01.00 Background

The Tenughat Thermal Power Station (TTPS) is situated near Tenughat Dam at Lalpania in the district of Bokaro, Jharkhand. The nearest railway station is Gomia, which is about 22 Kms from the Power station. The power plant is also connected by road from Ramgarh and Gomia. The project was sanctioned for 3 stages, as stage-I of 2x210 MW and stage –III of 1x500 MW. This unit is under commercial operation since September 1997.

1877 acres of land was acquired for Stage- I. Main powerhouse, ash disposal area, colonies and railway sidings have been planned on this allocated block area. This land is insufficient for the expansion of the project, additional land of 250 acres is being acquired for the ash disposal area.

M/s Tenughat Vidyut Nigam Limited (TVNL) intends to implement the Ash Water Recirculation System at Ash pond area of TTPS, Lalpania, so that the effluents generated from Ash pond units and flowing in to the Tenughat dam may be reduced to a minimum level as per statuary guidelines.

Photo – 1 – Showing Tenughat Power plant
Photo – 2 – Showing Tenughat Reservoir
Photo – 3 – Showing Ash Pond
02.00 INSTRUCTION TO TENDERER

02.01 INTRODUCTION

A large quantity of fresh water is required in the Power Plant for wet ash pumping to the ash pond, flushing and other miscellaneous uses. To conserve the requirement of fresh water from source, water used for ash flushing will be pumped back to ash water pump house.

Water from the existing ash pond is discharged through four pipes having diameter DN 300. The discharged water is diverted to existing RCC spillway (Approximate length 50m). Water from spillway is further gravitated to the nearby KATEL River. This River further joins the Tenughat reservoir.

Total decanted / out fall water coming from the ash pond through 04 Nos. of DN 300 pipe is assumed to be 660 m3/h (Approx). In order to reduce the fresh water requirement from source and to arrest the ash particles disposal to the Tenughat reservoir. It is proposed to collect and reuse decanted water from ash pond. The water reclaimed shall be pumped back to the existing ash pump house for further use.

02.02 INTENT OF THE SPECIFICATION

The intent of this specification is to cover the design, engineering, manufacture/ fabrication, supply, transportation, unloading, storage, transportation to site, erection, testing and commissioning of Ash water recirculation system of Tenughat Thermal Power Station (TTPS) at Lalpania along with auxiliaries.

The intent of this Specification is to make the tenderer appreciate the scope for this project to enable him to submit a detailed comprehensive offer matching the requirement of the augmentation program as specified in this document. The tenderer shall base his offer on the information contained in this specification.

The Tenderer shall satisfied himself regarding suitability of the plant and equipment and system, specified in the technical document and take full responsibility for suitability thereof for output, reliable working as well as ease of operation, inspection, and maintenance including replacement with minimum down time.
All equipments / systems shall be complete in all respects & any equipment or accessories not covered in the technical specification but essential for proper design and operation shall be deemed to be included in the scope of the Tenderer.

The Tenderer shall satisfy himself regarding the nature and location of work place, kind of equipment, facilities, services etc. needed during performance of work, general and local conditions as well as all other matters which can, in any way, affect the work covered in this specification.

Effort shall be made by the Tenderer to maximize equipment/ supplies from indigenous sources.

The successful Tenderer shall be responsible for coordinating the supplies covered in the different parts of this Specification and execute the contract within agreed time schedule.

All the equipment & supplies shall be suitable for the tropical climatic conditions prevailing at TTPS Lalpania, Jharkhand.

This technical specification shall be read in conjunction with the Commercial Specification including Special Condition of Contract (SCC) and General Condition of Contract (GCC).

02.03 GENERAL INSTRUCTION TO TENDERERS

This specification shall be read in conjunction with Invitation to Tender, General Condition of Contract and other such documents related with this job.

The Tenderer shall study the specification and satisfy himself regarding the workability of the proposed system and shall take full responsibility for the design of the equipment / system / sub-systems, quality of material, workmanship, guaranteed operation and smooth performance of the equipment / system / sub-systems.

This Technical Specification is intended to provide general guidance to the Tenderer and as such, all items, even though not specifically mentioned in the TS, but considered necessary for safe and satisfactory operation and guaranteed performance of the offered equipments /
system / sub-systems, etc. shall be considered to be included in the scope of work of the Tenderer.

Make of all bought out items shall be as per the list provided in this TS. For approval of items not covered in this TS, names of those manufacturers shall be considered who are in the field for at least five years.

The Tenderer shall satisfy himself by visits to the proposed site, before submitting their offer, may conduct necessary survey, take required measurements to locate various units of the proposed system, to collect / generate all the required data and study various aspects of design and execution of the job / system. No claims, what so ever, for any extra payment on plea of ignorance of the site conditions shall be entertained after award of contract. Tenderer shall submit certificate from site-In-Charge of Ash Pond area at TTPS that site visit is carried out by them.

The Tenderer shall clearly bring out to the knowledge of TVNL / MECON any deviation or exclusion from the Technical Specification in respect of scope of work or technical specification of different parts of equipment, or any other details mentioned in the above documents giving technical reasons/ explanation in line with NIT.

The Tenderer shall clearly indicate any assumption made in respect of specification, data or any other details that have not been mentioned in this specification but considered necessary for sizing and selection of equipment and pipelines to meet the specified duty requirements. Any such assumptions not indicated during tendering stage, shall not be binding on TVNL. The successful Tenderer, under these conditions, shall supply plant and equipment based on the data acceptable to TVNL without any extra cost. The successful Tenderer shall list out all equipment along with its component/parts indicating make, type and other details. In respect of components/ parts of equipment whose details are not mentioned in TS.

02.04 DELIVERY SCHEDULE

a) The complete ash water recirculation system along with all the facilities in the scope duly constructed, erected & tested complete in all respects shall be ready for commissioning within ten (10) months inclusive of monsoon period from the date of award of contract. For time schedule /
b) The Tenderer shall include in his offer a firm time-bound schedule giving duration of various activities viz. design & engineering, equipment manufacture including procurement of brought-outs, delivery, civil works, structural fabrication & erection, equipment erection, testing and commissioning. The above schedule shall be supported by Bar chart.

All moving parts of equipment, which can conceivably cause injury to the operator and other authorized personnel, within the vicinity of the working area, shall be suitably guarded. Design and selection of equipment shall be made with the following in view:

- Safety of personnel
- Uninterrupted operation
- Long life of plant & equipment
- Easy maintenance at low cost
- Good system design for proper accessibility, maintainability and operability of the plant and equipment.
- Plant & equipment system and design will be compatible for long campaign life of more than 20 years, fuel efficiency and low operating cost.
- System design and equipment selection suitable for maintaining environmental norms and non-hazardous operation as per latest guidelines of Central Pollution Control Board.
- Pollution control measurements

02.05 The successful Tenderer shall submit well in advance general arrangement drgs, detailed civil and structural drawings, detailed fabrication drawings, scheme drawings, welding procedures, material specification, testing method etc., for various units, sub-assemblies, and component of the complete equipment for the approval of TVNL. However, such approval shall not relieve the successful Tenderer of his responsibilities towards completion of work as defined in the Contract. During the course of manufacture if any additions / alterations are found necessary by TVNL and intimated to the successful Tenderer, the same shall be implemented by the successful Tenderer without any extra cost.

All necessary facilities including tools, tackles, testing equipment, instruments, accessories etc. shall be provided by the Successful Tenderer to enable stage wise inspection of equipment by TVNL during its manufacture / fabrication and assembly.
The Tenderer shall study this specification and technical documents / drawings and visit the site and see the existing site conditions and satisfy themselves fully regarding the scope and extent of work involved, prior to submission of his quotation.

Special tools and tackles shall be handed over to TVNL for repair and maintenance after contract period.

The Tenderer shall base his proposal on reputed national/ international standards subject to approval of TVNL. The Tenderer shall follow the latest IPSS wherever available.

Supply of all technical literature, drawings & documents, general arrangement drawings, assembly & sub assembly drawings of all the plant & equipment, construction & erection & as-built drawings, operation & maintenance manuals, manufacturing drawings, etc. are also in the scope of successful tenderer.

AWRS plant shall be complete in all respects with all associated works / facilities and any equipment or material not specifically mentioned in this specification, but required for safe, efficient & smooth operation and guaranteed performance of the system / plant shall be deemed to be included under the scope of work of the Tenderer.

A non-corrodible nameplate giving major parameters for the mechanical as well as electrical and instrumentation equipment shall be provided on each equipment.

02.06 REGULATIONS AND STANDARDS

a) All equipment shall be designed, assembled, erected and tested in accordance with the standards of National Standards institutions of the country where the equipment will be manufactured and/or latest publication of the relevant Indian, IPSS, and International Standards like, ASTM, BS, DIN, etc. These standards shall also include relevant statutory regulations/ standards like pollution control, environmental norms, electricity rules, safety rules, static and mobile pressure vessel rules, boiler regulation act, etc., conforming to Jharkhand state/ Indian and/or international standards.

b) The latest revisions of the relevant Indian/ International standards shall be used by the successful tenderer for materials, design, fabrication, manufacture, inspection, installation and testing of the plant and
02.07 STANDARDISATION

In order to minimize the inventory of spares parts and ease of their changeability / replacement, the Tenderer shall ensure that the plant and equipment offered have maximum interchangeability and similarity of equipment & components.

In the interest of Standardization, TVNL reserves the right of selecting a particular make of equipment / component and the Successful Tenderer shall supply the items according to acceptable make or make approved by TVNL.

The Tenderer shall select the make/ manufacturer of items/ equipment, such as electrical equipment, pumps, valves, motors, couplings, bearings, instruments & controls, or other similar items from the list of preferred makes indicated in this TS.

02.08 GUARANTEE

a) Tenderer shall be responsible for trouble free operation and satisfactory performance of all the equipment supplied by him. The material used shall be new and best of its kind available and shall conform to relevant latest Indian standards and international standards.

b) The guarantee shall also cover faulty design or materials or workmanship. The supplier shall rectify or replace the equipment / system free of cost to the entire satisfaction of TVNL.

c) The tenderer shall replace equipment / component without any cost implication to TVNL in case of any failure during testing & commissioning and during the period of 12 months from the date of commissioning.

d) The tenderer shall replace the wrong/ defective equipment supplied by them, missing items, (observed during inspection at site after receipt of materials) or any damages caused to equipment during transportation free of cost after receipt of information from TVNL. In case of any dispute, decision of TVNL shall be final. The supplier shall depute his representative to site for replacement/ rectification work without any extra cost to TVNL.
02.09 IMPLEMENTATION PHILOSOPHY

This package shall be executed on “Turnkey Basis” i. e. successful Tenderer shall be responsible for all activities from design to commissioning.

Tenderer may submit their best offer on “Turn Key” basis for this package as per their resources, ability and subject to fulfillment of the eligibility criteria of this Tender.

However, TVNL reserves the right to accept/ reject the offers in totality or alter the specified quantity of supply / services or delete any item / service from the scope of work without assigning any reason. TVNL also reserves the right to procure directly some items / equipment as per Tenderer’s design & specification.

02.10 QUALITY SYSTEM, INSPECTION & TESTING

Quality System, Inspection & Test of Plant / Equipment shall be as per the relevant chapter of this Technical Specification.

02.11 CAPABILITY OF THE TENDERER

a) The Tenderer shall be capable to design, engineer, procure, supply, manufacture/ fabricate, erect and commission the specified system / equipment within the specified delivery period indicated in this specification. In this regard the Tenderer shall submit a list of qualified engineers for design and engineering, various manufacturing facilities, man-power availability, testing facilities, erection facilities, etc. to enable TVNL to assess the capability of the Tenderer. TVNL reserve the right to visit the Tenderer's office to assess the technical capability (design and engineering strength) before price opening, if required.

Deployment of qualified engineers for design and execution

1. Tenderer shall submit a list of qualified engineers for design and engineering along with the offer.

2. The successful Tenderer shall depute at site, engineer/ specialists from various disciplines for the supervision of erection, testing trial run, commissioning and performance guarantee tests of the plant and equipment under his scope of supply.
b) The Tenderer shall also submit along-with his offer a statement of similar job executed by them during the last ten years which shall include brief system detail, name of key persons involved with design and engineering, capacity of the plant, location, date of initial operation / status, client’s name, order value, client’s performance certificate etc.

02.12 LANGUAGE AND UNIT

a) All technical details, dimension, weight and quantities shall be in metric units. English language shall be used in drawings, documents, manuals reports official correspondence, etc.

b) All drawings, data sheets, name plates of equipment, material test certificates, equipment performance test results, etc., shall be in English language.

02.13 STATUTORY REGULATIONS

a) The Tenderer shall adhere to various statutory regulations, such as Indian Boilers Regulations, Indian Explosives Acts, State Electricity Rules, etc., enforced/laid by the Govt. of India and State Government of Jharkhand during the design, fabrication / manufacture, inspection, testing, painting, transportation and delivery of plant and equipment.

b) The successful Tenderer shall be solely responsible for obtaining necessary clearances from the various statutory bodies including those of Govt. of India, Govt. of Jharkhand and others as applicable during the course of manufacture / fabrication, testing, painting, transportation and delivery of the plant and equipment as well as during construction, erection of equipment, laying of pipelines, commissioning etc.

c) Safety Rules & Regulations

1. The Tenderer shall comply with the relevant Safety Rules and Regulations applicable in the state but not limited to the following:

   - State Factory Rules/Acts
   - Indian Electricity Rules/Acts
   - Indian Explosive Manuals/Acts
   - Carbide of calcium Rules/Acts
   - Static and Mobile Pressure Vessels (Unfired) Rules / Acts
• Fire protection manual issued by Tariff Advisory Committee (India) in 2003
• Pollution Control Regulations / Acts

2. Strict attention shall be paid to all statutory regulations and safety rules for prevention of accidents.

3. The Tenderer at appropriate places shall display the safety posters/regulation for prevention of accidents. Notices and warning signs shall be displayed for all sources of dangers.

4. The Tenderer is not permitted to construct any temporary road crossing on the rail tracks for the sake of their convenience at work site.

5. When the work is carried-out at night or in the obscure daylight, adequate arrangements for flood lighting in the working area shall be made by the Tenderer at his own cost and got approved by TVNL.

6. All handling / transport and rigging equipment including lifting tools and tackles shall be checked at regular intervals and kept in good and safe working condition. A register is to be maintained regarding the results of periodical tests/checks and other particulars in respect of each and every such equipment.

7. The Tenderer must take sufficient care in moving his construction plant and equipment from one place to another, so that it do not cause any damage to the property of TVNL /Government or obstruct construction activities of other Tenderer's and public at large.

8. The successful Tenderer shall depute a full time safety engineer who will exclusively look after all the jobs pertaining to safety at site and keep close liaison with TVNL. He will be responsible for maintaining safe working condition at site, promoting safety consciousness among the workmen and reporting to concerned authorities in case of accident /dangerous occurrences.

9. A protocol shall be prepared in association with the concerned agencies of TVNL before execution of work in hazardous areas like

• Working at height
d) **Safety while working with Explosives**

1. Explosives shall not be used on the work site by the successful Tenderer without the written permission of TVNL and that too only in the manner and to the extent to which it has been prescribed.

2. Explosives shall be stored in special premises approved by TVNL and at the cost of the successful Tenderer who shall be liable for all damages, loss or injury to any person or property and shall be responsible for complying with all statutory obligations in these respects.

e) **Safety Appliances**

1. The successful Tenderer shall provide the safety appliances conforming to the relevant Indian Standards to all their workmen and supervisors engaged by them as well as by the sub-contractors.

2. The Tenderer shall ensure that all the workmen and supervisors, are using the safety appliances regularly during work at site. Any violation in safety provisions or failure to maintain safe working conditions will lead to serious penalty on the Tenderer and finally may lead to termination of the Contract.

3. The workmen of the Tenderer deployed for construction and erection in hazardous areas shall be provided with personnel protective safety appliances of special nature suitable for hazardous working conditions.

f) **Safety during Construction/ Execution**

1. The successful Tenderer shall be responsible for the safety of his workmen and employees. The successful Tenderer shall ensure that safety practices are followed so as to prevent personal injury to his workmen and also to other persons working / passing by in that area.
2. The successful Tenderer shall ensure that in case of any accident, the same are reported without delay to TVNL /Statutory Authorities as per Rules. In case of any injury/accident, the Tenderer shall bear all the expenditure for medical treatment and shall pay the compensation in case of permanent disability or death.

3. The Tenderer shall ensure that all personnel employed do not stray into other areas. Any injury caused due to this shall be the sole responsibility of the Tenderer.

4. The Tenderer shall ensure that skilled labors required for specific works have necessary trade certificates and adequate experience of the job. This is likely to be checked by TVNL. The concerned operators, mechanics, electricians, fitters, riggers, etc. must be fully conversant with the hazards associated in operation/maintenance of their relevant equipment.

g) Safe Work Platforms

1. The successful Tenderer shall use strong and secured planks and boards of the right sizes.

2. These planks shall be painted at the edges brightly to warn the workers for any misuse (usually zebra paint)

3. Barricades should be put-up to prevent them from falling.

4. The successful Tenderers shall make sure that trained scaffolders erect scaffoldings.

5. Supervisors must inspect scaffoldings once every week.

h) Falling Objects and Debris

1. No loose materials, which can fall down, should be kept on the working platforms.

2. Overhead shelters should be provided to minimize damage from falling objects.

3. Strong nets to be provided to catch these objects or debris.
4. Nets must envelop all sides of the building / construction area.

i) Personal Safety Equipment

1. Workers must wear approved safety helmets and shoes.

2. For those working in high places safety belts shall be provided.

3. The safety belts must be attached to strong anchorage points.

j) Operating Construction Machine

1. The successful Tenderers shall make sure that those operating the construction machinery are well trained for their jobs.

2. The keys of such machinery shall be kept with the authorized persons.

3. The keys shall be removed after use of the machine.

k) Safe Electrical Installations

1. The successful Tenderer shall use approved types of electrical sockets and plugs.

2. Proper insulators for all electrical wirings shall be provided.

3. Wiring must not be allowed to lie on the floor or on the ground.

l) Safety in Designing of Equipment

1. All machinery and equipment must be equipped with safety devices. The safety provisions shall conform to the recognized standards, safety codes and statutes.

2. All safety measures as required to be adopted as per the statutory regulations and the successful Tenderer shall strictly follow the safety rules of the plant during the execution.

02.14 Construction power shall be made available by TVNL at a single point at a distance of 100m from the proposed pump house area free of cost inside plant premises. Decanted water from the ash pond shall be used
as a source of Construction water. The same shall be collected in temporary tank and shall be utilized suitably for the construction work.

Power charges shall be borne by TVNL during entire Defect Liability Period.

02.15 WORKMANSHIP

a) Quality of workmanship shall be in accordance with modern engineering practice. Any defects / deficiencies pointed out by TVNL during or after commissioning shall be made good as directed without any extra cost to TVNL.

b) Equipment and its various components shall be generally of welded steel construction unless specified otherwise. The finish of the components shall be first class in all respects.

c) During various stages of manufacture/ fabrication and erection, the Tenderer shall ensure that the various dimensions of the equipment and its components conform to the equipment/ erection drawings approved by TVNL.

d) Any fabrication work shall not impair the quality of the material. Wherever applicable mechanized equipments, such as plate bending machine, plate cutting machine, pipe-handling machine, thread milling machine and riveting machines, etc. shall be used.

e) Complete assembly shall be fabricated/ manufactured with minimum number of welded joints and the seams of the weld shall be dispositioned in such a way that no two seams come in one line.

f) All the pipe connections to the equipment shall be truly perpendicular/ exactly to the angle shown in the fabrication drawing.

g) All the flanges shall be welded so as their surfaces are truly perpendicular to the respective pipe axes.

02.16 SHIPPING PROTECTION

All equipment shall be packed properly for prevention of damage during transit and deterioration during storage.
02.17 COMPLETENESS

Any items of work, supply and services which has not been specifically mentioned but is required for completing the design, engineering, manufacture, supply erection, testing and commissioning of the AWRS system shall be under the Tenderer’s scope for work without any extra cost. The tenderer shall clearly indicate such additional requirement, if any, with adequate justification.

02.18 GENERAL INSTRUCTIONS ON DESIGN AND SUPPLY

02.18.01 Plan and Equipment

01 General

The selection, design and manufacture/ fabrication of plant and equipment shall be suitable for the intended service and duty conditions and ensure maximum interchangeability of components and least maintenance. Each unit shall be complete in all respects.

All the equipment, technological structures, pipes, valves, fittings, etc shall be subjected to inspection and testing as per accepted national or international standards and practices. All the components shall be subjected to inspection and testing as per standard practices of the manufacturer prior to offering them for inspection by the TVNL.

All equipment shall be assembled at manufacturer’s works on a suitable bed. Alignment of all assemblies, levels and center lines shall be measured and recorded. Any errors of deviations from the approved drawings shall be corrected.

All equipment shall be complete with approved safety devices, wherever a potential hazard to personnel and or equipment exists. There shall be adequate provision for safe access of personnel to and around the equipment for operational and maintenance functions.

All equipment shall be complete in all respects including all accessories essential for proper installation, operation and maintenance irrespective of whether such items are specifically mentioned in the specifications or not.

Machinery and equipment shall be designed to have good maintainability.
All working parts shall be arranged for convenience of operation, inspection, lubrication and ease of repair and replacement of parts and sub-assemblies with minimum downtime.

Suitable working platform, walkways, ladders, lifting tackles and tools required for the above shall be provided.

02 Design Basis

Machinery and machinery components shall be compatible with the operating conditions in the plant atmospheric conditions at TTPS, Lalpania.

Standardization and unification shall be carried out to the maximum extent for the various sub-assemblies constituting the machinery. Items shall be designed such that they can be dismantled quickly without disturbing the installation of the neighboring units.

