure</td>
</tr>
<tr>
<td></td>
<td>Part1:1976</td>
<td>General principles</td>
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<tr>
<td></td>
<td>Part2: 1976</td>
<td>Underground pipelines</td>
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<tr>
<td>25.</td>
<td>IS 10221:1982</td>
<td>Code of practice for coating and wrapping of underground steel pipes</td>
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<tr>
<td>26.</td>
<td>IS 8329:1977</td>
<td>Centrifugally cast(spun) ductile iron pressure pipes for water, gas, and sewerage</td>
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<tr>
<td>27.</td>
<td>IS 9523:1980</td>
<td>Ductile iron fittings for pressure pipes for water, gas, and sewerage</td>
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<tr>
<td>28.</td>
<td>IS 11906:1986</td>
<td>Recommendation for cement mortar lining cast iron, mild steel and ductile iron pipes</td>
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<td>29.</td>
<td>IS 12288:1987</td>
<td>Code of practice for laying of ductile iron pipes</td>
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<tr>
<td>30.</td>
<td>IS 4984:1987</td>
<td>HDPE pipes for potable water supplies, sewage and industrial effluents(third revision)</td>
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<td>32.</td>
<td>IS 8008</td>
<td>Injection moulded HDPE fittings for potable water supplies</td>
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<td></td>
<td>Part1:1976</td>
<td>General requirement</td>
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**NOTE:** Quality assurance program of the manufacturer shall have to be enclosed with the Tender along with BIS registration.