02.18.02 Optimization of Indian Supplies & Services

The successful Tenderer shall make all efforts to optimize the supplies and services from Indian sources and shall, however, ensure that the performance of the plant and equipment are achieved as envisaged in the Technical Specifications.
03.00 SCOPE OF WORK AND BATTERY LIMIT

The scope of work of the Tenderer covers design, engineering, manufacture/ fabrication, shop painting, shop testing, packing, transportation, transit insurance, unloading, storage at site, watch and ward, handling at site, erection, site testing, final painting and commissioning of entire civil work, steel structural work, mechanical equipment, Piping with valves and fittings, handling & hoisting equipment, associated electrics, instrumentation & control, illumination, ventilation etc in accordance with the requirement of the proposed plant complete with interconnecting pipes and cables for the proposed Ash water recirculation system as per the technical specification outlined hereinafter on turnkey basis.

The scope of work shall include the following activities:

i) Supply of all technical literature, drawings & documents, general arrangement drawings, assembly & sub assembly drawings of all the plant & equipment, construction & erection & as-built drawings, operation & maintenance manuals, etc.

ii) Submission of all design calculations, data sheets for various equipments, pipeline sizing calculation and calculation for sizing of various sub systems and integrated systems for approval of Purchaser/Consultant and finalizing the same as per approval of Purchaser/Consultant.

iii) Proposed plant shall in general comprise of the following facilities:-

a) Collection of the decanted water from 04 Nos. of existing DN 300 pipes into decanted water sump. Tenderer shall extend these DN 300 pipes from ash dyke to sump with carbon steel pipes of DN 450 size (Refer scheme drawing enclosed with this TS).

b) Providing isolation valve on DN 450 collection header with a bypass arrangement to divert the flow to spillway in case of maintenance of recirculation system. Motorised valve with interlocking with level transmitter of decanted water sump.

c) Decanted water sump as per the details in this TS.

d) Pump house for accommodating decanted water pumps, slurry pumps, electrical equipments etc.

e) Pipe line laying from the proposed pump house to the sump of existing ash water pump house.
f) Carbon steel pipe from proposed pump house to existing ash pond to transfer the ash slurry settled at the base of sump.
g) Survey work along the proposed route of pipe line and finalizing the route in case of any interferences / obstruction encountered at site.
h) Fire fighting facilities.
i) Area drainage /storm water drainage system of complete complex.
j) Associated electrics and Instrumentation/ Automation
k) Hoisting facilities.
l) Civil and structural work
m) Ventilation Facilities
n) Site leveling.

iv) Supply of commissioning spares & consumables
v) Office cum store inside pump house.
vi) Illumination facilities.
vii) Pipe lines shall be laid underground, on ground or overhead on trestles and same shall be as per layout drawing enclosed alongwith this technical specification.
viii) Supply of erection, testing & commissioning materials.
ix) Pipeline flushing fluids, chemicals & consumables.
x) Handing over the entire system in good running condition after contract period with the fulfillment of above.
xi) Participation in design conference with TVNL as and when called for.

xii) Fulfillment of guarantee of all plant & equipment, sub systems & integrated system of water supply facilities covering various cooling water system.

xiii) R.C.C pedestals, pipeline structural stockades, bridges for overhead pipelines.

xiv) Pipeline supports, thrust blocks / anchor blocks, etc.
xv) Inspection and performance testing of individual equipment and system as a whole.

xvi) Proposed Plant shall be complete in all respects and any equipment or material not specifically mentioned in this specification, but required for safe, efficient & smooth operation and guaranteed performance of the plant will be deemed to be included under the scope of work of the Tenderer. Detailed scope of work for electrics, Instrumentation, Automation and control, Civil, Structural, Material Handling, ventilation etc. have been specified in the relevant chapters of this specification.

03.01 Tentative area layout is shown in the drawing (Drg. No. MEC/11/40/Q7GR/TS/AWRS/0001, R-0) enclosed with this TS. The Tenderer shall prepare and submit along with his offer detail layout drawing, P & I diagram and duly dimensioned general arrangement drawings of each unit of water supply complex taking due consideration of maintenance space and approach roads.

03.02 Collection/ generation of design and site data within one month from the date of issue from the award of Contract.

a) Collection of all input design data. However indicative data is provided separately in the specification.

b) Safety and security for man, machine, materials etc.

c) Construction of temporary road, stores, offices, etc. for movement of man, machine and material wherever required.

03.03 Tenderer shall furnish comprehensive mechanical, civil, electrical & Instrumentation engineering and structural engineering design drawings for pump houses, sumps, electrical rooms, pipe trestles, pedestals for pipes etc. for approval.

03.04 Make of all bought out items shall be as per the makes indicated in in this technical specification.

03.05 Warranty and Guarantee

The Successful Tenderer shall warrant that the equipment and system to be supplied shall be new and in accordance with the contract specification and free from defects in material and workmanship.
The Successful Tenderer shall warrant for satisfactory performance of the system for a period of 12 months from the date of commissioning of system. The Successful Tenderer shall replace/repair within seven days of receiving the notice at his own cost any defective parts in the equipment of his own manufacture or those of his sub-vendor's, under normal use and arising from faulty design, material and/or workmanship.

In the event of an emergency where in the judgment of the owner, delay would cause serious damage, repairs or replacement may be made by the owner or a third party chosen by the Owner without advance notice to the Successful Tenderer and the cost of such work shall be paid by the Successful Tenderer. In the event the Owner takes such action, the Successful tenderer shall be notified promptly and he shall assist in making the necessary corrections.

The Successful Tenderer shall guarantee various performance parameters as specified in various chapters of this document.

### 03.06 BATTERY LIMIT

The Tenderer is to collect decanted water from the DN 300 pipes of ash pond area as shown in the enclosed layout drawing, laying pipes from the same upto the proposed water sump, pumping system as mentioned in relevant chapters of this TS, pumping of the water from proposed water sump to the existing ash water pump house inside the plant.
04.00 TECHNICAL SPECIFICATION AND DESCRIPTION OF WORK

Tenderer shall prepare layout for the proposed plant based on available space and shall design, supply, erect, commission and establish guaranteed performance parameters of the proposed Plant. Please refer the scheme drawing no. MEC/11/40/Q7GR/TS/AWRS/ 0002, R 0.

The following system shall be provided as per following details as covered in this specification:

a) Extension of piping system from existing DN 300 pipes upto proposed decanted water sump with DN 450 collection header.

b) Providing isolation valve on DN 450 collection header with a bypass arrangement to divert the flow to spillway in case of maintenance of recirculation system (Refer scheme drawing enclosed with this TS).

c) Construction of RCC water sump (for storage of decanted water from ash dyke), pumping system, piping along with valves, fittings etc.

d) Proposed water sump shall have capacity of minimum 2640 m³.

e) Pump details (minimum requirement) to be provided at pump house:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Pump Capacity (m³/hr)</th>
<th>Head (mWC)</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decanted water Recirculation pumps</td>
<td>330</td>
<td>To be decided by Tenderer during DE</td>
<td>3 Nos. (2W+1S)</td>
</tr>
<tr>
<td>2</td>
<td>Slurry pumps</td>
<td>10</td>
<td></td>
<td>2 Nos. (1W+1S)</td>
</tr>
</tbody>
</table>

f) Electrical details as per the specifications mentioned in relevant chapters.

g) Carbon steel pipe (DN 65) shall be laid from the pump house to existing ash pond to transfer the settled ash slurry in the sump. Tenderer shall use the slurry pumps to dewater the sump and to transfer the settled slurry into ash pond. Necessary isolation valves and valves on branch pipes shall also be provided.
h) The pipe shall be extended 100 meters inside the ash pond.

i) Carrying out the survey work for the pipe route suggested in the layout drawing and finalizing the head of pump, levels, route, type of supports etc.

j) Manual hoist of capacity of 2 Tonnes for handling of equipments in pump house.

k) Necessary instrumentation work.

l) Piping inside the pump house shall be of carbon steel and the same shall be extended from the pump house towards ash dyke (Refer layout drawing battery limit A-A).

m) Pipe from ash dyke (A-A) to the existing structural trestle near water canal shall be DI pipes (DN 400) and same shall be laid underground (Refer layout drawing battery limit B-B).

n) From the existing structural trestle near water canal, pipes shall be of carbon steel and for the same new structural trestles to be planned & provided along the existing trestle (Refer layout drg battery limit C-C). Structural trestle shall be dedicated for these pipes and the columns of proposed trestle shall be designed in staggered manner so as to avoid existing structural column.

o) The pipes (Carbon steel) shall be laid on RCC pedestal after the structural trestle, following the same route along the existing pipelines. Necessary dismantling/modification work for laying pipes is in the scope of tenderer.

p) Tenderer shall provide section isolation valves (Gate valve) along with valve pits on the DN 400 pipe header at every 800 m for maintenance and isolation purpose. Suitable drain valve shall be provided inside the valve pit.

q) Pipe marker shall be provided at every 200m for underground piping.

n) Load of future pipe shall also be considered while designing the structures for piping. The supply and erection of this future provision is not in the scope of tenderer.
Water sump (for collection of decanted water)
Sump shall be provided to collect the decanted water from ash water pond. DN 450 CS pipes shall be connected from the existing overflow pipes in ash water pond and the same shall be connected to the sump. Sump shall be constructed on ground.

Capacity of proposed water sump shall be minimum 2640 m³. The decanted water shall be discharged into a common distribution channel which will be connected to the two compartments of the sump through sluice gates. While cleaning of one of the compartment, the other shall be isolated with the help of sluice gate.

Suction of the decanted water recirculation pumps shall be taken from these two compartments through a common suction header.

The sump shall be open type and all around structural walkway with handrails shall be provided. Necessary rungs shall be provided in both the compartments for maintenance works.

Pump House
RCC above ground pump house shall be provided to accommodate decanted water recirculation pumps, slurry pump, manual hoist, cable trenches, valves, instruments, pipe headers etc. Pump house shall be provided in such a way that there shall be clear space for walkway and maintenance. The clear distance of pumps from wall shall be minimum 02 meters. Space between two equipments (outer part) shall be minimum 01 meter. All equipments and instruments shall have safe and proper approach. Manual hoist shall be provided in such a way that the lifting hook shall be approachable to all equipments installed inside the pump house e.g. pumps, motors, valves etc.

Other guidelines for designing of the pump house shall be as per the relevant clause of this TS.

04.01 TECHNICAL SPECIFICATION OF MECHANICAL EQUIPMENTS

04.01.01 DESIGN CRITERIA FOR PUMP HOUSE

The layout of the various equipment inside the pump house shall be designed keeping in view the safety of the personnel, accessibility of equipment and
space for maintenance.

The sump/suction chamber shall be designed as per the standard of Hydraulic Institute. Cast iron sluice gates shall be provided for isolation of the compartments. The suction chambers / sump shall be provided with drain and overflow connections leading to the nearest storm water drain.

The pump house shall be provided with necessary illumination facilities along with portable lamps.

The pump house shall be provided with adequate drainage facilities with necessary side slope, channels, etc. leading to drainage sump of suitable capacity.

The pump house sump shall be provided with low level alarm and the pumps shall be provided with dry running protection.

Common suction header shall be provided for the decanted water recirculation pumps. The delivery line of each pump shall be connected to the main header. The delivery header shall be of size DN 400. The velocity at suction and delivery line of pumps shall be within 1.0 – 2.0 m/s.

Each pump shall be provided with a Gate Valve on the suction side and a non-return valve and Gate Valve on the delivery side.

In case of slurry pumps knife edge gate valve shall be provided in delivery. Each pump shall be provided with local indication of pressure on suction side and local indication and signaling of pressure on delivery side.

In case of drainage pumps and other special type of vertical pumps, the pumps shall include the electric motor suitable or vertical mounting, motor stool, base plate with accessories and fixing bolts, flexible coupling, shaft enclosing pipe column assembly, bearings, lubrication gaskets and washers pressure gauges, strainer at suction side etc. the characteristics of the prime mover shall be same as described under the main pumps.

Dismantling / Rubber Expansion joints near the pumps on both suction and delivery lines and compensators on the main header shall be provided wherever necessary.

**Pump House Operation Philosophy**

The following interlocks shall be provided, as applicable, in the operation of all the pumps, such that for the starting of any of the pumps:

- The level of the liquid in the pump house basin is higher than the low level,
All the pumps shall be tripped when the low-low level is reached.

Wherever gravity drainage of premises is not feasible, suitable drainage pit shall be provided for collection of drain and stray effluents. Minimum two submersible drainage pumps of adequate capacity shall be provided in the drainage pit for automatic operation based on the drainage pit water level. The level control equipment for automatic operation shall consist of the following:

- level indication,
- low level to stop the pump(s),
- high level to start the first pump,
- high-high level to start the second pump,
- High-high-high level for alarm annunciation.

04.02 DESIGN CRITERIA FOR PIPE WORK

The term pipe work referred herein generally cover pipes, fittings (such as bends, tees, reducers, plugs, nipples, sockets, unions, flanges, crosses etc.), valves of various types and functions (such as gate, butterfly, ball check, electrically operated, etc.) pipe supports, corrosion protection etc.

Pipe work is intended to convey fluids such as different qualities of water and industrial effluents.

The pipe work shall be designed, manufactured, assembled and tested as per the latest standards, codes and recommendations of the Bureau of Indian Standards, ANSI, ASTM, AWWA, or other equivalent international standards. Pipe work shall be complete in all respects including all accessories essential for proper installation, operation and maintenance, even though such items are not specifically mentioned in the specification.

Piping system shall be designed with high degree of reliability so that the systems perform the duty of fluid handling without any failure under all conditions of plant operation.

Piping layout must follow good engineering practice. Proper attention shall be given to obtain full functional requirement of the piping system with a layout which provides sufficient clearance for other equipment and operating personnel, easy access for operation and maintenance, convenient supporting points and neat appearance.

The design shall take into account the effect of internal / external pressure, thermal expansion, self-weight of piping, support reactions, surge and water hammer, earthquake and wind effects at site, corrosion and erosion etc. and any other effects dictated by good engineering practices.
Inside the plant after the trestle, pipelines shall be laid on-ground on the RCC pedestals. The pipes shall follow the similar supporting arrangement and routing as per the existing pipelines. Refer enclosed lay out drawing for further clarity.

The entire pipe network shall be provided with manually operated valves for isolation purpose. Valves for size 250 mm and above shall be gear operated.

The pipe network shall be provided with air release valves at high points and drain valves at the lower points.

Compensators shall be provided on the over-ground pipe network to take care of thermal expansion/contraction. Compensators shall conform to relevant IS/International standard.

Wherever pipelines are crossing roads and railway tracks, they shall be laid below rail/road for traffic movement. Valves provided on the over-ground pipe network shall be provided with civil platforms and access ladders.

Provision shall be made for support of piping which may be disconnected during maintenance work. All large pipes and all long pipes shall have at least two supports each arranged in such a way that any length of piping or valve may be removed without any additional supports being required.

Pipe supports shall be capable of supporting the pipelines under all conditions of operation.

All the buried pipelines shall be laid with a nominal slope towards the drain point.

All the buried pipelines shall be laid as far as possible at a depth of about 1200 mm, below finished ground level (i.e. the top of the pipelines shall be 1.2 m below the finished ground level).

Isolation /control valves drain valves, air release valve provided on the buried pipe network shall be housed in suitably sized covered valve pit and the valve pits shall be of self-draining type. Air release valves shall be provided at the highest points of each sector of the pipeline and drainage valves shall be provided at the lowest points of each sector of the pipeline.

Wherever the buried pipelines are crossing the roads and tracks, they shall be suitably encased with mild steel pipes or reinforced concrete casing pipes and the different sizes of the encasing pipes shall be as appended:
<table>
<thead>
<tr>
<th>Encase pipe diameter (mm)</th>
<th>Encasing pipe (For Flanged pipe) size (mm)</th>
<th>Encasing pipe (for welded pipe) size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 100</td>
<td>300</td>
<td>250</td>
</tr>
<tr>
<td>150</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>200</td>
<td>500</td>
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<td>900</td>
<td>1200</td>
<td>1100</td>
</tr>
<tr>
<td>1000</td>
<td>1400</td>
<td>1200</td>
</tr>
</tbody>
</table>

Mechanical cleaning and anticorrosive protection of underground MS pipelines shall conform to IS: 10221 – 1982. The anticorrosive protection of pipelines shall consist of the following activities in sequence.

i) Application of one coat of coal tar primer

ii) Application of one coat of coal tar enamel

iii) One wrap of fiber glass tissue

iv) Application of one coat of coal tar enamel

v) One layer of fiberglass tissue impregnated in coal tar enamel.

vi) Application of the final coat of a water-resistant white wash.

Alternatively Coal tar based anticorrosion tape as per IS: 15337 – 2003 shall be provided for protection of underground mild steel pipelines. The thickness of tapes shall be 3 mm upto pipe diameter DN 300 mm and 4 mm above pipe diameter of DN 300 mm.

**LAYING BURIED PIPELINES**

All buried pipelines shall be laid with earth cover sufficient to avoid damage from pressure of vibration caused by the surface traffic. Minimum earth covering over the pipe shall be 1200 mm from the finished ground levels. For laying of buried pipelines earth work in excavation, back filling and acceptance of trenches etc. shall be as per IS: 5822-1994 and IS: 3114-1994 and IS: 12288-1987.
The trench shall be so dug that the pipeline can be laid to the required alignment and at the required depth; proper leveling of the excavated surfaces is an essential requirement.

In case stones, boulders etc. are found at the bottom of the trench which cannot be removed completely, the bottom shall be leveled by sand layer for a minimum thickness of 150 mm.

If the depth of excavation is more, proper protection for sidewalls shall be provided till the pipe leveling is completed.

The entire pipe trenches bottom shall be covered with local sand bed of 50 mm thick layer.

After laying the pipelines, 150 mm thick layer of local sand shall be provided over the sand bed. Precautions shall be taken at all the times to prevent damage to the coating and wrapping in the pipe lines and appurtenances as applicable by workmen or trespassers during laying or at any other time. Pipe handling slung and any blocking used in handling or storing the pipes must be well padded to avoid damage to pipe and its coating.

After laying a pipeline on skids it shall be thoroughly cleaned, inspected and for any damage to the protective coating, satisfactory repair work shall be performed while the pipe is suspended above the trench.

After the pipes are erected and tested, the back filling of the trenches shall be done with loose soil free from stones, bricks and metallic pieces, in layers and shall be well rammed and compacted.

Manholes of adequate size shall be provided at all pipe junctions.

Where the pipelines cannot be laid overhead on stockades and are crossing roads and tracks at too many points in a given area, the pipeline may be laid in walk-able tunnels.

Pipelines in tunnels shall be provided with isolating valves, air release valves and drain valves, which are easily accessible for operation and maintenance. Gland type of Compensators shall be provided on these pipelines wherever necessary.

### Spacing of Pipes in Tunnels, Trenches & Trestles

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Nominal dia (mm)</th>
<th>Spacing (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>150</td>
</tr>
</tbody>
</table>

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The typical cross-section of tunnel/trench showing pipe arrangement is as indicated below:

Wherever pipelines are crossing culverts or any other structure necessary modification in that existing structure shall be carried out by Tenderer.

**PIPE SPECIFICATION**

**Pipe Specification (Carbon Steel)**
<table>
<thead>
<tr>
<th>Type</th>
<th>Dia. (mm)</th>
<th>Standard</th>
<th>Material</th>
<th>Thickness</th>
<th>Manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black pipe</td>
<td>15-50</td>
<td>B36.10</td>
<td>A106</td>
<td>Sch 80</td>
<td>Seamless</td>
</tr>
<tr>
<td>Black pipe</td>
<td>65-150</td>
<td>IS1239:2004</td>
<td>Fe410</td>
<td>Heavy class</td>
<td>ERW</td>
</tr>
<tr>
<td>Black pipe</td>
<td>200-250</td>
<td>IS3589:2001</td>
<td>Fe410</td>
<td>6.35mm</td>
<td>ERW</td>
</tr>
<tr>
<td>Black pipe</td>
<td>300-350</td>
<td>IS3589:2001</td>
<td>Fe410</td>
<td>7.14mm</td>
<td>ERW</td>
</tr>
<tr>
<td>Black pipe</td>
<td>400-450</td>
<td>IS3589:2001</td>
<td>Fe410</td>
<td>7.14mm</td>
<td>ERW.</td>
</tr>
<tr>
<td>SW</td>
<td>500-1000</td>
<td>IS3589:2001</td>
<td>Fe410</td>
<td>7.92mm</td>
<td>Spiral Welded.</td>
</tr>
<tr>
<td>SW</td>
<td>1000-1200</td>
<td>IS3589:2001</td>
<td>Fe410</td>
<td>8.74mm</td>
<td>Spiral Welded.</td>
</tr>
</tbody>
</table>

**CS Fittings (Class 3000)**

<table>
<thead>
<tr>
<th>Applicable standards.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe butt welded fittings</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Forged fittings: -</td>
</tr>
<tr>
<td>(Socket / Screwed fittings)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mitre Bend: -</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS OF CENFUGALLY CAST CEMENT MORTAR LINED DUCTILE IRON (SPUN) PIPES (As per IS 8329:2000, amended up to date)**

1. **GENERAL**

The Ductile Iron Pipes to be supplied and erected shall be with BIS marking conforming to IS 8329:2000. The CMDI Centrifugally Cast (SPUN) Pressure Pipes for water application shall be with socket, spigot ends and Tyton joints conforming to IS 8329:2000 in standard working lengths of 5.5 & 6m for classification K-9 as per details given below. It shall be suitable for Push on-Joint (Rubber Gasket Jointing) with cement mortar lining inside the pipes as per Annexure-“B” of IS 8329:2000 and Zinc rich paint with finishing layer of Bituminous on external surface as per Annexure-“A” of IS 8329:2000. The pipe shall be supplied with ISI marked EPDM quality Rubber Gaskets (5% in excess of the requirement for jointing of pipes). The tenderer shall source all Ductile Iron pipes from manufacturers having experience of supplying for at least five years in Indian projects and whose Ductile Iron Pipes are in satisfactory performance for at least three years in Indian projects for which documentary evidence will have to be submitted from Govt. Authority not below the rank of the Executive Engineer. For a new manufacturer / a manufacturer not meeting the criteria set-out in the preceding sentence, in such a case the criteria then will have to be fulfilled by any one of its Group Company and/or its technology provider, otherwise disqualification will follow. Ductile Iron pipes and fittings will be sourced from the same manufacturer. If Ductile Iron pipes and fittings are not sourced from the same manufacturer,
necessary Leak Tightness Type Tests Certificate as per clause no. 7.2 of EN 545:2010 € will have to be submitted in addition to provisions of clause 11.2 mentioned below.

2. **REFERENCE**

The Indian Standards listed at 16 shall be referred along with IS 8329:2000.

3. **MATERIAL**

3.1 The material used for manufacturing the pipes shall be of good quality, commensurate with the mechanical requirements laid down in clause 10 of IS 8329:2000. It shall be centrifugally cast (spun) pipes and be heat-treated in order to achieve the necessary mechanical properties to relieve casting stresses caused due to the method of manufacture and repair work.

The pipes shall be stripped with all precautions to avoid warping or shrinkage defects, detrimental to their good quality. The pipes shall be sound and free from surface or other defects.

3.2 If necessary the pipes may be subjected to reheat treatment to ensure that Brinell hardness does not exceed the specified value and the other mechanical properties specified in the standard are achieved.

4. **CLASSIFICATION**

The D.I pipes to be supplied and erected shall be of class 'K-9'. The Critical dimensions for socket and spigot of pipes for push-on flexible joints for class K-9 shall be as per table-2 of IS 8329:2000.

5. **LENGTH**

The standard working length of socket and spigot pipes shall be 5.5m and 6m.

6. **WALL THICKNESS**

The nominal wall thickness of pipes shall be as per table 2 or be calculated as a function of the nominal size (DN) as per clause 4.3 of IS 8329:2000.

7. **TOLERANCES**

7.1 **Diameter:**

7.1.1 **External diameter:**

The value of external diameter (DE) of the spigot end of socket & spigot pipes and when measured circumferentially shall confirm to the requirement as per...
clause 12 of IS 8329:2000. The positive tolerance is +1mm and applies to all sizes for thickness class K-9. Whereas the negative tolerance of the external diameter depends on the design of each type of joint shall be limited as per table - 7 of IS 8329:2000.

7.1.2 For requirement of interchange ability all pipes should be within the tolerance specified. Push-on flexible joints may need closer tolerance for its effective performance.

7.1.3 In addition, the ovality of the spigot end of pipes shall (i) remain within the tolerances on DE for DN 100 to 200. (ii) Not exceed 1 percent for DN 250 to 600.

7.2 Tolerance on ovality:

7.2.1 Pipes shall be as far as possible circular internally and externally. The tolerance for out-of-roundness of the socket and spigot ends in the jointing zone for push-on-joints is as per table -8 and for mechanical joints as per table-9 of IS 8329:2000.

7.3 Tolerance on Thickness:

The tolerance on the wall thickness and the flange thickness of the pipes shall be as per clause 15.4 of IS: 8329-2000.

7.4 Tolerance on length:

The tolerance on length of pipes shall be as below:

<table>
<thead>
<tr>
<th>Type of Castings</th>
<th>Tolerance (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socket &amp; Spigot</td>
<td>± 100</td>
</tr>
</tbody>
</table>

8. JOINTS

Push-on-joints shall be as per clause 6.1 of IS 8329:2000.

9. RUBBER GASKET

Rubber gasket used with push-on-joints shall conform to IS: 5382:1985 and amended up to date. Other requirements of gaskets are as per clause-8 of IS 8329:2000. Rubber Gaskets to be ISI marked EPDM quality.

10. SAMPLING

Sampling criteria for various tests, unless specified in IS 8329:2000, shall be as laid down in IS: 11606:1986 and amended up to date.
11. TESTS

11.1 All tests prescribed in IS 8329:2000 shall have to be carried out.

NOTE: Hydrostatic test shall be witnessed on all samples drawn notwithstanding 100% Hydrostatic tests by manufacturer. The 0.2% proof stress shall be measured and shall not be less than 300 Mpa.

11.2 Joint Leak Tightness Test –

allowable site test pressure (STP) as per Table -1 of Annexure – E of IS: 8329:2000. The efficacy of joint design shall be proved by suitable Type Tests (Proof of Design test which is done once) and test results, certified by a Govt. recognized institution/inspection agency and the same are to be submitted with the Technical Bid.

11.3 Cement Lining Smoothness Type Test –

The pipe supplied shall be ensured meeting the desired hydraulic smoothness of Cement Mortar Lining. “C” value type test certificate (Proof of Design Test which is done once) showing the minimum Hazen Williams’s “C” value of 140, corroborating the guideline of CPHEEO’s manual Water Supply and Treatment (Table 6.1 page 108) shall be submitted. The “C” value type test result certified by a Government recognized institution/inspection agency shall be submitted with Technical Bid. The test sample diameters shall be chosen as per clause 9.2 of IS: 8329:2000.

11.4 Potability Test –

It shall be ensured that the paints used inside the socket and the part of spigot engaged in the joint assembly, cement mortar lining and rubber gasket which come in contact with the water, will not have any detrimental effect on the quality of water and should not impart any bad taste or foul odor as per Clause no. 8.5 and 14 of IS: 8329: 2000. Necessary Test Certificate from a government recognized institution/inspection agency is to be submitted with the Technical Bid.

12. The CMDI pipe shall be provided with external protection of zinc rich paint with finishing layer of bituminous paint as per Annexure ‘A’ of IS 8329:2000 (clause 16.2).

13. INTERNAL LINING

The pipes shall be provided with cement mortar internal lining as per clause 16.3/ Annexure ‘B’ of IS 8329:2000.
14. MARKING

14.1 BIS Certification Marking:

The Pipes shall be marked with the Indian Standard Mark.

14.2 Each Pipe shall have as cast or stamped on legibly and indelible painted. The marking shall show the following:-

(i) The Manufacturer's name or trademark on each pipe.

(ii) The nominal diameter of pipes.

(iii) Batch Number.


(v) ISI certification mark on each pipe.

(vi) Purchaser's name on each pipe.

(vii) Any important information that the manufacturer deems fit to be inscribed on pipe.

(viii) Year of purchase.

NOTE: Wherever there is reference of IS No. it shall be considered amended up to date at the time of inspection of supply / replacement by inspection agency.

15 All above Pipes to be supplied, delivered and stacked properly either on wooden blocks or rubber pads or other means so that external coating on pipes shall not be deteriorated/damaged.

16 List of referred Indian Standard (to the extent applicable)

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>IS no.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>455:1989</td>
<td>Portland Slag Cement (Forth revision)</td>
</tr>
<tr>
<td>2.</td>
<td>638:1979</td>
<td>Sheet Rubber Jointing and rubber insertion jointing (Second revision)</td>
</tr>
<tr>
<td>4.</td>
<td>1500:1983</td>
<td>Methods for Brinell hardness test for metallic materials (second revision)</td>
</tr>
</tbody>
</table>
5. 1608:1995 Mechanical testing of metals-Tensile testing (second revision)
6. 5382:1985 Rubber sealing ring for gas mains, water mains and sewers (first revision)
7. 6452:1989 Specification for high alumina cement for structural use
8. 6909:1990 Specification for super sulphated cement
9. 8112:1989 43 grade ordinary Portland cement
10. 9523:2000 Ductile iron fittings for pressure pipes for water, gas & sewage.
12. 12330:1988 Sulphate resisting Portland Cement
13. 13382:1992 Cast iron specials for mechanical and push-on-flexible joints for pressure pipelines for water, gas and sewage

**TABLE FOR MAXIMUM SPAN OF SUPPORTS**

<table>
<thead>
<tr>
<th>Nominal pipe size (mm)</th>
<th>Maximum span for liquid services (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>2.1</td>
</tr>
<tr>
<td>40</td>
<td>2.7</td>
</tr>
<tr>
<td>50</td>
<td>3.0</td>
</tr>
<tr>
<td>65</td>
<td>3.4</td>
</tr>
<tr>
<td>80</td>
<td>4.0</td>
</tr>
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<td>100</td>
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<tr>
<td>600</td>
<td>9.8</td>
</tr>
<tr>
<td>900</td>
<td>12.0</td>
</tr>
</tbody>
</table>
Note: Vertical pipe work shall be clamped at intervals of 3.5m (approx.) and at the base of each riser. Maximum span at the place of turning shall be 0.7 times of normal span.

Dimensional Performance and End Finishes

Tolerance on outside diameter of the pipe and specified thickness shall conform to the limits laid down in IS: 3589-2001. Finish pipe shall not deviate from straightness by more than 0.2% of the total length.

Pipes to be butt-welded shall be supplied with ends beveled to an angle of 30 degrees (+ 5 degree – 0 degree) measured from a line drawn perpendicular to the axis of the pipe. The root face shall be 1.6 ± 0.8 mm.

Method of Quality Control in Welded Joints

Following steps shall be taken by the Tenderer, besides controlling quality in general, to make effective control in carrying out welded joints.

a) Welding procedures shall be prepared in line with IS: 7307 (Part – I) – 1974, reaffirmed in 1991 and tests shall be carried out to quality procedures. Number of procedures will depend on variables like positions of welding, thickness range etc. Once a welding procedure is qualified, strict adherence to it shall be made during actual welding.

b) Welders employed shall be qualified as per IS: 7310 (Part – I) – 1974, reaffirmed in 1987 after passing necessary tests.

c) Welding consumables shall be of approved type. Such consumables are, however, subject to qualifying initial check tests as per IS: 814-1991.

d) The Tenderer shall strictly follow approved welding procedures during actual welding. Besides, the following stages of inspection shall also be carried out:

i) Weld edge preparation before welding, proper fit up, position of welding, cleaning of slag between the passes, proper weld profile etc., shall be checked visually amongst others.

ii) Non-destructive tests of weld of welded joints shall be carried out as per approved procedures/ drawings.

Preparation of Joints
The Tenderer shall prepare the edge correctly to the shape, size and dimensions of the vee-grooves as per ANSI B-16.25 unless otherwise specified in drawings/documents.

The welding surfaces shall be smooth, uniform and free from fins, tears, notches or any other defect which may adversely affect welding and shall be free from loose scale, slag, rust, grease, paint, moisture or any other foreign material. The clean surface shall extend to about 10 mm beyond the welding faces to avoid contamination of the weld metal with foreign material and to avoid unsound weld deposit.

**Assembly, Alignment & Welding**

The sequence of welding shall be so planned and followed that there shall be a balance of welding about the neutral axis of the fabrication. The Tenderer shall employ sufficient number of welders working at the same time in diagonal quadrants of the shell using back-step method of welding. The rate of progress of each welder shall be more or less equal and quality uniform.

The general direction of welding shall be towards the free end of the joint, but in a long joint as in shell fabrication, back-step technique shall be used to reduce distortion.

To minimize internal locked up stresses due to welding, the vertical joints for the shell shall be welded and completed to a circular course and then the horizontal circumferential seam welded. However, before the welding of horizontal seam started, the complete circular course shall be aligned and adjusted for their correct axes.

Alternatively, the Tenderer shall complete each course in all respect on ground and then the pre-assembled course shall be listed and placed in position. In such a sequence and planning, the same principle of balancing of weld about the neutral axis shall be followed and the method of fabrication of each course shall be similar to fabrication of penstock pipes of transmission/industrial pipelines of bigger diameter.

Pipe and attachment shall be aligned properly by accurate and permanent methods prior to welding. If tack welds are used, the tack shall be either fused into the first layer or weld or else chipped out.

**Tests on welded joints**

(a) Visual examination

The Tenderer shall conduct visual examination and measurement of external
dimensions of the weld for all joints. Before examining the welded joints, areas close to it on both sides of the weld for a width not less that 20 mm shall be cleared of slag and other impurities. Examination shall be done by magnifying glass which has a magnification power of ten (10) and measuring instrument which has an accuracy of ± 0.1 mm of by weld gauges. Welded joints shall be examined from both sides. The Tenderer shall examine the following during the Visual examination: -

i) Check the correctness of shape and size of the welded joints.

ii) Incomplete penetration of weld metal.

iii) Influx

iv) Burns

v) Under cuts

vi) Un-welded crates

vii) Cracks in welded spots and heat affected zones.

viii) Porosity in welds and spot welds.

ix) Compression in welded joints as a result of electrode impact while carrying out contact welding.

x) Displacement of welded element.

The Tenderer shall carryout any or all tests as specified hereinafter to satisfy the Purchaser about the acceptability of the welded joints, as directed by the Purchaser.

(b) Liquid Dye-penetrant Test

Liquid dye-penetrant tests shall be carried out in accordance with IS: 3658-1981, reaffirmed in 1991 for surface/ sub-surface defects.

(c) Test by Blowing

The surface of the weld shall be covered with soap solution consisting of one (1) litre of water and hundred (100) grams of soap. Compressed air shall be blown from the opposite side at pressure of 4 to 5 kg/cm². The distance between the tip of base and the weld shall not be more than 50 mm. Any formation of soap bubble will indicate welding defects. Portable compressor shall be arranged by the Tenderer, if necessary, for this purpose.
Tolerance

Deviations for assembly of welded joints may be permitted to the following extent:

<table>
<thead>
<tr>
<th>Source butt-Joints</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Gap between the ends of plates</td>
<td>Manual arc</td>
<td>Automatic</td>
</tr>
<tr>
<td></td>
<td>+ 2.00 mm-1.00 mm</td>
<td>± 1.00 mm</td>
</tr>
<tr>
<td>ii) Stepping of one plate over the other</td>
<td>1.00 mm</td>
<td>2.00 mm</td>
</tr>
<tr>
<td>Single Vee-groove Joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Bevel angle</td>
<td>Manual arc</td>
<td>Automatic</td>
</tr>
<tr>
<td></td>
<td>± 5 deg.</td>
<td>± 5 deg.</td>
</tr>
<tr>
<td>ii) Gap between two plates</td>
<td>Manual arc</td>
<td>Automatic</td>
</tr>
<tr>
<td></td>
<td>+ 2.00 mm-1.00 mm</td>
<td>+ 1.00 mm</td>
</tr>
<tr>
<td>iii) Stepping of one plate over the other</td>
<td>2.00 mm</td>
<td>2.00 mm</td>
</tr>
<tr>
<td>Lap Joint</td>
<td></td>
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<tr>
<td>i) Overlap</td>
<td>Manual arc</td>
<td>Automatic</td>
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<tr>
<td></td>
<td>5.00 mm</td>
<td>5.00 mm</td>
</tr>
<tr>
<td>ii) Gap between the surface</td>
<td>Manual arc</td>
<td>Automatic</td>
</tr>
<tr>
<td></td>
<td>2.00 mm</td>
<td>1.00 mm</td>
</tr>
<tr>
<td>Tee-filler Joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Gap between the edges of the web and the surface of the flange</td>
<td>Manual arc</td>
<td>Automatic</td>
</tr>
<tr>
<td></td>
<td>2.00 mm</td>
<td>2.00 mm</td>
</tr>
</tbody>
</table>

04.03 HORIZONTAL & VERTICAL CENTRIFUGAL PUMPS

Decanted water recirculation pumps shall be horizontal centrifugal type with flooded suction.

Drainage pumps installed in sump pits shall be horizontal, centrifugal type with priming tank arrangement. In the event of space constraints, the use of vertical centrifugal, non-clog submersible pumps may be permitted. As far as practicable, pumps of reputed indigenous makes shall be preferred. Pump
type shall be HSC type only.

The horizontal pumps shall be mounted on a common base plate with the motor and shall be directly coupled to the motor through a flexible coupling without any gear reducer. In case of slurry pumps use of fluid coupling may be permitted.

Slurry pumps shall be horizontal belt driven pumps. Material of wear parts shall be as per IS: 4771, type – 3, 500 BHN.

The pumps (horizontal as well as vertical centrifugal) will be designed, manufactured and tested as per IS: 1520-1980, IS: 5120-1977 R.A.1991, IS: 9137-1978 R.A.1993 or as per international standards acceptable to the Purchaser and will be suitable for the required duty conditions and capacities.

The pumps and their auxiliary equipment shall be suitable for the required duty conditions and shall be designed and constructed for continuous duty at full load.

The centrifugal pumps shall be suitable for a capacity range of 25% to 125% of duty point capacity.

The motor capacity shall have a margin over its BHP absorbed at the pump shaft at duty point and the margin shall be 25% for motors of rating upto 15 kW, 20% for motors of rating 18.5 kW to 160 kW and 15% for motors of rating 200kW and above. The above margin shall be in addition to temperature de-rating.

The equipment and auxiliaries shall be designed for quick and economical maintenance. The equipment shall be easily dismantable without disturbing the suction and delivery pipe connections.

The equipment design shall incorporate provisions for reduction in noise level.

The rotating elements of the pumps shall be checked for critical speed in bending as well as in torsion. The critical speeds shall be at least 30% away from the normal speeds for units with flexible shafts and at least 20% away from the maximum operating speed in case of stiff shafts.

All passages inside the pump casing and impellers, which may be inaccessible to machining, shall be ground to a smooth finish as far as practicable.

The direction of rotation shall be clearly marked either by incorporating it on the casing or by separate metal plate arrow securely fitted to the casing.
The head – Vs – discharge characteristics of the pump shall be continuously rising from the duty point to the shut off point without any zone of instability. The required duty range for a pump shall be on the stable portion of its head capacity curve close to the best efficiency point. The head developed at the best efficiency point shall be close to the required differential pressure so that throttling is not required at pump discharge. The power-Vs- discharge characteristics shall be non-overloading type.

The pump shall be so selected and installed that the available NPSH is not lower than the required NPSH even in the most adverse operating conditions.

The pump shall be of proven make and design having material of construction which is the best of its kind for the particular application and shall be manufactured using best engineering practices under strict quality control. Each pump shall be tested as per the standards stipulated elsewhere in this document. The test shall include hydrostatic test, static and dynamic balancing tests, performance tests material tests and motor routine tests.

The pump shaft and bearing shall be adequately sized to take the unbalanced forced due to mal-operation. The pump gland shall ensure proper sealing without excessive tightening of the packing. Proper cooling and flushing arrangement for the gland shall be provided wherever required.

All moving parts of the pump shall be adequately guarded to prevent any injury to operating personnel.

Pumps shall be designed and installed keeping in view the easy accessibility of its parts for maintenance. All end suction pumps shall be of back-pull-out design and shall be provided with spacer coupling of adequate length.

Mechanical seals shall be provided at all pumps envisaged for closed loop circuit.

Minimum no. of standby pump shall be provided for each group of pumps and drainage pumps as specified in the design criteria for pump house. The group of Pumps for scale water or other abrasive slurries shall be provided with at least two standby units. Special abrasion resistant material shall be used for these pumps and the design shall allow easy replacement of parts subject to wear and tear.

An isolating valve shall be provided on the suction line of each pump and another isolating valve together with a non-return valve shall be provided.
at the delivery line of each pump. Pressure gauges shall be provided at the suction and delivery flange of each pump.

- The suction pipeline shall be laid at a constant downward slope from pump center line to the suction chamber. Reducers used in the line shall be eccentric type to keep the top of the suction line straight.

- Each pump shall be provided with adequate safety interlocks including overload and dry running protection.

- Dismantling joints shall be provided on the delivery side of large size pumps to facilitate quick maintenance, wherever required.

- All pumps shall be provided with suitable lifting attachments and each pump installation shall have suitable handling facilities.

- A clear minimum gap of 800 mm shall be maintained between the pump and the adjacent piping, other equipment or structures for proper movement. In case the height of the top most part of the pump from the working floor is more than 1.0 m, the minimum clearance shall be increased to 1000 mm.

- The details of pumps should match with the drive motors throughout the working life of these equipments and to meet operational requirement. High-speed motors of 3000 rpm shall not be used, as far as practicable. Working hour meter shall be provided on control panels to monitor conditions and subsequent ageing / reduced efficiency, etc.

- Vibration readings, etc. of new installation shall be supplied.

- Pumps shall be installed and commissioned as per manufacturer's instructions. A continuous running for 72 hours shall be required before final acceptance is given to the pumping installation.

**Shop testing of pumps**

- All materials, casting and forging shall be of tested quality.

- Pump casing shall be of robust construction and hydrostatically tested at 200% of the rated pressure or 150 % shut off pressure, whichever is higher. The test pressure shall be maintained for at least 15 minutes.

- The impellers along with any other unmachined rotating parts shall be tested for proper balancing in order to avoid undue vibration during operation.
● Performance tests shall be carried on each centrifugal pump. Performance test shall be made to determine the following.

a) The discharge against a specified head when running at a specified speed under a specific suction head.
b) The power absorbed by the pump at the shaft (BHP) under the above-specified conditions.
c) Efficiency of the pump under the above specified conditions.
d) Variation of required NPSH with discharge.

● The pump accessories like bearings, couplings etc. shall be subject to shop tests as per manufacturer's standards.

● The materials of construction of various components of all equipment and material covered under the scope of his specification shall be certified by the Tenderer with regard to their compliance to specifications laid down for them under relevant clauses of applicable standards and/or the manufacturing drawings of the Tenderer duly approved by the purchaser. Formal material test certificates to the effect shall be issued by the Tenderer.

● All test results and certificates including material test certificates shall be submitted for approval to the purchaser before dispatch of equipment.

The vertical centrifugal pump sets shall be supplied with flange mounted vertical motors, motor stool, base plate, coupling, column pipe, delivery pipe, suction strainer, companion flanges, gaskets, bolts, nuts, washers, etc.

A stainless steel name plate shall be furnished and securely attached by stainless steel pins at an easily accessible point on the pump. The plate shall be stamped with the following minimum information:

- Name of Manufacturer
- Model No.
- Purchaser's item no. or tag No.
- Serial number of pump
- Capacity in cubic meters per hour
- Pumping head in meters of liquid column
- Specific gravity of liquid pumped
- Revolutions per minute
- Pump input power, kW
- Motor rating, kW
- Design code IS/IPSS:

MATERIAL OF CONSTRUCTION FOR PUMPS

A) HORIZONTAL PUMPS:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>ITEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Casing</td>
<td>CI IS: 210 FG260</td>
</tr>
<tr>
<td>b)</td>
<td>Impeller</td>
<td>CF8M</td>
</tr>
<tr>
<td>c)</td>
<td>Shaft</td>
<td>En8</td>
</tr>
<tr>
<td>d)</td>
<td>Shaft sleeve</td>
<td>SS410</td>
</tr>
<tr>
<td>e)</td>
<td>Wearing rings</td>
<td>CI FG 220</td>
</tr>
<tr>
<td>f)</td>
<td>Shims &amp; packings</td>
<td>Brass IS: 442</td>
</tr>
<tr>
<td>g)</td>
<td>Neck ring</td>
<td>CI FG 260</td>
</tr>
<tr>
<td>h)</td>
<td>Lantern ring</td>
<td>CI FG 220</td>
</tr>
<tr>
<td>i)</td>
<td>Gland</td>
<td>CI FG 220</td>
</tr>
<tr>
<td>j)</td>
<td>Bearing end cover</td>
<td>CI FG 220</td>
</tr>
<tr>
<td>k)</td>
<td>Bearing Housing</td>
<td>CI FG 220</td>
</tr>
<tr>
<td>l)</td>
<td>Coupling Pump &amp; motor</td>
<td>CI FG 260</td>
</tr>
<tr>
<td>m)</td>
<td>‘O’ rings</td>
<td>Nitrile Rubber</td>
</tr>
<tr>
<td>n)</td>
<td>Sleeve nuts</td>
<td>SS 410</td>
</tr>
<tr>
<td>o)</td>
<td>Cowl nuts</td>
<td>SS410</td>
</tr>
<tr>
<td>p)</td>
<td>Base plate</td>
<td>MS Fabricated</td>
</tr>
</tbody>
</table>

B) VERTICAL PUMPS:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>ITEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IMPELLER</td>
<td>CS ASTM A 216, CF 8M</td>
</tr>
<tr>
<td>2</td>
<td>CASING</td>
<td>CAST IRON (IS 210 FG 260)</td>
</tr>
<tr>
<td>3</td>
<td>CASING RING</td>
<td>CAST IRON (IS 210 FG 260)</td>
</tr>
<tr>
<td>4</td>
<td>SHAFT</td>
<td>EN 8</td>
</tr>
<tr>
<td>5</td>
<td>SHAFT SLEEVE</td>
<td>SS – 410</td>
</tr>
<tr>
<td>6</td>
<td>GLAND</td>
<td>CAST IRON</td>
</tr>
<tr>
<td>7</td>
<td>BASE FRAME</td>
<td>M.S FABRICATED</td>
</tr>
<tr>
<td>8</td>
<td>COMPANION FLANGES</td>
<td>M.S</td>
</tr>
<tr>
<td>9</td>
<td>COLUMN PIPE</td>
<td>M.S</td>
</tr>
</tbody>
</table>
C) SLURRY PUMPS:

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<tbody>
<tr>
<td>1</td>
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<td>27% Cr.</td>
</tr>
<tr>
<td>2</td>
<td>CASING</td>
<td>CAST IRON (IS 210 FG 260)</td>
</tr>
<tr>
<td>3</td>
<td>Throat bush</td>
<td>27% Cr.</td>
</tr>
<tr>
<td>4</td>
<td>SHAFT</td>
<td>EN 8</td>
</tr>
<tr>
<td>5</td>
<td>SHAFT SLEEVE</td>
<td>CA 40/C 420</td>
</tr>
<tr>
<td>6</td>
<td>GLAND</td>
<td>SS 316</td>
</tr>
<tr>
<td>7</td>
<td>BASE</td>
<td>CI</td>
</tr>
<tr>
<td>8</td>
<td>COVER PLATE LINER</td>
<td>NATURAL RUBBER</td>
</tr>
<tr>
<td>9</td>
<td>FRAME PLATE LINER</td>
<td>NATURAL RUBBER</td>
</tr>
<tr>
<td>10</td>
<td>FRAME PLATE LINER INSERT</td>
<td>27% Cr.</td>
</tr>
<tr>
<td>11</td>
<td>VOLUTE LINER</td>
<td>27% Cr.</td>
</tr>
<tr>
<td>12</td>
<td>BEARING HOUSING</td>
<td>CAST IRON</td>
</tr>
</tbody>
</table>

VERTICAL TURBINE PUMP

Vertical Turbine Pumps along with their auxiliary equipment shall be suitable for the required duty conditions and shall be designed and manufactured for continuous duty at full load.

The vertical turbine pump shall be designed, manufactured and tested as per IS: 1710 – 1989 (Reaffirmed 1999).

The motor rating shall be maximum of the following requirements:

a) 15% margin over the pump shaft input power at the rated conditions.

b) 5% margin over the maximum pump shaft input power required within its operating range including the shut-off point.

The above margin shall be in addition to temperature de-rating.

Capacity Vs discharge pressure curve for each pump shall preferably be continuously drooping from the shut-off point to the rated operation point and be suitable for parallel operation. The pumps shall be designed to avoid cavitation at any of the operating points. The characteristic of the pump shall be non-over loading type.

The required duty range for a pump shall be on stable portion of its head-capacity curve close to the best efficiency point. The head developed at the best efficiency point shall be close to the required differential pressure so that throttling is not required at pump discharge.
The equipment and auxiliaries shall be designed for quick and economical maintenance.

The equipment design shall incorporate provisions for reduction in noise level.

The rotating elements of the pumps shall be checked for critical speed in bending as well as torsion. The critical speeds shall be at least 30% away from the normal speeds for units with flexible shafts and at least 20% away from the maximum operating speed in case of stiff shafts.

The pumps shall be capable of reverse rotation up to 125% of rated speed due to reverse flow of water.

All passages inside the pump casing and impellers, which may be inaccessible to machining, shall be ground to a smooth finish as far as practicable.

The direction of rotation shall be clearly marked on a separate metal plate arrow securely fitted to the casing.

A stainless steel name plate shall be furnished and securely attached by stainless steel pins at an easily accessible point on the pump. The plate shall be stamped with the following minimum information:-

- Name of Manufacturer
- Model No.
- Purchaser's item no. or tag No.
- Serial number of pump
- Capacity in cubic meters per hour
- Pumping head in meters of liquid column
- Specific gravity of liquid pumped
- Revolutions per minute
- Pump input power, kW
- Motor rating, kW
- Design code IS/IPSS:

**INSPECTION & TESTING**
The tests to be conducted at shop for various sub-assemblies/ assemblies of equipment shall include, but not limited to the following:

I. Material/ identification tests for all the components of the pump

II. NDT as indicated below:

   (a) Impeller Dye Penetration Test (DPT)
   (b) Shaft DPT and Ultrasonic test
   (c) Wearing rings DPT
   (d) Impeller Dynamic balancing
   (e) Pump assembly Visual inspection

III. Hydrostatic test:

   Hydrostatic test shall be done for the following components at a minimum pressure of 200% of shut-off head. The test pressure shall be maintained for at least one hour.

   (a) Bowl
   (b) Suction bell
   (c) Discharge head
   (d) Column pipe

IV. Performance test:

   Performance test shall be conducted on each pump with one of the actual drive motors at the manufacturer’s works in presence of Purchaser’s representative as per the requirements of the relevant test codes.

   Performance tests shall be conducted at rated rpm. to cover the entire range of operation of the pumps. These shall at least cover the range from shut-off point upto 1.3 times the rated capacity of pumps. A minimum of 5 readings shall be taken for capacity Vs Head, covering the above range. After performance test, the pump shall be dismantled for inspection of internal components.

   Mechanical run test shall be carried on all pumps to demonstrate smooth running of the pumps, measurement of noise levels, vibration, etc. This test shall be carried out at site also and the site test shall be taken for acceptance of the pump. The noise level shall not exceed 85 dB at 1.0 m distance from the pump of as per the latest norm whichever is less.
The pumps shall be tested for vibration at the guarantee points. Vibration limit shall be as per Hydraulic Institute Standard/ API 610.

The following tolerances shall apply for the performance tests: -

i) Rated capacity: +2.5% at rated head

ii) Efficiency at rated capacity: No negative tolerance

Test reports and manufacturer’s test certificates shall be submitted to the Purchaser/ Consultant for approval.

The final tests shall be conducted in the presence of the Purchaser’s representative. Test certificates for different tests shall be made available to the Purchaser during the inspection. Material test certificates for bought out items shall be obtained from original manufacturer/ reputed test house. For all bought out items, test certificates as relevant to the items shall be furnished by the Tenderer.

All the pumps shall be subject to stage inspection by the Tenderer’s own inspecting authority. However, Purchaser’s Inspector may visit the works from time to time who should have free access to all the places of the manufacturing premises where any part/ parts are under manufacture.

The Tenderer’s inspecting authority shall have a close surveillance in respect of the quality of job for the design dimensions, tolerances, surface finish, etc.

04.04 DESIGN CRITERIA FOR VALVES:

Flow control /isolating valves, drain valves, air release valves and Compensators, wherever necessary, shall be provided for the complete pipe network including cross-country pipeline.

All valves shall be suitable for service conditions i.e. quality of fluid, flow temperature and pressure under which they are required to operate.

Valves shall be provided on pipe network for isolation of pipe section and equipment, control of pressure and flow, venting, draining etc. They shall be suitable located considering ease of operation and maintenance.

All valves shall be provided with hand wheel and position indictor. The face of each hand wheel shall be clearly marked with words “Open” and “Shut” with arrows adjacent to indicate the direction of rotation.

Valves shall be provided with suitable extension spindle and head stock.
assembly wherever required. In case gears or bevel system are used, these shall be of cast steel or suitable grade cast iron with machine cut teeth.


The body end ports shall be circular. The area of the flow way between the body end ports shall not be less than the area of a circle of which the diameter is the nominal bore size of the valve.

The disk shall be either integral with or separate from the hinge and shall have a flat seating face. Where the disk is separate from the hinge, means shall be provided to prevent the disk, hinge pin and retainers becoming detached in service.

Any parts of the valve which can become detached in service, such as hinge pin and disk, hinge pin plugs, hinge pin stuffing boxes and two-piece disks, shall be locked. Hinge pin design shall ensure accurate alignment of the disk and the valve seat.

Larger size valves shall be provided with by pass and drain arrangement.

Float operated valve shall be preferably be right angled pattern complete with ball float, level and other accessories.

**SPECIFICATIONS FOR VALVES**

A) **SPECIFICATION FOR SLUICE VALVES (GATE VALVES)**

<table>
<thead>
<tr>
<th></th>
<th>Type</th>
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<th></th>
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<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>Rising spindle type sluice valves for water works</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>2</td>
<td>Body / Bonnet</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hand wheel</td>
<td>Carbon steel</td>
<td></td>
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<tr>
<td>4</td>
<td>Wedge</td>
<td>CS ASTM A216 Gr. WCB + 13% Cr. Hard facing</td>
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<td>5</td>
<td>Body seat ring</td>
<td>CS ASTM A515 Gr. 70 + 13% Cr. Hard facing</td>
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<tr>
<td>6</td>
<td>Stem</td>
<td>AISI 410</td>
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</tr>
<tr>
<td>7</td>
<td>Gaskets</td>
<td>Neoprene rubber</td>
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<tr>
<td>8</td>
<td>Gland</td>
<td>AISI 410</td>
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<td>9</td>
<td>Gland Flange</td>
<td>Carbon steel</td>
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### Technical Specification for Ash Water Recirculation System

<table>
<thead>
<tr>
<th>No.</th>
<th>Specification Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Gland Packing</td>
<td>Spiral wound metallic</td>
</tr>
<tr>
<td>12</td>
<td>End connections</td>
<td>Flanged</td>
</tr>
<tr>
<td>13</td>
<td>Pressure rating</td>
<td>PN = 1.6 N/mm²</td>
</tr>
<tr>
<td>14</td>
<td>Manufacturing Standard</td>
<td>API 600/BS 1414</td>
</tr>
<tr>
<td>15</td>
<td>Hydro static testing</td>
<td>Body: 24 kg/cm²&lt;br&gt;Seat: 16 kg/cm²</td>
</tr>
<tr>
<td>16</td>
<td>Test certificates</td>
<td>Required for material/hydro test</td>
</tr>
<tr>
<td>17</td>
<td>Service</td>
<td>Water</td>
</tr>
<tr>
<td>18</td>
<td>Max. operating temp</td>
<td>100 °C</td>
</tr>
<tr>
<td>19</td>
<td>Type of operation</td>
<td>Upto DN250 - Manual&lt;br&gt;Beyond DN350 - Gear operated</td>
</tr>
<tr>
<td>20</td>
<td>Operation</td>
<td>Manual / Pneumatic (As and where specifically mentioned)</td>
</tr>
</tbody>
</table>

### B) Specification for CS Dual Plate Check Valve

<table>
<thead>
<tr>
<th>No.</th>
<th>Specification Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>Dual Plate Zip Check Valve</td>
</tr>
<tr>
<td>2</td>
<td>Body</td>
<td>ASTM A 216 Grade WCB</td>
</tr>
<tr>
<td>3</td>
<td>Plate</td>
<td>ASTM A 351 Gr. CF8 M (SS 316)</td>
</tr>
<tr>
<td>4</td>
<td>Stop Pin</td>
<td>AISI SS 410</td>
</tr>
<tr>
<td>5</td>
<td>Hinge pin</td>
<td>AISI SS 410</td>
</tr>
<tr>
<td>6</td>
<td>Spring</td>
<td>INCONNEL</td>
</tr>
<tr>
<td>7</td>
<td>Retainer</td>
<td>CF8M (SS 316)</td>
</tr>
<tr>
<td>8</td>
<td>Body Bearing</td>
<td>AISI SS 316</td>
</tr>
<tr>
<td>9</td>
<td>Plate Bearing</td>
<td>AISI SS 316</td>
</tr>
<tr>
<td>10</td>
<td>Spring Bearing</td>
<td>AISI SS 316</td>
</tr>
<tr>
<td>11</td>
<td>Eye Bolt</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>12</td>
<td>Body Seal</td>
<td>EPDM</td>
</tr>
<tr>
<td>13</td>
<td>Plate Seal</td>
<td>Integral</td>
</tr>
<tr>
<td>14</td>
<td>Body Test Pressure</td>
<td>450 psi (g)</td>
</tr>
<tr>
<td>15</td>
<td>Seat Test Pressure</td>
<td>320 psi (g) (Max.) / 285 psi (g) (Mini)</td>
</tr>
<tr>
<td>16</td>
<td>Design Standard</td>
<td>API 594</td>
</tr>
</tbody>
</table>
## Technical Specification for Ash Water Recirculation System

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Dimensions</td>
</tr>
<tr>
<td>18</td>
<td>Testing</td>
</tr>
</tbody>
</table>
| 19 | Special features required | 1. Arrow indicating the flow direction.  
2. Embossed name plate giving details of tag No. size, etc. |
| 20 | End Connections | • Wafer type upto DN200mm,  
• Flanged ends for size DN250 and above. |
| 21 | Service | Water |

### C) Specification for Ball Valve / Full Bore / 2 Way / 3 Way

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
</tr>
<tr>
<td>2</td>
<td>Body, Cover &amp; Gland</td>
</tr>
<tr>
<td>3</td>
<td>Ball</td>
</tr>
<tr>
<td>4</td>
<td>Stem</td>
</tr>
<tr>
<td>5</td>
<td>Fasteners</td>
</tr>
<tr>
<td>6</td>
<td>Gland Packing</td>
</tr>
<tr>
<td>7</td>
<td>End connection</td>
</tr>
<tr>
<td>8</td>
<td>Pressure rating</td>
</tr>
<tr>
<td>9</td>
<td>Manufacturing Standard</td>
</tr>
<tr>
<td>10</td>
<td>Test certificates</td>
</tr>
<tr>
<td>11</td>
<td>Service</td>
</tr>
<tr>
<td>12</td>
<td>Max. operating temp</td>
</tr>
<tr>
<td>13</td>
<td>Remarks</td>
</tr>
</tbody>
</table>

### D) Specification for Air Release Valve

Air release valves shall be cast iron, single large orifice type, with flanged ends. Air release valve shall conform to IS: 14845-2000.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
</tr>
<tr>
<td>2</td>
<td>Body</td>
</tr>
<tr>
<td>3</td>
<td>Body seat ring</td>
</tr>
</tbody>
</table>
3 Float Timber core with vulcanite/ rubber coating
4 Disc Gun metal IS:318 LTB-2
5 Stem SS, IS: 6603, 04Cr17
6 Disc nut Gun metal IS:318 LTB-2
7 Bolts/studs, nuts Carbon steel IS:1367
8 Gland CI FG 200 as per IS:210
9 Gland packing Graphite asbestos/ jute/ hemp
10 Air release nipple Gun metal IS:318 LTB-2
11 Gasket Compressed asbestos Fiber 3 mm thick
12 Rubber ball Vulcanite Ebonite
13 End connection Screwed up-to DN40 and flanged for DN50 & above
14 Pressure rating PN 1.6 N/mm²
15 Test pressure Body : 24 kg/cm²
Seat : 16 kg/cm²
Test duration : 30 minutes

E) SPECIFICATION FOR COMPANION FLANGES

1 Type Raised face plate flanges, Slip-on, welded, plate fabricated, machined finish.
2 Dimensional Standard As per IS-6392-1971 (RA'88), PN=1.6 /1.0 N/mm² as per valve rating, Table-17/11, drilled off center, RF.
3 Material C.S as per IS-2062-1992 GR.A.

Note: Valve flanges and matching flanges shall be drilled as per IS:6392-1971 (RA'1988), table 17 for PN 1.6.

All valves shall be supplied with companion flanges, fasteners, gasket, nuts/bolts/ studs, etc.

04.05 DESIGN CRITERIA FOR RUBBER EXPANSION JOINTS:

EQUIPMENT SPECIFICATION

Material specification:

Rubber Expansion Joints shall be made of high grade abrasive resistant natural rubber compound reinforced with adequate numbers of piles of heavy cotton duck, rayon cord, impregnated within rubber compound and further reinforced with square metal ring embedded in it. The outer exposed surface of rubber expansion joints shall be given a coating of synthetic/neoprene rubber and further painted with chlorinated rubber based paint. Rubber expansion joints will be suitable for design temperature of 50 °C and for handling clear water. Rubber expansion joints shall absorb vibration, shock and axial compression of 10 mm, axial elongation of 10 mm and lateral movement of 10 mm.
Control unit:

One set of control unit (stretcher bolt assembly) consisting of 2/3 nos. limit rod (material IS: 3657 Gr. 6.6), Stretcher Bolt, Triangular Plate (material IS: 226), Nuts (material IS: 1363 Gr. 6.0) Steel Washer and Rubber Washer of durometer hardness of 100 deg Centigrade ± 5 deg Centigrade.

The control unit shall be made suitable to make RE joint and no. of limit rod matched against each.

TECHNICAL PARAMETERS OF RUBBER EXPANSION JOINT

1. Test pressure : 18 kg/cm² or as per relevant standards
   Max. Pressure (operating) : 12 kg/cm²
   Design pressure : 16 kg/cm²
   Burst pressure : 4 times design pressure (Guaranteed)

2. Leak test : 18 bar (g), joint shall be kept immersed in water bath to check leak tightness.

3. Length : As per relevant Standard.

4. Tie rod : 3 tie rods per Rubber Expansion Joint.

5. Material of construction
   Body : Natural rubber compound
   Cover : Neoprene rubber
   Tie rod : Carbon steel

6. Design temperature : Normal 40 Deg Centigrade
   Max 80 Deg. Centigrade (Worst Case)

7. End connection : Carbon steel forged loose flanges at both ends, with dimensions as per IS: 6392

DESIGN CRITERIA FOR SLUICE GATES

EQUIPMENT SPECIFICATION

Sluice gates shall be supplied as per IS: 13349 / AWWA C 560 / BS 7775. Gearbox arrangement shall be of open type for small size and closed type for sizes above 400 mm size.

All assembly bolts / studs, nuts, anchor, bolts and washers are acceptable in
stainless steel construction to AISI: 304 / AISI: 410.

Sealing of single face is acceptable. Accordingly leakage test shall be performed to ensure committed leakage for seating head only applied for unseating side.

Item Nos. of all the gates shall be punched on the gate (at an easily identifiable place) before dispatch.

DATA FOR DESIGN OF SLUICE GATES

i) Type of Mounting: Wall mounted type with head stock. Headstock shall have geared handle for operation.

ii) Spindle type: Rising Spindle.

iii) Design code: Sluice gates shall be generally as per IS: 13349; 1992 (Reaffirmed 1998). Wedges shall be provided on the sides to ensure maximum water tightness. Velocity through sluice gates shall be in the range of 0.3-0.5 m/s.

MATERIAL OF CONSTRUCTION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Head Stock, wedge, Shutter, Gate frame, Stop-nut.</td>
<td>CI, IS: 210, Gr. FG 220 -1993</td>
</tr>
<tr>
<td>2.</td>
<td>Hinge Pin &amp; Stem</td>
<td>SS, AISI 410</td>
</tr>
<tr>
<td>4.</td>
<td>Fasteners</td>
<td>SS, AISI 304/410</td>
</tr>
<tr>
<td>5.</td>
<td>Anchor bolts</td>
<td>SS, AISI 304/410</td>
</tr>
<tr>
<td>6.</td>
<td>Stem Coupling</td>
<td>SS AISI 410</td>
</tr>
<tr>
<td>8.</td>
<td>Hand wheel</td>
<td>M.S.</td>
</tr>
</tbody>
</table>

04.07

ERECTION OF EQUIPMENT

The foundation slab shall be checked in order to have sufficient clearance between the lower surface of the machine and the foundation slab for the sealing compound and the shims.

The foundation holes for the anchor bolts shall be free and clean and must have been checked for correct positioning in relation to the machine axes as
well as for the depth to the elevation points, before erection work is undertaken.

Clean-up, Assembly & Installation

The foundation bases shall be cleaned by water and compressed air to expose the surface.

The top of the concrete foundations shall be thoroughly cleaned with air or air and water-jet prior to placing of equipment on foundations. Concrete surface shall be roughed up by chipping uniformly and the surface shall be washed clean with jet of water to remove fine dust.

The Tenderer shall place bedplates, cover plates, sole or sub-sole plates on the foundations and shims inserted until the equipment is in level as checked with precision machinist's levels. Required shim stocks, machined steel wedges, if required, shall be furnished by the Tenderer and used in sufficient numbers to avoid unsupported spans with any perceptible deflection.

Alignment, Leveling & Grouting

The machined base shall be cleaned with a solvent, e.g. kerosene, etc. The equipment shall be placed over the base plate taking care of the foundation bolts. They shall be then aligned with reference to the axes and levelled with the help of shims or any other suitable devices. The lines, levels and alignments of all installed equipment and structural steel work shall be ensured to be within such tolerances as are recommended in the respective equipment manufacturer's instructions.

All required adjustments shall be made by the Tenderer as directed by the equipment manufacturer. The Tenderer shall make permanent datum marks on the floors/ permanent structures after installation of all equipment. These marks shall be subject to inspection by the site engineer and are intended to ensure proper alignment and leveling of equipment during re-assembly after maintenance/overhaul, etc.

All motors and driven equipment shall be accurately levelled and aligned to required tolerances. Equipment shipped with motor mounted, shall be rechecked and realigned, if necessary. Alignment, leveling, coupling connections, etc. and final certification for alignments and erection shall be the responsibility of the Tenderer.

After the equipment/ structure, etc. have been installed, lined, levelled and aligned, the foundation bolts shall be pulled up tightly and the equipment shall be grouted with shrimkomp grout (ACC make) and grouting cured for seven days. When the grout is thoroughly cured, the alignment shall be rechecked. All grouting material including shrimkomp grout shall be supplied by the
Erection of Valves

Before erection of valves, it shall be ensured that:

a) All grit and foreign matter are removed from the inside of the valves before connecting the pipes.

b) All the faces are thoroughly cleaned and coated with a thin layer of mineral Grease.

Gate valves shall normally be installed with the spindle vertical except on vertical pipes where the spindle shall be horizontal. On slopes, the sluice valves may preferably be kept vertical if slope is nominal and gradient can be adjusted with the help of pipes on both sides.

The valves should be tightly closed when being installed, to prevent any foreign matter from getting in between the working parts of valves.

It shall be ensured that the joining material sits squarely between the flanges of valves and pipelines without obstructing the waterway.

Site Testing

Hydraulic tests on pipeline system shall be carried out in accordance with IS: 5822 and guidelines furnished in this document. The Tenderer shall arrange at his own expenses necessary pumps, other required materials, instruments and consumables to conduct hydraulic tests of the piping system erected by him.

The Tenderer shall determine the locations of the beginning and the end of each test section. The minimum test pressure shall be 1.5 times the internal maximum working pressure or 10 kg/cm² whichever is more. Test pressure shall be held for 15 minutes. All the joints of the system shall be checked for leakages. The pressure shall be reduced to working pressure and tested with water and compressed air as applicable. After 8 hours there shall not be drop in fluid test pressure. The system shall be checked for leakages after the test. The Tenderer shall acquire water for hydrostatic tests in a manner satisfactory to the authorities. The quality of water shall be clean with containing silt, suspended matters or harmful corrosive constituents. The Tenderer shall be responsible for obtaining this water and disposing it off after completion of the test.

All valves and appurtenances shall be checked prior to filling the pipeline to ensure that they are in proper working order and in the proper position for filling. All fittings shall be checked for tightness prior to filling.
Prior to a pressure test, warning signs shall be placed along the way at all public crossings and at all points where there is exposed pipe or appurtenances. The equipment shall be disconnected before performing the pressure test.

Hydraulic test results will be considered satisfactory, if during tests manometric pressure does not decrease and no leakage or mist is found in the joints fittings, etc.

The weld seams of welded pipe shall be inspected full length (100%) for cracks, lack of complete penetration or complete fusion and discontinuities. In addition, the skelp end weld in finished spiral welded pipe shall also be inspected.

If a leak is detected, it shall be located and repaired. If the leak occurs in the pipe seam or the pipe body, the entire faulty joint of the pipe shall be cut out and replaced with a new joint of the pipe. If a leak occurs in the circumferential weld, the pipe shall be cut one pipe diameter on each side of the faulty weld and replaced with a new section of the pipe. Upon completion of the repair, the pipe test section shall be retested in accordance with this specification. The Tenderer shall be responsible for repair of all failures during hydraulic test.

All the piping and fittings found defective after repeated tests shall be replaced by new ones as per the drawings, specifications and all other documents referred to in the contract. Any approval which the purchaser may have given in respect of the stores, materials or other particulars and the work and the workmanship involved in the contract (whether with or without test carried out by the tenderer) shall not bind the purchaser notwithstanding any approval or acceptance given by the Purchaser.

Holiday test shall be performed for underground pipelines (MS) to check the completeness of wrapping the pipes with anti-corrosive tape. All equipment required for performing this test is included in scope of tenderer.

Flush of Pipelines

Various types of control valves, cocks, orifice plates, filters, etc. shall be removed and fitted with distance pieces. The above fittings will be flushed and cleaned manually. All pumps, strainers, etc. shall be isolated during flushing and cleaning operation.

All the pumps and equipment in the cleaning circuit shall be isolated by blanking and by passing through temporary connections on the pipelines. If filters and strainers are kept in the main circuit during flushing operation, these
will be removed, cleaned and refitted after flushing is completed.

04.08 Painting Specification

This specification covers the materials, tools, facilities and quality requirement for surface preparation and painting of steel structures, equipment, piping, ducts, chutes, wood work etc.

This is only a general guideline of the painting scheme to be followed by the Tenderer. However, in case a specific painting procedure is stipulated in any tendering specification, then this general guidelines shall be superseded. Any special case which may arise from time to time shall be dealt with individually on the merit of each case.

The term “painting” referred herein covers rust preventive, fungus/insects preventive and decorative coating along with surface protection of the following area but not limited to the areas indicated below.

i) Structural steel works
ii) Mechanical equipment
iii) Electrical equipment
iv) Instrumentation and control equipment.
v) Pipe work, etc.

Surfaces made of asbestos, aluminum, brass, bronze, galvanized steel, stainless steel, cast iron and other corrosion resistant alloys and rubber/synthetic polymer/fiber reinforcement plastic and buried pipe work are not required to be painted unless specified except for aesthetic purposes or for identification bands, wherever relevant.

The complete paint system for any item includes the following basic activities:

i) Proper surface preparation
ii) Application of primer coats
iii) Application of intermediate coats
iv) Application of finished coats

All the above coats shall be of quality paint products and of approved make. The scope of work shall also include supply of all paint materials as per specification described herein.

If the contractor desires to adopt alternative paint system for any specific item for an improvement or equivalent to the system specified...
here-in or as per recommendations of paint manufacturer, may do so subject to purchaser's approval in advance.

SURFACE PREPARATION

02.01 Surface preparation required for paint application, shall be such as to clean the surface thoroughly of any material which will be conducive to premature failure of the paint substrates.

02.02 All surfaces shall be cleaned of loose substances, and foreign materials, such as dirt, rust, scale, oil, grease, welding flux, etc. in order that the prime coat is rigidly anchored to the virgin metal surface. The surface preparation shall confirm to pictorial representation of surface quality grade of Swedish Standards Institution SIS – 055900 or equivalent standards such as SSPC – VIS – 1.67 or DIN 55928(Part 4) or BS 4232 or IS 1477 – 1971 (Part I)

02.03 The acceptable surface preparation quality / grade are described undereach paint system. The procedures include solvent cleaning, hand tool cleaning, power tool cleaning, blast cleaning, wood surface cleaning, flame cleaning and pickling. This will ensure surface quality as required by the specific primer paint. For ready reference surface preparation quality grade to be adopted in respect of SIS 055900 and DIN 55928 (part-4) is given in Annexure-01.

02.03.01 Solvent Cleaning
The surface shall be cleaned by wiping, immersion, spraying or Vapourcontacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning shall not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning shall be followed by other cleaning procedures as stated in subsequent clauses.

02.03.02 Hand Tool Cleaning
The surface shall be cleaned manually by vigorous wire brushing as per grade St-2 quality of Swedish Standard Institution SIS 055900 and DIN 555928. This method effectively removes loosely adherent materials, but would not affect residues of rust or mill scales that are intact are firmly adherent. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation the surface shall have a faint metallic shine. The appearance shall correspond to the prints designated St – 2.

02.03.03 Power Tool Cleaning

The surface shall be cleaned by electric or pneumatic tools, such
as brushes, sanding machines, disc abrasive grinder, rotary disc scaler etc. to St – 3 quality. The tools shall be used carefully to prevent excessive roughening of surface and formation of ridges and burrs. This method will remove loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent and intact.

Blast Cleaning

The surface shall be cleaned by impingement of abrasive materials, such as graded sand at high velocity created by clean and dry compressed air blast as per the grade according to Swedish Standard Institution SIS 055900. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning excessive surface scales are removed by hand tools or power tool cleaning. The extent of removal of adherent scales is varied, depending on the application and are defined by the surface quality grades Sa1, Sa2, Sa2.5 and Sa3 in the order of increasing cleanliness. The blast cleaning is not recommended for sheet metal work.

02.03.05 Flame Cleaning

The surface is cleaned by rapid heating by means of oxyacetylene flame to loosen the adherent scales, followed immediately by wire brushing. This method will remove loosely adherent materials as well as most of the adherent scales and mill scales. In order to minimize or prevent distortion flame cutting shall not be used on members having thickness of 6 mm and lower.

02.03.06 Pickling

In this method the surface is cleaned of mill scales, rust or mill scales by chemical reaction or electrolysis or both.

03. PAINT APPLICATION

03.01 Paints

03.01.01 Paint shall be applied in accordance with paint manufacturer’s recommendations. The work shall generally follow IS 1477 – 1971 (Part II) for jobs carried out in India and SSPC-PA-1 or DIN 55928 or equivalent for jobs carried out outside India.

03.01.02 General compatibility between primer and finishing paints shall be established by the paint manufacturer supplying the paints.

03.01.03 In the event of conflict between this general procedure on painting and the
paint manufacturer’s specification, the same shall be immediately brought to the notice of the Purchaser. Generally in cases of such conflicts, manufacturer’s specifications/recommendations shall prevail.

03.01.04 Before buying the paint in bulk, it is recommended to obtain sample of paint and establish “Control Area of Painting”. On Control Area, surface preparation and painting shall be carried out.

03.01.05 If required, samples of paint shall be tested in laboratories to establish quality of paint with respect to:

   (i) Viscosity
   (ii) Adhesion/Bond of paint in steel surfaces
   (iii) Adhesion/Simulated salt spray test.
   (iv) Chemical analysis (percentage of solids by weight)
   (v) Normal wear resistance as encountered during handling & erection.
   (vi) Resistance against exposure to acid fumes, etc.

03.01.06 Whole quantity of paint for a particular system of paint shall be obtained from the same manufacturer.

03.01.07 The main Contractor shall be responsible for supply of paints and this responsibility shall not be passed on to the sub-contractor.

03.01.08 The painting material as delivered to the Contractor, must be in the manufacturer’s original container bearing thereon manufacturer’s name brand and description. Paint/Painting material in containers without labels or with illegible labels shall be rejected, removed from the area and shall not be used.

03.01.09 Thinners wherever used shall be those recommended by the paint manufacturers and shall be obtained in containers with manufacturer’s name and brand name of thinner legibly printed, failing which the thinner is liable to be rejected and shall not be used.

03.01.10 All paint containers shall be clearly labeled to show the paint identification, date of manufacture, batch number, special instruction, shelf life etc. The container shall be opened only at the time of use.

03.01.11 All paints shall be stored in accordance with the requirements of laidown procedure by the paint manufacturer.

03.01.12 All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments before use and during application to maintain homogeneity.

03.01.13 The proposed make, quality and shade of the paint shall have
the approval of the client.

03.01.14 The colour code of the finishing paint to be followed shall be intimated to the successful Tenderer after finalisation of order. The undercoat shall have different tint to distinguish the same from the finishing coat.

03.01.15 The Contractor shall furnish paint manufacturer’s test report or technical data sheet pertaining to the paint selected. The data sheet shall indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading rate, flash point, method of application, quality of surface preparation required, corrosion resistance properties and colour shades available.

03.01.16 For details of paint materials refer Annexure - 02

03.02 General

03.02.01 Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots.

03.02.02 Each coat of paint shall be sufficiently dry before application of next coat.

03.02.03 Paint shall be applied at manufacturer’s recommended rates. The number of coats shall be such that the minimum dry film thickness specified is achieved. The dry film thickness of painted surfaces shall be checked with ELCOMETER of measuring gauges to ensure application of specified DFT.

03.02.04 Zinc rich primer paints which have been exposed several months before finishing coat is applied shall be washed down thoroughly to removesoluble zinc salt deposits.

03.02.05 The machine finished surfaces shall be coated with white lead and tallow before shipment or before being put out into the open air.

03.02.06 Areas which become inaccessible after assemble shall be painted before assembly (after obtaining painting clearance from the inspecting authority) after requisite surface cleaning as specified.

03.02.07 Paint shall not be applied when the ambient temperature is 5 deg C and below or 45 deg C and above. Also paint shall not be applied in rain, wind, fog or at relative humidity of 80 % and above unless the manufacturer’s recommendations permit. Applications of paint shall be only by spraying or brushing as per IS 486 – 1983 and IS 487 – 1985.

03.02.08 Primer paint shall be applied not later than 2 – 3 hours after preparation of surface, unless specified otherwise.
03.02.09 Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of the required thickness.

03.02.10 Surfaces which cannot be painted but require protection shall be given a coat of rust inhibitive grease according to IS 958 – 1975 or solvent deposited compound according to IS 1153 – 1975 or IS 1674 – 1960.

03.02.11 Surfaces in contact during shop assembly shall not be painted. Surfaces which will be inaccessible after assembly shall receive minimum two coats of specified primer.

03.02.12 Surfaces to be in contact with wood, brick or other masonry shall be given one shop-coat of the specified primer.

03.03 Site/Field Painting

03.03.01 Wherever shop primer painting is scratched, abraded or damaged, the surface shall be thoroughly cleaned using emery paper and power driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.

03.03.02 If more than 50% of the painted surface of an item requires repair, the entire item shall be mechanically cleaned and new primer coats shall be applied followed by intermediate and finishing coats as per painting specification.

03.03.03 All field welded areas on shop painted items shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas where existing primer paint is burnt).

Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

03.03.04 The first coat of finish paint at site shall be applied preferable within three months of the shop paint.

03.04 Structural

03.04.01 All fabricated steel structure, fabricated steel pipes, etc. shall have a minimum of two coats of primer paint before dispatch to site.

03.04.02 Parts of steel structures embedded in concrete shall be given a protective coat of Portland cement slurry immediately after fabrication and after surfaces of this part is thoroughly cleaned from grease, rust,
mill scales, etc. No paint shall be applied on this part.

03.04.03 All structures shall receive appropriate number of primer and finishing coats in order to achieve overall DFT as per design drawings/specification.

03.05 Hot Surfaces

03.05.01 Total DFT for heat resistant paints should not exceed 100 – 120 microns, otherwise flaking occurs (as per paint manufacturer’s recommendations).

03.05.02 Heat resistant paints should be applied by brush.

03.05.03 Primer coat should not be applied on the surfaces having temperature condition more than 120 deg C.

04 PAINTING SCHEMES

For a complete painting scheme of any item being printed, all types of paints are to be procured from the same manufacturer as approved by the purchaser.

04.01 Legend

SP - Surface preparation quality as per SIS standard
2P1 - Two (2) coats of Primer paint type P1
1I1 - One (1) coats of Intermediate paint type I1
2F1 - Two (2) coats of Finish paint type F1
DFT - Dry Film Thickness in microns developed
CRT - Clean and Retouch

Type of paint products like P1 to P9, I1 to I4 and F1 to F10 have been specified under Annexure-02.

04.02 The painting scheme to be followed for various structure/equipment exposed to different condition is briefly given in Annexure-03 for guidance to the tenderer.

04.03 The colour code for different applications are indicated in Annexure-04. Wherever colour codes are not specified, the same is to be mutually agreed between the Purchaser and Contractor.

05. GUARANTEE

05.01 The Contractor shall guarantee that the physical and chemical properties of the paint materials conform with the specification of paint products.
05.02 The Contractor shall submit internal test reports from paint manufacturers regarding the quality of paint whenever asked by the Purchaser/Consultant.

05.03 Guarantee period shall commence from the date of completion of finishing coat of paint. The guarantee period will be indicated depending on the type of surface preparation and system of painting. To fulfill this obligations the Contractor may obtain from the painting manufacturer, guarantee for the performance of paint/painted surfaces.
# Technical Specification for Ash Water Recirculation System

## Surface Preparation Grade

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Surface Preparation</th>
<th>Swedish Std SIS 055900</th>
<th>DIN Std. Din 55928 (Part 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blastcleaning to whitetemal: Removal of all visible rusts, mill-scales, paint and foreign matters.</td>
<td>Sa3</td>
<td>Sa3</td>
</tr>
<tr>
<td>2</td>
<td>Blastcleaning to near whitetemal: 95% of any section of surface area is free from all rusts, mill-scales and visible residues.</td>
<td>Sa2.5</td>
<td>Sa2.5</td>
</tr>
<tr>
<td>3</td>
<td>Blastcleaning to commercial quality: At least 2/3 of any section of the surface area is free from all rusts, mill-scales and foreign matters.</td>
<td>Sa2</td>
<td>Sa2</td>
</tr>
<tr>
<td>4</td>
<td>Brush-off blast cleaning: Removal of all loose mill-scales, rust and foreign matter etc.</td>
<td>Sa1</td>
<td>Sa1</td>
</tr>
<tr>
<td>5</td>
<td>Powertool cleaning: Very thorough scraping and wire brushing to remove loose mill-scales,</td>
<td>St3</td>
<td>St3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hand tool cleaning: Removal by hand brushing of loose mill-scale, loose rust and foreign matters.</td>
<td>St2</td>
<td>St2</td>
</tr>
</tbody>
</table>
Annexure–02 – Paint Materials

01. PRIMER PAINTS (P)

Primer paint products shall be applied only on dry and clean surfaces.

01.01 Primer Paint – P1 ( Phenolic – Alkyd Based)

A single pack air drying phenolic modified alkyd composition with zinc phosphate as primer paint conforming to IS:2074.

- Airdrying time: About 60 minutes (touch dry)
- Dry film thickness (DFT)/Coat: 40 microns (min)
- Temperature resistance: Upto 100°C dry heat

01.02 Primer Paint – P2 (Chlororubber Based)

A single pack air drying high build chlorinated rubber-based zinc phosphate primer.

- Percent Chlororubber: 20 to 22 (Chlorine above 65% in Chlororubber)
- Airdrying time: About 15 minutes (touch dry)
- Dry film thickness (DFT)/Coat: 50 microns (min)
- Temperature resistance: Upto 65°C dry heat

01.03 Primer Paint – P3 (PVCCopolymer Alkyd Based)

Polyvinyl chloride (PVC) - Alkyd zinc phosphate - redoxide based primer

<table>
<thead>
<tr>
<th>Ratio</th>
<th>PVC copolymer + alkyd resin (1:1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigments</td>
<td>Zinc phosphate &amp; Fillers</td>
</tr>
</tbody>
</table>
01.04 **Primer Paint–P4(Epoxy Based)**

A two pack air drying Epoxy polyamide resin based red oxide-zinc phosphate primer.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy content (%wt.)</td>
<td>15 to 18</td>
</tr>
<tr>
<td>Airdrying time</td>
<td></td>
</tr>
<tr>
<td>About 30 minutes (touchdry) overnight (harddry)</td>
<td>DFT/Coat</td>
</tr>
<tr>
<td>Temperature resistance</td>
<td>Upto 80°C dry heat</td>
</tr>
</tbody>
</table>

01.05 **Primer Paint–P5(Epoxy Based)**

A two pack air drying Epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy content (%wt.)</td>
<td>8 to 10</td>
</tr>
<tr>
<td>Airdrying time</td>
<td></td>
</tr>
<tr>
<td>Less than 10 minutes (touchdry)</td>
<td>Less than 2 hours (harddry)</td>
</tr>
<tr>
<td>DFT/Coat</td>
<td>40 microns (min)</td>
</tr>
<tr>
<td>Temperature resistance</td>
<td>Upto 300°C dry heat</td>
</tr>
</tbody>
</table>

01.06 **Primer Paint–P6(Poly–Vinyl Butyral Resin Based)**

A two pack air drying polyvinyl butyral resin based wash primer with rust inhibitive pigments.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airdrying time</td>
<td>5 to 7 minutes (touchdry)</td>
</tr>
<tr>
<td>2 hours (harddry) DFT/Coat</td>
<td>8 microns</td>
</tr>
<tr>
<td>Temperature resistance</td>
<td>Upto 65°C dry heat</td>
</tr>
</tbody>
</table>

**Application for**: Galvanized iron, aluminium, light alloy etc. on which the adhesion of conventional paints are poor.
01.07 Primer Paint–P7(EthylZincSilicate,EZS Based).

A twopack heavyduty zincdustrich silicateprimer whichprotectsthe surfacewithjustasinglecoat.

- TotalSolids(3wt) - 84+/-2
- Density(g/cc) - 3.07+/-0.05
- Airdryingtime - Totopcoat16hours
- DFT/coat - 60microns
- Temperature resistance - Upto450degC dryheat

01.08 Primer Paint–P8(HighBuildCoalTarEpoxy)

A two pack cold cured H.B.Epoxy coal tar coating – no primer is required.

- Mixingratio - Base:Hardener(4:1byvol.)
- Airdryingtime - 48hours(harddry)
  - Fullcure7days
- DFT/Cover - 100microns

01.09 Wood Varnish-P9

Treataoilbasedprimerpigmentedwithsuitablepigments:

- Airdryingtime - 16hoursforapplicationof topcoat.
- Coverage - 10to14sq.m/litre

02.01 Intermediate Paint–II(Phenolicalkyldbased)

A singlepack highbuildphenolicbasedpaintwithmicaceousironoxide(M10).

- AirDryingTime - 4to6hours(touchdry)
  - 2days(harddry) DFT/Cover
- Temperature resistance - Upto100degC dryheat
Compatible with - Primer P1

02.02 Intermediate Paint I2 (Chlororubber-based)

A single pack air drying high build chlorobased paint with MIO.

Air Drying Time - 15 minutes (touch dry)
- 24 hours (hardt dry)

DFT/Coat - 70 microns (min)

Temperature resistance - Upto 65 degree C dry heat

Compatible with - Primer P2, P3 & P4

02.03 Intermediate Paint I3 (PVC-Alkyd Based)

PVC Copolymer - Resin 1:1

Pigments - Micaceous iron oxide (MIO)

DFT/Coat - 80 microns (min)

Temperature resistance - Upto 80 degree C dry heat

Compatible with - Primer P2 & P3

02.04 Intermediate Paint I4

A two pack air drying high build epoxy resin based paint with MIO.

Air Drying Time - 6 to 8 hours (touch dry)
- 7 days (full cure)

DFT/coat - 100 microns

Temperature resistance - Upto 180 degree C dry heat

Compatible with - Primer P4 & P5

03 Finishes Paints (F)

Finish paint costs shall be applied over primer coats and intermediate coats after proper cleaning and touchup of primed surface.

03.01 Finish Paint - F1

A single pack air drying high gloss phenolic alkyd modified synthetic enamel paint suitably pigmented.

- Air Drying Time - 3 to 4 hours (touch dry)
- 24 hours (hardt dry)
DFT/Coat - 25microns(min)

Temperature resistance - Upto100°Cdryheat

Compatible with - PrimerP1
                 IntermediateI1

Colour - Generally all shades

03.02 FinishPaint–F2

A single pack air drying polyurethane enamel of high gloss and hard finish suitably pigmented.

Airdryingtime - 2to2½ hours(touchdry)
                 6hours(harddry)

DFT/Coat - 30microns(min)

Temperature resistance - Upto100°Cdryheat

Compatible with - PrimerP1&P8and
                 IntermediateI1

Colour - Generally all shades
03.03 FinishPaint–F3

At two pack air-drying bituminous aluminumpaint.

Airdryingtime 1 to 2 hours (touchdry) 21 hours (harddry)

DFT/Coat - 25 microns (min) Temperature resistance

- Upto 100°C dry heat

Compatible with Primer P1 and Intermediate I1

Colour - Bright metallic

03.04 FinishPaint–F4

A ready mixed oil-alkyd based synthetic enamel paint of high gloss and hardwearing properties.

Airdryingtime 6 to 8 hours

Coverage - 14 to 16 Sq.m /litre

Temperature resistance - Upto 60°C dry heat

Compatible with P8

Colour - Generally all shades

03.05 FinishPaint–F5

A single pack air drying plasticized chlororubber paint suitably pigmented.

Airdryingtime 30 minutes (touchdry) 24 hours (harddry)
03.06  **FinishPaint–F6**

APVC–Copolymeralkydbasedenamel.

- **Density**  
  - 1.17U+U0.05

- **Totalsolids (1wt)**  
  - 55U+U2

- **DFT/Coat**  
  - 40microns

- **Compatible with**  
  - PrimerP2&P3, IntermediateI2&I3

- **Colour**  
  - Nearlyallshadesexceptfew.

03.07  **FinishPaint–F7**

Atwopackairdryingepoxypolyamideenamels suitably pigmented.

- **Airdrying time**  
  - 2to3hours(touchdry)
  - 7days(fullcure)

- **DFT/Coat**  
  - 40microns(min)

- **Temperatureresistance**  
  - Upto130°Cdryheat

- **Compatible with**  
  - PrimerP4&P5, IntermediateI4

- **Colour**  
  - Generallyallshades.

03.08  **FinishPaint–F8**

Asinglepacksyntheticrubberbasedaluminiumpaint.

- **Airdrying time**  
  - 2hours(touchdry)
  - 24hours(harddry)
DFT/Coat - 25microns(min)

Temperature resistance - Upto200°C dry heat

Compatible with - No primer paint except primer P6 is applicable in case of non-ferrous substrate.

Colour - Smooth Aluminium.
## Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Painting Scheme</th>
<th>At Shop</th>
<th>At Site</th>
<th>Total DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel Structures (Temp. not exceeding 800°C)</strong></td>
<td></td>
<td></td>
<td></td>
<td>(Refer Note-1)</td>
</tr>
<tr>
<td><strong>Technological steel structures for plant and equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indoor</td>
<td>SP – Sa 2.5 2P1</td>
<td>CRT 2F1</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Outdoor</td>
<td>SP – Sa 2.5 2P1 1I1</td>
<td>CRT 2F1</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td><strong>Fabricated steel structures at site for rung ladders, cat-ladders, gates, rolling shutters, etc. (Springs/rubbing surfaces excluded)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor / Outdoor</td>
<td>SP – St-2 and/or St-3 2P1</td>
<td>CRT 2F1</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td><strong>Walkways, stairs, platforms etc. which are of wearing surface</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP – St-2 and/or St-3 2P1</td>
<td>CRT 2F1</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP- St2 and/or St-3 2P1 1I1</td>
<td>CRT 2F1</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td><strong>Steel doors and windows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor / outdoor</td>
<td>SP–St-2 and/or St-3 2P1 1I1</td>
<td>CRT 2F2</td>
<td>215</td>
<td></td>
</tr>
</tbody>
</table>
### Sl. No.

<table>
<thead>
<tr>
<th>Description</th>
<th>Painting Scheme</th>
<th>Total DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.0</strong> <strong>MECHANICAL EQUIPMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.1</strong> Mechanical equipment (Temp. not exceeding 80 deg.C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.1.1</strong> Static equipment like storage tanks, vessels, bins, bunkers, heat exchangers, coolers, cyclones, scrubbers, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP – Sa 2.5</td>
<td>CRT 2F5/2F 6</td>
</tr>
<tr>
<td></td>
<td>2P2/2P3</td>
<td>6</td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP – Sa 2.5</td>
<td>CRT 2F5/2F 6</td>
</tr>
<tr>
<td></td>
<td>2P2/2P3+1I2/1I3</td>
<td>6</td>
</tr>
<tr>
<td><strong>2.1.2</strong> Rotary/moving equipment and machineries like crushers, mills, vibratory screens, bin activators, blowers, fan, air/gas compressors, pumps, gear boxes, machine housings etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP – Sa 2.5</td>
<td>CRT 2F6/2F 7</td>
</tr>
<tr>
<td></td>
<td>2P3/2P4</td>
<td>7</td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP-Sa 2.5</td>
<td>CRT 2F6/2F 7</td>
</tr>
<tr>
<td></td>
<td>2P3 + 1I3/1I4</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>At Shop</strong></th>
<th><strong>At Site</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2P2/2P3 + 1I2/1I3</td>
<td>170/240</td>
<td>240/320</td>
</tr>
<tr>
<td>2P3/2P4</td>
<td></td>
<td>240/140</td>
</tr>
<tr>
<td>2P3 + 1I3/1I4</td>
<td></td>
<td>320/340</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Painting Scheme At Shop</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.1</td>
<td>Static equipment like storage tanks, vessels, bins, bunkers, heat exchangers, coolers, cyclones, scrubbers, etc.</td>
<td>SP – Sa 2.5 2P2/2P3</td>
</tr>
<tr>
<td></td>
<td>- Indoor</td>
<td>SP – Sa 2.5 2P2/2P3+1I2/1I3</td>
</tr>
<tr>
<td></td>
<td>- Outdoor</td>
<td></td>
</tr>
<tr>
<td>2.1.2</td>
<td>Rotary/moving equipment and machineries like crushers, mills, vibratory screens, bin activators, blowers, fan, air/gas compressors, pumps, gear boxes, machine housings etc.</td>
<td>SP – Sa 2.5 2P3/2P4</td>
</tr>
<tr>
<td></td>
<td>- Indoor</td>
<td>SP-Sa 2.5 2P3 + 1I3/1I4</td>
</tr>
<tr>
<td></td>
<td>- Outdoor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Pipe / Duct work (Overground)</td>
<td></td>
</tr>
</tbody>
</table>
### Technical Specification for Ash Water Recirculation System

#### 3.1 Non-insulated (temperature up to 800°C)
- Indoor
- Outdoor

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Painting Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Structures</td>
<td>SP – St2 and or St3 2P1 or St3 2P1 + 1I1 CRT 2F1 CRT 2F1</td>
</tr>
<tr>
<td>4.2</td>
<td>Rotary equipment like air compressors</td>
<td>SP- St2 and/ or St3 1P1 CRT 2F3 CRT 2F7</td>
</tr>
<tr>
<td>5.0</td>
<td>Others</td>
<td>Remove paint and insulate</td>
</tr>
<tr>
<td>5.1</td>
<td>Standard mobile equipment like chasis of trucks, dumpers, crawler cranes bulldozers, railway rakes, chasis of slag cars, ladle cars, etc.</td>
<td>As per manufacturer’s standards</td>
</tr>
<tr>
<td>5.2</td>
<td>Laboratory equipment like ovens, screens, magnetic stirrers, samplers, etc.</td>
<td>Stove enameling CRT</td>
</tr>
<tr>
<td>5.3</td>
<td>Steel structures partly immersed in water</td>
<td>SP – Sa 2.5 2P8 CRT</td>
</tr>
</tbody>
</table>

**0B Notes:**
1. Painting scheme of all fabricated steel structures, fabricated pipe work, building structure, conveyer galleries, pipe trestles etc. is indicated in the Technical Specification of steel structures.

2. Primer Paint
   Primer coat shall be suitable for intended temperature applications as per manufacturer’s recommendation. The primer selection shall be generally inline with the specification laid down in Annexure-02.
3. Finish Paint - In case of Aluminium cladding final painting will not be required.

COLOUR CODE

The colour codes are mentioned for all the items including pipe work. Shades of finish coat of paint applied over respective item indicated below are tentative and subject to alteration as per Purchaser’s request or due to compatible paint system adopted. The service for which colour code/bands are not specified are to be mutually agreed for by the Purchaser & the Contractor.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Items Painted</th>
<th>1BColour</th>
<th>Colour No. of IS:5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Building frames including bracings, side girts, louvers etc.</td>
<td>Aircraft grey</td>
<td>693</td>
</tr>
<tr>
<td></td>
<td>Crane girders</td>
<td>Azure blue</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>Crane stops</td>
<td>Post office red</td>
<td>538</td>
</tr>
<tr>
<td></td>
<td>Gutters</td>
<td>Black aluminium bituminous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire escape platforms ladders, etc.</td>
<td>Signal red</td>
<td>537</td>
</tr>
<tr>
<td></td>
<td>General hand railing, top runners</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>Rung ladders</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>All members blocking passages for movement</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>Trestles, towers and pipe bridges</td>
<td>Dark admiralty grey</td>
<td>632</td>
</tr>
<tr>
<td></td>
<td>Conveyor gallery structures</td>
<td>Aircraft grey</td>
<td>693</td>
</tr>
<tr>
<td></td>
<td>Steel chimneys</td>
<td>Aluminium</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Equipment and Machinery</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General indoor equipment</td>
<td>Light grey</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>General outdoor equipment</td>
<td>Dark admiralty grey</td>
<td>632</td>
</tr>
<tr>
<td></td>
<td>Crane bridges, trolleys, hooks etc. and other mobile equipment</td>
<td>Base: Lemon yellow Stripes: Black (100 mm wide)</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>Furnaces</td>
<td>Aluminium</td>
<td></td>
</tr>
</tbody>
</table>
TANKS
Base: Same as for general equipment
Strips: Same shade as for piping around the tank at half the tank height

Fire-fighting equipment
Signal red
537

3. Pipe work
Pipeline shall be painted as per the IPSS No. 1-07-064-03 code of practice for painting in steel plant.
05.00 VENTILATION FACILITIES

Ventilation System

Exhaust ventilation shall be provided for areas like Electrical room, pump house, toilets etc.

Propeller type Exhaust Fan

Propeller type axial flow fan shall be used for Exhaust systems.

The fan shall be heavy duty and wall mounted type propeller fan design shall conform to IS: 2312 – 1967 (Reaffirmed 1994). Fan impeller blade shall be of aerofoil section and mounted directly at the motor shaft. The RPM of the fan shall be restricted to 1000 RPM. Noise level should not exceed 85 dB (A) at 1 m distance. The fan shall be provided with fixing frame, supporting lugs and other standard accessories.
06.00 HOISTING AND HANDLING FACILITIES

Manual Hoist

06.01 The scope of work of the Tenderer shall consist of design, manufacture, inspection, assembly, and painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of manual hoist with traveling trolley of various capacity.

06.02 Technical Specification of Manual Hoist with Traveling Trolley

● The Chain Pulley Block (CPB) shall conform to class-I duty as per IS: 3832-2005 (or latest revision, if amended).

● The manual hoist (CPB) with travelling trolley shall be of independent unit

● Ball and roller anti friction bearing only shall be used.

● Swiveling type standard shank hook mounted on grease lubricated anti-friction thrust bearing shall be used.

● Load chain & operating chain shall be of calibrated type.

● Pulley used for the operating mechanism shall have suitable guards to prevent the operating chain from coming out.

● All the open gearing shall have suitable cover.

06.03 DOCUMENTATION

1. Drawings/ Documents to be submitted with the tender.

The Tenderer shall submit the following technical drawings & technical data/information with tender for manual hoist with traveling trolley, without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) Typical General arrangement drawings & catalogues of the hoist.

b) The questionnaire filled in.
2. Final drawings/documents to be furnished along with the equipment:
   
a) General Arrangement drawings and all data /catalogues.

b) Supply of report on shop tests and material test certificate.

c) Supply of all operating manual, maintenance schedule & lubrication chart.

06.04 Questionnaire

1. Equipment No. : 
2. Capacity : 
3. Quantity : 
4. Height of Lift : 
5. Class of Duty : 
6. Make : 
7. Minimum radius of Curvature Of Track beam size : 
8. Max. Tractive effort (Kgs)
   ● Hoist : 
   ● Travel : 
9. Movement in ‘m’ corresponding to Operating chain movement of 30m
   ● Hoist : 
   ● Travel : 

07.00 ELECTRICS

07.01.00 SPECIAL INSTRUCTIONS TO TENDERER

07.01.01 Compliance with Specification

All equipment and accessories covered under this specification shall conform to ‘Technical Specifications’ given in this document.

All equipment will be supplied as per Technical specification except specifically brought out in deviations and further discussed and agreed upon.

All equipment shall be suitable for voltage/frequency variations and other data given in Electrical System Design.

The Tenderer shall be responsible for satisfactory working of system with guaranteed parameters. All the major equipment shall be installed, tested and commissioned under supervision of representative of manufacturer of respective equipment.

07.01.02 Standards and Regulations

The design, manufacture, performance, testing and installation (including safety, earthing and other essential provisions) of equipment and accessories covered under this specification shall, in general, comply with the latest issue of the following:

- Applicable Standards and Codes of Practices published by Bureau of Indian Standards.
- Central Board of Irrigation and Power
- Indian Electricity Act, 2003
- Central Electricity Authority
- Indian Electricity Rules
- Equipment specific statutory regulations
- Indian Factory Act

Equipment complying with other recognized Standards such as IEC, BS, VDE, DIN etc. will also be considered if it ensures performance equivalent to or superior to Indian Standards.

Equipment and accessories for which Indian Standards are not available, shall be designed, manufactured and tested in accordance with the latest issues of recognized Standards such as IEC, BS, VDE, DIN etc.

In case of conflict between applicable Standards referred to in this part and technical specifications, the Technical Specifications shall govern to the extent
of such difference.

07.01.03 Make & Interchangeability

This specification is issued for procurement of specified equipment and system preferably from indigenous suppliers who may make use of imported systems / sub-systems / equipment / parts and who have valid collaboration agreement with reputed foreign suppliers with experience in design and supply of similar systems as specified. The Tenderer shall furnish division list of supplies from foreign and Indian sources indicating the name of the agency or make against the respective items. It shall be the responsibility of the successful Tenderer to arrange the import license for the imported items offered and to co-ordinate the supply of equipment from foreign and Indian sources and execute the contract within the agreed time schedule.

The make of major equipment shall be limited to preferred makes indicated under chapter `List of preferred makes'. Makes of all other equipment and accessories are subject to prior approval by the Purchaser.

Similar equipment and components shall be of same make; equipment of same type and rating shall be interchangeable.

07.01.04 Safety

All equipment shall be complete with approved safety devices wherever a potential hazard exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions.

The design shall include not only those usually furnished with elements of machinery but also the additional covers, stairways, ladders, steel structural platforms for operator's control panels, handrails, partitions etc. which are necessary for safe operation of the plant. In addition, maintenance platform, wherever required, shall be included in the design.

All danger and caution notice boards shall be in Hindi and English.

The Tenderer must take sufficient care in moving his construction plants and equipment from one place to another so that those may not cause any damage to the property of the Purchaser particularly to the overhead and underground cables and other service lines.

When the work is carried out at night or in the obscure day light, adequate arrangements for flood lighting in the working area shall be made by the Tenderer at his own cost and got approved by the Purchaser.
The safely postures/regulations for the prevention of accidents shall be displayed by the successful Tenderer at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

All electrical drives and equipment must be equipped with safety devices. The safety provisions shall conform to the recognized standards, safety codes and statutory regulations.

All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the successful Tenderer during the execution of the Contract.

Adequate number of first aid boxes as defined in the State Factory Rules shall be provided and maintained at all the work sites.

07.01.05  
**Coding/Numbering Scheme**

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by the Tenderer in a sequential manner.

07.01.06  
**Contractor’s License**

The Tenderer shall possess a valid and competent contractor's license of specified voltages issued by the electrical licensing authorities of the Govt. of Jharkhand or other States for carrying out electrical installation work of the type and magnitude covered in this document, in the state of Jharkhand. The Tenderer shall also be required to obtain labour license from Statutory Authority.

Copy of the license shall be made available to the owner/Consultant for verifications during the execution of contract.

All linemen, wiremen, electricians, supervisors and engineers engaged by the Tenderer or his sub-Contractor shall possess necessary valid license issued by the statutory authority and the same shall be submitted for verification, if called for.

07.01.07  
**Compliance with rules, regulations, and obtaining statutory approval**

All equipment/materials shall be installed in accordance with the requirements of relevant standards, Indian electricity Rules, Indian Electricity Act, 2003 and also the Factory Act. It is the responsibility of the Tenderer to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Chief Electrical Inspector, Central Electricity Authority or any other statutory
body having jurisdiction in the area and also to the owner/ Consultant.

The responsibility for obtaining all statutory approvals for the installation to be carried out rests entirely with the Tenderer. It shall be the responsibility of the Tenderer to prepare and submit all necessary drawings, calculations, test certificates and relevant details (other than those given by the owner/Consultant) to the Electrical Inspector and obtain prior approval for commencing the work and for the complete installation work done.

The inspection fee for statutory approvals shall be reimbursed by the owner on submission of documentary evidence.

07.01.08 Type test certificate from CPRI or Govt. institute (conducted with in 10 years from the date of LOI) for all the equipment shall be submitted, otherwise Type test of the equipment shall be carried out by the supplier without any cost implication to the Purchaser at CPRI or Govt. institute.

07.02.00 SCOPE AND BRIEF DESCRIPTION OF WORK AND ELECTRICAL SYSTEM DESIGN CRITERIA

07.02.01 General

The scope of work includes the basic engineering, detailed engineering, construction/manufacture or procurement, shop testing, packing, transportation, loading, delivery at site, unloading, storage at site, handling, erection, pre-commissioning tests and commissioning of all equipment/system including preliminary acceptance test, performance guarantee and post commissioning services, including insurance cover during transit, storage, erection and commissioning of total electrical system for the Blowing system.

The job shall be done on turnkey basis including.

• Supply of commissioning spares

After successful commissioning, the commissioning spares not used, will be the property of the owner

The electrical scheme is indicated in enclosed single line diagram No: MEC/TS/11/Q7GR/E1/01, Rev 0.

07.02.02 The major equipment covered under scope of work shall be as follows:

1. Motor Control Center cum PDB for AWRS Pump house auxiliaries, utilities including Power supply feeders etc, as required.

2. Local Push button stations.

3. LV Motors.

5. Supply as well as laying of LT power and control cabling including their termination at both ends and jointing / termination materials.

6. All erection / installation accessories, cable supporting structures, cable tray, cable termination at both ends, cable fixing, support materials for all equipment, conduits, prefabricated GI cable trays, cable racks, other associated accessories like cable glands, lugs, termination kits, ferrules, clamps and all other hardware material as per requirement with in Tenderer’s scope.

7. Base frame/ base channel/ base plate, if required for 415 V switchboards / any other equipment under Tenderer’s scope to flush them with FFL shall be under scope of Tenderer. Similarly cross channels and chequered plates shall be provided by the Tenderer over cable trenches & floor cutouts for installation of these switchboards.


9. Equipment earthing system and other system/safety/equipment earthing, etc. AWRS Pump House internal earthing ring including equipment earthing and connection to Purchaser’s nearby earthing grids.

10. Illumination of entire AWRS Pump House area.


12. Safety items, etc.

07.02.03

**Battery limits**

Broad battery limits for the work covered in tenderer’s scope are indicated below.

LT Power for the AWRS Plant shall be fed from two nos. over head lines terminated on nearby single pole structures being installed by the Purchaser.

Entire Electrics beyond this point, down upto the drives including LT Power and Control cables and equipment earthing to Purchaser’s nearby earthing ring, etc. is included in the scope of the Tenderer.

Supply, laying & termination of all power and control cables from the Purchaser’s pole structure and within AWRS Plant area shall be carried out by the Tenderer.

Tenderer shall include all installation equipment and services in his scope for the equipment being supplied by them.

Two nos. 63 Amps welding socket shall be provided in the AWRS Plant which
will be fed from the MCC cum PDB to be installed by the Tenderer.

Also two nos. 100 Amps Power feeders shall be provided in the MCC cum PDB for Purchaser's use in future apart from 20% normal spares / modules.

07.02.04 Installation, Testing and Commissioning

The scope of the Tenderer shall also include the following;

- Erection, testing, commissioning including transportation of all equipment and material which are in the scope of supply of Tenderer.
- Necessary coordination work required for erection, testing & commissioning and resolving problems of all equipment.
- Installation & testing of cabling system, including cable, trays/supports etc.
- Laying and termination of all interconnecting cabling required for completeness and commissioning of the plant.

07.02.05 Scope of Miscellaneous Activities

Following miscellaneous works shall also be included in the scope of tenderer;

- Obtaining approval certificate from Chief Electrical Inspectorate of the state and CEA for installation and energizing the complete electrical system and equipment covered under the package is in the scope of Tenderer. Any modification or additional requirements by Electrical Inspectorate shall have to be carried out without time and cost implication to the Purchaser.
- Any modification or additional requirements by Statutory Authorities shall have to be carried out without time and cost implication to the Purchaser.
- Arranging any other statutory approval, if required.
- The Tenderer shall provide and install GI cable trays as required for laying all cables under his scope of supply along with 30% spare trays for future use.
- For construction power supply, 415V source (single source) shall be provided by the Purchaser. Tenderer shall have to make their own arrangement for feeding to various load centres. This shall include required power and control cables, and MCCBs / Isolstors, etc.
07.02.06

Electrical system design criteria

General
The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision) and other relevant standards.

In case the Tenderer is not in a position to comply fully with certain IS specifications, or in respect of certain items for which there are no IS specifications, the Tenderer may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards subject to the approval of the Purchaser.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Jharkhand.

Climatic Conditions

Electrical Equipment selection and derating shall generally be based on ambient temperature of 50°C. For specific hot areas the ambient temperature conditions shall be taken into consideration and equipment suitably derated where necessary. In hot areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air.

The equipment offered shall be suitable for smooth, efficient and trouble free service in the climate prevailing at Lalpania, Jharkhand, India.

Standard Voltage levels

Following power utilization standard voltage levels shall be adopted for various systems:

<table>
<thead>
<tr>
<th></th>
<th>1. Auxiliary supply</th>
<th>415 V, 3 phase, 4 wire, solidly earthed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>AC drive motors</td>
<td>415 V, 3 phase, 4 wire, solidly earthed.</td>
</tr>
<tr>
<td>3</td>
<td>Control, protection and indication for MCC feeders including ACBs</td>
<td>240V, 1 phase, line and neutral (through control Transformers having auto changeover arrangement)</td>
</tr>
<tr>
<td>4</td>
<td>Metering</td>
<td>110 V, AC, PT supply</td>
</tr>
<tr>
<td>5</td>
<td>Plant illumination</td>
<td>240 V, 1 phase, line &amp; neutral</td>
</tr>
<tr>
<td>6</td>
<td>Panel lighting and space heaters</td>
<td>240 V, 1 phase, 2 wire, 50 Hz, A.C. with one point earthed</td>
</tr>
<tr>
<td>7</td>
<td>Welding socket / power receptacles</td>
<td>415 V, 3 phase, 50 Hz, A.C. outlets / 240 V, 1 phase, 2 wire, 50 Hz, A.C. with</td>
</tr>
</tbody>
</table>
TENUGHAT VIDUYT NIGAM LIMITED,
LALPANIA JHARKHAND
TECHNICAL SPECIFICATION FOR
ASH WATER RECIRCULATION SYSTEM

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Sockets for electrical tools, etc.</td>
</tr>
<tr>
<td></td>
<td>240 V, 1 phase, 2 wire, 50 Hz, with one point earthed</td>
</tr>
</tbody>
</table>

**Permissible variations**

The system/ unit/ plant/ equipment shall be designed suitably for following variation in voltage and frequency:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>+10% to -10% (for LT)</td>
<td>+5% to -5%</td>
</tr>
<tr>
<td>+/– 10%</td>
<td>+5% to -5%</td>
</tr>
<tr>
<td>-10%</td>
<td>-----</td>
</tr>
</tbody>
</table>

**Symmetrical short circuit ratings**

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels envisaged are as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Breaking Capacity</th>
<th>Making Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>415 V</td>
<td>50 kA</td>
<td>105 kA</td>
</tr>
</tbody>
</table>

The rated short circuit withstand duration for 415 V switchgears including MCCs, it will be 1.0 sec.

**Electrical System Requirements**

MCC cum PDB shall be provided with 20% subject to minimum 1 no. spare starters/feeders of each type and rating. The rating and type of spare feeder/starters shall be decided during detailed engineering stage. These spare cubicles/modules shall be complete with the MCCBs / contactors /starters/ other accessories and shall be fully wired upto the terminal block.

The electrical distribution schemes will be subject to approval of purchaser/purchaser's consultants.

All CTs shall be of 1A secondary. Control cable from CT to panel shall be of 4 sq.mm. Copper.

Power supply to miscellaneous loads like A/C, sockets, Welding sockets, cranes,
hoists, etc shall be through Tenderer’s MCC cum PDB.

Selection of components and cable size for MCCs shall be as per chart given in Annexure-I.

Motor space heater power supply shall be fed from the MCC cum PDB Board. Space heaters will be interlocked with motor main power supply.

### 07.02.07 PAINTING

The primers & finishing paints will conform to latest Indian Standard or equivalent international standards. These shall be of approved quality and shade.

General precautions for painting such as preparation of surfaces, application of paints, inspection and testing etc. will be as per relevant clause of IS:1477 (Part I & II)-1971 and shall be followed, wherever possible.

**Colour codes:** All electrical equipment

i) Outdoor Motors : Dark admirality grey Shade no. 632 (epoxy) As per IS-5.

ii) Indoor Motors : Light grey shade no. 631 as per IS-5.

iii) MCC / Panels : Siemens Grey RAL 7032 (Powder coated)

### 07.02.08 INSPECTION AND TESTING

**Inspection**

Within 6 weeks of the award of contract the successful Tenderer shall furnish the quality assurance plan (QAP) for electrical equipment.

Inspection & testing of equipment shall be undertaken by the Purchaser after finalization & approval of QAP by the Purchaser / Consultant.

The Purchaser shall have the right to be present and witness all tests being carried out by the successful Tenderer /sub-contractor at their own laboratory or approved laboratories.

**Method of giving inspection calls**

Inspection calls shall be given by the Tenderer. All calls shall accompany four sets of relevant test certificates and inspection report of the successful Tenderer /sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP.
Obligations of the Tenderer

The Tenderer shall provide all facilities and ensure full and free access of the Inspecting Engineer of the Purchaser to the Tenderer’s or their sub-contractor's premises at any time during contract period, to facilitate him to carryout inspection & testing of equipment during manufacture of equipment.

Testing

Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC/VDE/DIN/BS.

All routine tests shall be carried out at manufacturer's works in presence of purchaser or his representative.

The Tenderer shall submit type test certificates for similar equipment supplied by him elsewhere. Type test certificate shall not be more than 10 years old. In case type test certificates for similar equipment is not available, the same shall be conducted in presence of purchaser or his representative if purchaser so desires, without any financial implications to purchaser.

07.02.09

Drawings/Document to be Submitted By the Tenderer

A) Drawings/Data alongwith tender:-

1) Scope of work with general description of the system & equipment offered specifying the important features.

2) Bill of Quantities (unpriced) in specified format.

3) Detailed scope of Work.

4) List of deviations from technical specifications,

5) List of commissioning spares and consumables included with the main offer.

6) List of LT feeders above 110 kW rating (working + stand by).

7) Type test certificates for major categories of equipment, issued by independent testing authority.

8) Technical catalogues of equipment offered.

B) Data/Drawings to be submitted by supplier after placement of order:-
1. For Approval:

A. Calculations

1) Calculations for voltage dip for largest Motors.

B. Others

1. Technical details of MCC, PDB etc.
2. Front view and GA diagrams for all panels.
4. Control and schematics drgs. for local/remote control/protection for each equipment and drives.
5. Drive list. Starting torque/speed characteristics of motors.
7. Logic diagrams for start/stop of various mechanism/drives

2) For Information:

1. Details of painting for all equipment
2. Cable schedule.
3. Core wise control cable termination details indicating ferrule no./terminal block no. for each cable/each equipment.
4. Internal wiring diagrams for all panels.
5. Type test certificates for all the equipment.
6. Details of test results conducted at works and site for all equipment.
7. Panel wise bill of material indicating type make and brief technical particulars of all items/accessories mounted on the panels.
8. Overall GA of all the panels/equipment.
9. Technical data sheet for each type of motors and characteristic curves.
10. As built drawings incorporating site changes along with reproducible/soft copy.

07.03.00 PERFORMANCE REQUIREMENT AND GUARANTEE

The Tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.

All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the specification document and relevant clauses of the General Conditions of Contract. The guarantee for performance shall cover individual items and systems for their ratings/outputs.

Tenderer shall also guarantee the integrated operation of all the systems and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment.
The supplier shall conduct performance/acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified. The total system performance shall also be guaranteed and demonstrated.

Should the tests specified show that the unit has failed to achieve the guaranteed parameters, the supplier shall carry out necessary modifications or part replacements to achieve the guaranteed parameters and for successful demonstration the tests shall be repeated, without any cost implications to Purchaser.

Loading of the various system and their performance shall be demonstrated to the maximum possible extent.

07.04.00 TECHNICAL SPECIFICATION

07.04.01 LT MOTOR CONTROL CENTRE CUM PDB

Constructional Features
Fully drawout type with modules having service, test and isolated positions. Floor mounting, free standing with base channel 50 mm high for fixing on the inserts on the floor. MCC shall be single / double front, totally enclosed, dust and vermin proof with a provision of extension from both ends.

All the module of the MCCs shall be spacious to facilitate maintenance of equipment inside the module.

Pollution degree applicable shall be pollution degree 4 as per IS-13947 (Pt-I), 1993.

Incomer and bus coupler panels
MCC cum PDB incomers and bus couplers shall have Air circuit breakers. Incomers and bus couplers shall be rated for at least 125% of maximum demand taking into account the spare feeders and shall be suitable for the specified fault level.

Incomers and bus coupler shall be electrically and mechanically interlocked to prevent parallel operation. Any two of the three ACBs shall be closed at a time.

Feeder Modules
Feeders shall be fully drawout type. Motor feeders of 110 kW and above shall have 800A ACBs with composite numerical motor protection relays and other below 110 kW outgoing power feeders shall be with MCCBs / MPCB with contactors, over load relays etc., as required.

Ammeters with selector switches shall be provided for all continuous /
intermittent running motors beyond 15 kW rated drives.

**Busbars and terminations**

Busbars and connection shall be of high conductivity aluminium/aluminium alloy of suitable hardness and purity complying with as per IS-5082-1981. Busbars shall be insulated by colour coded heat shrinkable sleeves.

Busbars shall be rated for the nominal current rating of incoming breaker and for the full short-circuit rating. Earth bus shall run throughout the length of MCC at bottom.

Control bus shall be provided in the bus bar chamber isolated with main bus in all the MCCs. Similarly power and control terminations shall be in separate chambers in the MCCs. Cable allay shall have sufficient space for maintenance and minimum width of cable allay shall be 300 mm. Shrouding/isolation shall be provided for outgoing power terminations in the cable allays. Modules of MCCs shall be spacious for easy maintenance of the various equipment inside.

**Short circuit strength**

Rated short time withstand current shall not be less than 40 kA for 1 second. Rated peak withstand current not less than 2.1 times the specified short circuit level.

**Air circuit breaker(ACB)**

Air break, drawout type conforming to IS 13947 (1993) and symmetrical breaking capacity not less than 40 kA for 1 second shall be provided. Service short circuit breaking capacity (Ics) shall be 100% of rated ultimate short circuit breaking capacity (Icu). Performance category of the MCC shall be B.

Motor operated mechanism shall be applicable with air circuit breakers. Spring charged stored energy mechanism shall be there to ensure high speed closing and tripping independent of the operating forces. Electrical anti pumping and trip free feature shall also be provided. Spring charging universal motor suitable for rated control voltage (240 AC). The closing coil and trip coil shall be suitable to 240 V AC operation.

Closing and tripping of ACB shall be by closing coil (operating range 85% to 110% of rated voltage) and tripping by trip coil (operating range 70% to 110% of rated voltage) respectively.

ACBs shall have built-in direct acting type microprocessor based numerical releases for short circuit, over current and earth fault.

**Motor protection moulded case circuit breaker (MPCB)**

The characteristic shall match the motor duty application. Rated ultimate short circuit breaking capacity (Icu) shall be 40 kA. Ratings selected shall be at least
125% of the full load current of the motor. For small rating drives such as valves, Siemens 3UV13 type (or equivalent) or motor protection circuit breaker (MPCB) shall be used. Utilisation category shall be A.

**Magnetic contactors**
Pick up shall be positively at voltage between 85% to 110% of rated value. For frequently reversing drives, AC 3 rating selected shall be 50% higher than full load current of the motor at the specified duty cycle shall be provided. For reversible drives, mechanically as well as electrically interlocked contactors shall be used.

**Thermal overload relay**
Thermal overload relay shall be triple pole, ambient temperature compensated, inverse time lag, hand reset type, bimetallic with adjustable setting and built in single phase protection. The relay shall be able to withstand prospective short circuit-current without damage or injurious heating till the motor protection MCCB clears the fault. Tripping indication and reset push button operable from outside shall be provided.

**Push Buttons / Indicating Lamps / Indicating instruments**
Push buttons shall be spring return, push to actuate type and their contacts shall be suitable to carry and break 240 V AC, 10 A and 220 V DC, 1 A. Indicating lamps shall be LED LVGP (Low Voltage Glow Protection) type. Standard colours shall be applicable for push buttons and for indicating lamps. Indicating instruments shall be flush mounting, square dial with 90° scale with zero adjusting device for external operation. Accuracy class shall be 1.0 or better. KWh meter shall also be provided with incomers.

MCC shall have run/start, stop, tripped, and ready to start push button cum indication lamp for motor feeders.

**Current transformers**
The thermal and dynamic stability current for CTs and CT ratio shall be as per requirement. Protection and measuring current transformer shall be bar primary/window type with 1A secondary. Burden of CTs shall be as required by the associated measuring equipment.

**Control transformer**
Two (2) nos. Control transformers shall be provided. The power to these control transformers shall be tapped from the two incomers of the MCC cum PDB. Control transformers shall be dry type 415V/240V, primary taps at ±2.5 %, ±5 % and shall be mounted in draw out trolley. Control supply shall have supervision facility, alarm shall be provided for non availability of any one of the control supply. Automatic changeover facility shall also be provided. Auto-changeover shall be blocked if power supply to respective section is not available.

For capacity consideration of control transformers, each shall be capable to meet
100 % load including spare feeders and 20 % cushion for future and 15 VA for each module for remote aux. relays and indication lamps. However, suitable rating of control transformer shall be selected based on sizing calculation furnished by Tenderer subject to minimum rating of 5 kVA.

**Internal Control Wiring and external Terminations**

Internal control wiring shall be by 1100 V grade PVC insulated, single core stranded copper conductor of minimum cross section 2.5 sq.mm. for CTs and space heater circuits and 1.5 sq.mm for other circuits.

**For external terminations**, 1100 V grade multiway terminal blocks of non-tracking moulded plastic shall be used complete with insulated barriers, stud type terminals, washers, nuts and lock nuts and identification strips. Power and control terminals segregated.

**Other accessories**

Following items shall be provided for the MCCs under the scope of the Tenderer:

- Breaker lifting/handling trolley (for ACBs) : 1 No. per MCC
- Breaker racking handle (for ACBs) : 4 Nos. per MCC
- Panel key (if applicable) : 5 Nos. per MCC

**Other particulars**

Current transducers shall be provided for all the drives rated 30 kW and above and only for critical drives below 30 kW rating for remote metering.

All ACBs shall be EDO type with built in direct acting type microprocessor based numerical O/C, S/C & E/F releases. Minimum rating of incomer and buscoupler ACBs and outgoing ACB feeder shall be 800A.

Provision for tripping of pump motors on technological faults i.e., low level. Low pressure etc. shall be provided, wherever required. Also, standby pumps should start automatically in case of tripping of working pumps or if working pump fails to start. Tenderer to provide suitable provisions in the motor feeders.

Power supply to illumination, welding socket, power receptacle etc shall be fed from MCC cum PDB.

Selection of power components & wiring for continuous duty cage motor drives is given below:

<table>
<thead>
<tr>
<th>Motor Rating at S1 Duty (KW)</th>
<th>Minimum rating of MCCB</th>
<th>Minimum rating of contactor (AMPS) AC3 duty</th>
<th>Minimum size for internal power connections</th>
<th>Minimum size of power cable (sq.mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Copper wire (sq.mm)</td>
<td>Aluminium flat (mm x mm)**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aluminium</td>
<td></td>
</tr>
</tbody>
</table>

Technical Specification | ASH WATER RECIRCULATION SYSTEM | Page 100 of 203
Technical Specification

ASH WATER RECIRCULATION SYSTEM

Up to 3.7  *  25  4  ---  4 x 4 (copper)
5.5  *  40  4  ---  4 x 4 (copper)
7.5  *  40  6  ---  4 x 6
11  *  40  6  ---  4 x 16
15  *  63  10  ---  4 x 16
18.5  *  63  16  12 x 2  3.5 x 35
22  *  63  16  12 x 2  3.5 x 35
30  *  100  25  12 x 2  3.5 x 70
37  *  100  35  15 x 3  3.5 x 70
45  *  160  50  15 x 3  3.5 x 95
55  *  160  70  20 x 3  3.5 x 120
75  *  200  95  20 x 5  3.5 x 185
90  *  400  ---  20 x 5  3.5 x 185
110 ACB -  ---  30 x 5 (3.5 x 240)
125 ACB -  ---  40 x 5 (3.5 x 240)
135 ACB -  ---  40 x 5 (3.5 x 240)
160 ACB -  ---  40 x 5 (2(3.5 x 185)

* Minimum rating of MCCB shall be selected to achieve type `2' protection.

** Copper flat of equivalent size can be used instead of aluminium flat.

NOTES: Overload relay shall be selected based on actual full load current and starting time.

GENERAL TECHNICAL PARTICULARS OF MCC

GENERAL

1. System : 415V, 3 phase, 4 wire, 50 Hz. Solidly earthed neutral
2. Type : Indoor type, cubicle construction, free standing
3. Pollution degree : 4
5. Enclosure : IP54
7. Neutral earthing : Effectively earthed
8. Control supply : 240V AC for ACB
9. Short time rating : 50 kA for 1 sec
10. Autochangeover required? : No
11. Delay drop off required? : Yes
12. Control supply : 240V AC for ACBs, spring charge motor and for MCCB, etc.
13. Point shade : Siemens Grey RAL 7032 ( Powder coated )

AIR CIRCUIT BREAKER
1. **Service**: Indoor

2. **Type**: Air – break

3. **Insulation level Impulse withstand**: 6 kV (1.2x50 micro Sec)

4. **Utilization Category**: B

5. **Operating mechanism**: Stored energy type
   - **Closing**: Motor wound spring operated
   - **Opening**: Shunt trip coil
   - **Latching arrangement**: Mechanically and electrically trip free

6. **Auxiliary Voltage**
   - **Closing**: 240V AC (85% - 110%)
   - **Tripping**: 240V AC (70% - 110%)
   - **Spring charging motor**: 240V ± 10% AC
   - **Space heater & lamp**: 240V ± 10% AC 50 Hz

7. **No. of poles of C.B**: 3

### CURRENT TRANSFORMERS

1. **Type**: Resin cast, window type

2. **Rated voltage**: 415 V ±10%

3. **C.T. secondary rating**: 1 Amp

4. **Accuracy**
   - **Protection**: 5P10 or better for protection
   - **Metering**: Class – 1

### CONTROL TRANSFORMER

1. **Type**: Dry cast resin, class B or better

2. **Voltage ratio**: 415V/240V

3. **Rated burden**: As per requirement (Minimum 5 kVA)

4. **Quantity**: 2 nos. per board

### MOULDED CASE CIRCUIT BREAKER

1. **Type**: Air break (Motor duty)

2. **Rated service voltage**: 415 V ± 10%

3. **Utilization Category**: A

4. **Protection**: Type `2 to the contactor

CONTACTORS

1. No. poles : 3
2. Rated service voltage : 415 V ± 10%
3. Control circuit : 240V ±10% 1ph, 50Hz ±5%
4. Utilisation category : AC23A for uni-directional motors, AC24A for bi-directional motors
5. Limits of operation
   i. Closing (pick-up) : 85% to 110%
   ii. Dropout : Shall not be higher than 75%

RELAYS/RELEASE

1. Relay type : Numeric
2. Release type : Numeric

THERMAL OVERLOAD RELAYS

1. Type : Ambient temperature compensated bimetal operated hand reset type (direct or C.T. operated)
2. Hand resetting feature : To be provided at the front of the panel
3. Single phasing protection : Built in

07.04.02 ELECTRIC MOTORS / ACTUATORS

MOTORS

General

All motors shall generally conform to IS 325 and CBIP publication No. 140. Motors shall run continuously at rated output with ± 5 % variation in frequency and ± 10 % variation in voltage and ± 10 % combined variation of frequency and voltage (absolute sum). Motor shall not stall due to momentary drop in voltage up to 70 % of rated value and shall run satisfactorily for 5 minutes at a supply voltage of 75 % of rated value.

The limiting value of voltage at rated frequency under which motor will start and accelerate to rated speed with load shall be assumed to be a constant value of 80 % rated voltage throughout the starting period.

All motors shall be supplied with foundation bolts (if applicable), drain holes with plugs. Motors shall be designed for 50°C ambient temperature.

Motors supplied shall be complete with required double compression cable glands, crimp type cable lugs and first filling of lubrication, name plate, etc. Guards shall be provided to prevent accidental touch for couplings and for free shaft ends shall be provided.
Degree of protection for motor and bearings shall be IP-55 for indoor and IP55 with rain canopy for outdoor. Motor shall be suitable to withstand at least three successive starts from system cold condition and two starts from hot condition at normal system voltage and frequency.

The drive motor shall have at least 15% margin over the maximum power requirement of the driven equipment after considering all losses, derating due to temperature and specific site and operating conditions.

The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to phase difference between the incoming voltage and motor residual voltage.

**LOW VOLTAGE INDUCTION MOTORS**

Frame sizes shall be as per IEC. Casing feet shall be integral with the motor body. For motor of rating up to 5 kW, ball bearings shall be used for both DE & NDE end. For ratings above 5 kW the DE end shall be provided with ball/roller bearing and NDE end shall be provided with ball bearing. Bearings shall be suitable for running of motor in either direction. Motors 110 kW and above shall be provided with bearing temperature indicators. Explosion proof/increased safety design for explosion hazardous areas as per requirement.

Terminal box shall be of suitable dimension to receive aluminium cables and shall be rotatable by 4x90°.

Cooling of motors shall be of TEFC (IC0141) design. Ventilation shall be effective irrespective of direction of rotation.

Motors shall be dynamically balanced. Vibration intensity shall be limited as per IS 12075 (1987). Continuous noise level should not exceed 85 dBA at a distance of 1.0 m from motor body.

Starting current shall be less than or equal to six times the rated current with IS tolerance. Motors shall have class 'F' insulation with temperature limited to class 'B'.

Space heaters shall be provided for all motors rated above 30kW.

Adequate handling space shall be provided for all the big LT motors.

**ELECTRICAL ACTUATORS**

All control valves shall be motorized electrically operated with manual operating handles.

The actuator shall be designed for operation on 415V, 3 phase, 50 Hz system. The actuators shall consist of motor, torque/position limit switches, clutch, hand wheel, position indicator, space heater.
The actuator enclosure shall be totally enclosed dust tight, water proof without the necessity of any canopy. Insulation of the drive shall be class ‘B’.

Two torque limit switch one for each direction and four for end of travel limit switch (two for each direction) shall be provided. Emergency manual operation shall be provided and hand wheel shall de-clutch automatically when motor is energised.

Position transmitter, potentiometer type shall be provided for remote indications wherever required.

Internal wiring shall be of 1.5 sq.mm copper wire, however, terminals for external connections shall be suitable for 2.5 sq.mm.

07.04.03 CABLE AND CABLE ACCESSORIES

Type 1: 1.1 kV, XLPE aluminum power cables - suitable for 415V, 3 phase, 50 Hz system.

1.1 kV, heavy duty power cable multi-core aluminum conductors, XLPE insulated, core stranded together provided with a common covering of PVC extruded inner sheath of type ST1 PVC compound, galvanized flat / wire armoured and FRLS PVC extruded outer sheathed of type ST1 PVC compound conforming IS:7098. (Part-I) , as amended up to date.

Type 2: 1.1 kV PVC copper control cable.

1.1 kV annealed copper conductor, PVC insulated of type A PVC compound as per IS:5831 - 1984, cores stranded together provided with a common covering of PVC extruded inner sheath of type ST1 PVC compound, flat / wire galvanized armoured and overall FRLS PVC extruded sheathed of type ST1 PVC compound and multi-core to IS : 1554 (Part-I) - 1976, Type :

FRLS cables shall meet the following requirements;

Critical oxygen index, temperature index and smoke density tests shall conform to the requirement of ASTM-D 2863.

Oxygen index minimum 30%, the minimum temperature index 250 deg C and the minimum average light transmission of 40%.

Acid gas generation limit shall be as per IEC 754-1.(Hydrochloric acid gas released 20% maximum)

Ignition resistance and flame propagation shall conform to IEC 332-1 and Fire resistance test shall conform to IS 5831.
Flammability test and flammability test on group of cables (in installed condition) shall conform to requirement of IEEE 383 and IEC 332-1.

**In multi-core control cables, the following minimum reserve cores shall be kept at the engineering stage:**

- Upto 7 cores - One reserve core
- 10 cores - Two reserve cores
- 14, 19 & 24 cores - Three reserve cores

Sequential length marking shall be provided in outer sheath of all power and control cables.

Standard drum length for all types of power and control cables shall be offered. ISI marking at every meter of cable length shall be provided.

Cores of multi-core control cables shall be serially numbered.

For all cables, extra length of 2 meters will be left before jointing.

**Additional Tests on cable**

To prove the fire retardant low smoke characteristics, the following additional tests shall be conducted at works on any size of each type of cable namely, L.T/power, control and instrumentation cables.

- Oxygen index test as per ASTM D 2863. Minimum value of Oxygen index shall be 30.
- Flammability tests on finished cable as per the requirements of IEEE-383 and IEC-332-1.
- Smoke generation by inner/outer sheath fire as per ASTM D 2843. The cables shall meet the requirements of light transmission of minimum 40% after the test.

**Specifications for miscellaneous materials**

**Connectors**

Cable termination shall be made with aluminium/ tinned copper crimped type solderless lugs of approved make for all aluminium conductor and stud type terminals.
Cable identification
Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number as per cable schedule.

Ferrules
Ferrules shall be approved interlocked type & size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

Cable Glands
Cable glands to be supplied shall be nickel plated brass double compression type. Glands for classified hazardous areas shall be certified by CMRS and approved by CCE, Nagpur.

Cable clamps
All cables shall be clamped with metal clamps and single core cables shall be clamped with trefoil clamps made of aluminium.

Cable trays
This shall be prefabricated hot dip galvanised sheet steel trays. Runner size shall be 50x50x6 and rung size shall be 25x5 at every 250 mm. At one meter interval two rungs shall be provided side by side to facilitate clamping. Galvanising content shall be minimum 86 microns.

All the cable trays shall be hot dip galvanized GI trays, ladder or perforated as the case may be. Beside, Tenderer shall also provide 900/450 bends of cable trays at the bends as per actual site requirement.

07.04.04 ILLUMINATION

General
The scope shall cover the following illumination systems;

- Normal AC lighting of the plant
- Peripheral lighting within battery limit
- Rechargeable Portable LED Lamp set – 4 Nos.

Illumination shall be provided in all premises coming under the battery limit of the package including peripheral lighting.

Tenderer shall consider sufficient number of LDBs, as required. The main Lighting Distribution board (MLDB) shall be fed through lighting transformer of suitable rating considering 30 % margin for future.
The illumination system shall include the following in required quantities:

- Lighting DBs
- Light fittings with lamps
- Lighting fixtures and accessories
- Cables and wiring
- Ceiling fans
- Receptacles
- Switches
- Conduits
- Brackets
- Hangers
- Clamps
- JBs
- Any other items as required

Illumination levels envisaged for different areas will be as indicated below:

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Area</th>
<th>Lux</th>
<th>Type of light fittings</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control rooms</td>
<td>400</td>
<td>Decorative Fluorescent (FL)/CFL</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>2</td>
<td>Office</td>
<td>400</td>
<td>Decorative Fluorescent (FL)/CFL</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>3</td>
<td>Hall / Pump Area</td>
<td>250</td>
<td>Sodium Vapour (SV)</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>4</td>
<td>Equipment/switch gear &amp; MCC room</td>
<td>250</td>
<td>Fluorescent (FL) / CFL</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>5</td>
<td>Stores</td>
<td>150</td>
<td>FL / CFL</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>6</td>
<td>Toilets</td>
<td>100</td>
<td>FL / GLS</td>
<td>AC normal lighting</td>
</tr>
<tr>
<td>7</td>
<td>Corridor</td>
<td>100</td>
<td>FL / CFL</td>
<td>AC normal lighting</td>
</tr>
</tbody>
</table>

Sufficient numbers of areas wise lighting distribution boards (LDBs) will be distributed all over the plant. All the LDBs will be fed from MCC cum PDB.

All LDBs will have one incomer only. LDBs will have MCCB / MCB as incomer and MCB as outgoing feeders.

Peripheral lighting shall be done with 150 W HPSV lamps with suitable control gear compartment having ballast, igniter, P.F. improvement capacitor and connector block. The fittings shall be of outdoor use with degree of protection not less than IP 54 (for lamp compartment) and IP 53 (for control gear compartment).

All civil works required for illumination shall be under Tenderer’s scope.

The complete drawings of lighting networks and lighting layout shall be prepared and submitted by the Tenderer for approval.
Following types of light fittings shall be considered;

- Industrial SV light fittings (high bay / medium bay / low bay)
- Industrial SV light fittings (bulkhead)
- Decorative incandescent lamp fitting
- Decorative fluorescent light fitting
- Industrial type fluorescent light fitting

1400 mm sweep ceiling fans shall be provided at other required places. The ceiling fan shall be complete with electronic regulator. MCC room shall have 300 mm sweep exhaust fans.

230 V, 3 pin, 15/5 A decorative sockets shall be provided in the various premises as per requirement and shall be fed from LDB. Items such as brackets, hangers, clamps, junction boxes, etc which are required to make the lighting installations complete in all respects shall also be supplied.

Power supply to individual fittings shall be through 2x2.5 sq.mm armoured cables. Higher size cables like 10/16 sq.mm shall be considered for street lighting.

Miscellaneous items like 240 V single pole switch, 240 V socket outlets, cables and wiring, etc shall be provided by the Tenderer as per requirement of the plant.

Complete earthing of the illumination network shall be under scope of the Tenderer.

Following type of lamps shall be generally used;

<table>
<thead>
<tr>
<th>Type</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL / CFL</td>
<td>40W</td>
</tr>
<tr>
<td>SV</td>
<td>70W, 150W, 250W, 400W</td>
</tr>
<tr>
<td>MV</td>
<td>70W, 150W, 250W, 400W</td>
</tr>
</tbody>
</table>

Lighting fixtures of electrical rooms shall be industrial, energy efficient fluorescent type with electronic chokes. Control room shall have energy efficient CFL type lamps.

The complete drawings of lighting networks and lighting layout of each and every premise shall be prepared and submitted by the Tenderer for approval.

**LIGHTING DISTRIBUTION BOARD**

The LDBs shall be suitable for 415 V, 3 phase and neutral, 25KA (short time rating for 1sec) indoor type
The LDB shall generally comprise of incoming MCB / MCCB, requisite no of outgoing MCBs (as applicable and required) and adequately rated bus bars.

The board shall be sheet steel clad, totally enclosed, dust & vermin proof and wall mounting type. The board shall have welded back and sides and gasketted hinged door at the front with door handle and suitable locking devices. Detachable gland plates shall be provided a the top and bottom with suitable gaskets for cable entry. Operating knobs of MCCB shall be accessible only after opening the front door of the cubicle. Protective insulated cover plate shall be provided inside the cubicle to shroud all the live parts. Adequate space shall be provided within the board to facilitate termination of incoming & outgoing cables. The boards shall be factory wired and assembled. Where specifically called for, the boards shall be of special weatherproof design suitable for outdoor installation. Colour shade of the boards shall be 631 of IS: 5-1991. The enclosure class of LDB shall be IP 54. The terminals of MCCB shall be fully shrouded. The MLDB shall be fed from MCC cum PDB through lighting transformer. Identification labels and inscription plates shall be provided for the boards. These shall be as per approved drawings.

One continuous earth bus shall be provided at the bottom part of the LDBs along the full-length of the board with two bolted type earthing terminals. Proper danger plates shall also be provided on each board.

Number of LDBs and their locations shall be finalized during drawing approval stage.

| Incomer   | - 32A MCB / 63A MCCB |
| Outgoings | - 20A MCB |
| No. of feeders | - As per requirement + 30% spares |

**07.04.05 EARTHING AND LIGHTNING PROTECTION**

Earthing network shall be installed near the AWRS station premises by the Tenderer. Tenderer shall include complete earthing of the plant within battery limit including the following:

1. Main earthing Ring
2. Equipment earthing / Structure earthing
3. Electronic earthing, etc
4. Ring earthing
Tenderer shall include complete earthing material including earth electrodes, risers, MS rod, earthing strips, other accessories, etc. and carry out main earth grid, earth pits, risers, interconnections, equipment earthing, all associated civil works, etc. within battery limit of the package. All the interconnections with other earthing systems of the plant and with existing systems shall be under scope of the Tenderer.

The scope of Tenderer shall include the supply of all earthing materials viz. MS rod, earthing flats and all other required material to complete earthing system and lightning protection.

The actual soil resistivity of plant area shall be obtained by the Tenderer by carrying out soil resistivity tests and design the earthing system accordingly.

While designing the earthing system, Tenderer shall note following fault levels at different buses;

415 V : 50 kA

The materials shall be galvanized steel laid over the ground and mild steel buried inside the ground/concrete. Complete civil works related with earthing shall be under scope of the Tenderer.

Maximum allowable temperature rise for steel bolted joints shall be taken as 310°C taking ambient temperature of 50°C.

All electrical equipment shall be earthed as per provisions of Indian Electricity Rules / IS code of practice, namely, IS-3043 and others. Connection from the earth flat to the motors/devices shall be through stranded GI wires. Size of GI flat shall be 25 mm x 3 mm. Size of stranded GI wire for motors/starter upto 2.2KW shall be 6 sq.mm and for motors/starter above 2.2KW and upto 15KW, it shall be 16 sq.mm.

The termination of strips to the equipment shall be done by bolting and the wires shall be terminated by compression lugs. Contact surfaces shall be tinned. Jointing of strips shall be done by welding for proper continuity. All contact surfaces shall be thoroughly cleaned of dust and oil. Bitumen paint shall be applied on the joints.

Earthing conductors run on walls/floors/cable and equipment structures etc. shall be supported at suitable intervals and painted with black oxide paint.

At road/rail crossings earthing strips/rods shall be laid through conduits/concrete ducts.

For different floors in a structure/building, localized internal earthing ring shall be formed and connected to the ground earthing ring through vertical risers. The earthing mat shall be common to both power and lighting installations.

Each RCC steel column of the building will be interconnected to the under-ground
earthing grid in basement/ground floor.

The armour of cables and all conduits for cables shall also be connected to the earthing mains. A continuous earth strip shall run in each side of cable channel and in cable ducts and trenches.

All joints in the run of the main earthing conductors will be welded or brazed type. Connection to equipment structure shall be bolted type. All welded joints shall be protected from corrosion by applying bitumen paint.

For the purpose of dimensioning the earthing lines/conductors, the duration of the earth fault current shall be taken as 0.3 seconds.

For protective earthing separate conductor shall be used for flow of earth fault current as elaborated below.

The power supply cables (LT) from the sub-station and the distribution cables to individual motors shall have 4cores / 3.5 cores. The fourth core or armour of cables and all conduits for cables shall be connected to the earthing mains. A continuous earth strip shall be run in each side of cable tunnel and in cable ducts and trenches as applicable.

LT power supply cables shall have four cores and the fourth core shall have cross-sectional area of 50% of the other cores generally. The fourth core of the main supply lines shall be connected to the solidly earthed neutral bar in the MCC/distribution boards.

Conductor sizes for ground connections:

For equipment ground connections, the minimum conductor sizes used should be as follows:

<table>
<thead>
<tr>
<th>Size of GI flat</th>
<th>To be used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>6mm² Stranded GI wire</td>
<td>Motors and starters up to and including 2.2kW, shunt limit switches, push buttons and master controllers, light fitting, JBs, PBs, etc. Instruments and miscellaneous small items protected by fuses of ratings not exceeding 15A.</td>
</tr>
<tr>
<td>16 Sq. mm Stranded wire</td>
<td>Motors and starters above 3.7 kW and up to and including 15 kW.</td>
</tr>
<tr>
<td>25 x 3 mm GI flat</td>
<td>Motors and starters above 15 kW, and up to and including 45 kW Control desks, cabinets, LCB, socket outlet isolators, SLDBs/DBs.</td>
</tr>
<tr>
<td>50 x 6 mm GI flat</td>
<td>Motors and starters over 45 kW and HT motors Switchboards, MCC, PDB, PCC, MLDB.</td>
</tr>
<tr>
<td>50 x 6 mm GI flat</td>
<td>Main earthing ring in plant buildings Bonds to crane gantries</td>
</tr>
</tbody>
</table>
**Technical Specification for Ash Water Recirculation System**

<table>
<thead>
<tr>
<th>LT Switchboards and other equipment protected by circuit breakers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>65x8 mm GI flat</td>
</tr>
<tr>
<td>LT transformers, substation earthing ring</td>
</tr>
</tbody>
</table>

**Note:**

Earthing pits and earth ring in the Plant area shall be installed by the Tenderer. Connecting the equipment to the earthing network is also included in the Tenderer's scope.

**Erection, installation accessories**

All support structures required for cables, and for electrical equipment including conduits, inserts, shall be provided to complete the erection job in all respect. Cable tag markers, clamps, sealing compound, pull boxes, marshalling boxes etc. shall be considered as part of the tenderer's scope.

All buildings and plant structures shall be protected against atmospheric flash over and lightning strokes in such a manner as to eliminate any danger to the personnel employed therein. Stipulations of IS : 2309 - 1969 shall be followed.

A ‘Faraday Cage’ made of hot galvanised strip steel connected to all buried pipes and steel structures crossing this cage ring shall be laid around each main building or plant unit as earthing device. This shall be separate from the electrical equipment earthing ring main.

Design shall be as per the standard like IS 2309 (latest revision) and Indian Electricity Rules.

All lightning arrester earth leads of the buildings and plant units shall be connected to this cage ring.

Air termination network should cover all salient points of the structure. All metallic structures, ducts and the like above the roof of the structure shall be bonded to and form part of the air termination network. Vertical air termination points shall project at least 30 cm above the object on which it is fixed.

Down conductors shall follow the most direct path possible between air termination and earth termination avoiding sharp bends. Down conductor shall have a testing point adjacent to the earth electrode. Each conductor shall have an independent earth termination. All earth terminations shall be interconnected.
Earthing electrodes and grid for lightning protection will be distinct separate from the earthing system for earthing of electrical equipment and at no place will be connected to other earthing system.

07.04.06 MISCELLANEOUS ELECTRICS

A. LOCAL CONTROL STATION
Near all drives local control stations shall be provided. Local stations shall have sheet steel construction, dust and vermin proof, and wall/structure mounting. Push buttons shall be mounted on front hinged gasketted and lockable door. For HT motors, start, stop, and emergency stop push button and for LT motors, open/close/trip or start/stop, as applicable, shall be provided along with Local/Remote Selector switch, ON/OFF indication lamps, ammeter for motor rated 30 kW and above. LCS shall have 2NO+2NC contacts.

Suitable knockouts with glands shall be provided on the bottom or top cover for cable entry. Terminals shall be suitable for 2 cores of 2.5 sq.mm conductors with 20% spare terminals. Stop push button to be lockable type with mushroom head and key to release. Enclosure conforming to IP-54 class for indoor and IP55 with canopy for outdoor. Explosion proof/increased safety type shall be provided in hazardous areas.

All LPB stations shall be made of Cast Aluminium with minimum thickness of 2.5 mm. Press to stop and press to release (red colour) shall be provided for all the motors. All LPBS for HT Motors shall be provided with Ammeters.

B. ERECTION, INSTALLATION ACCESSORIES
All support structures required for cables, busducts and for electrical equipment including conduits, inserts, shall be provided to complete the erection job in all respect. Cable tag markers, clamps, sealing compound, pull boxes, marshalling boxes etc. shall be considered as part of the Tenderers scope.

C. OTHER ITEMS
All required safety items like shock treatment chart, first aid boxes, danger boards, boards indicating 'Man on Work, Do not switch ON', 'Do not switch OFF', 'EARTHED' etc. shall be provided in each electrical premises.

PVC floor of suitable voltage grades of 1 Mtr width in front of all the panels like HT switchboards, LT switchboards (PCCs), MCCs, PMCCs, DBs, control panels,
etc

Wall mounted aux. AC and DC distribution boards shall be provided in sufficient number to facilitate proper distribution of the power supply to various users.

Industrial type, metal clad welding socket, 240V & 415V power sockets shall be provided in sufficient number to facilitate extension of power supply to various machine tools, welding sets etc. in all the areas and floors. In addition to above 24V AC sockets with portable hand lamps shall be provided for maintenance lighting. All cabling for sockets shall be laid in conduit.

Tenderer to include closing of all cable and panel openings through a Fire sealing material. This shall include closing of all bottom opening of control room panels, MCC switch boards, wall openings in all the areas, etc. Tenderer shall also include earthing of all equipments/system, wherever required, under his scope of supply.

Welding socket outlets shall be provided at every 60 Mtr distance. The number of welding socket outlet shall be as per requirement and approach. Generally they shall be provided in such a way that using 30 mtr flexible cable with welding set, total plant area can be covered. They shall be fed from separate aux. ACDBs.

Tenderer shall include painting of all the plant and equipment with approved shades and include primers as well as finishing paints.

Sufficient quantity of GI ladder type factory fabricated cable trays made from 2.5 mm thick hot welded steel sheets grade ‘o’ as per IS : 2062 shall be provided. Hot dip galvanizing of 85 micron thick as per IS-2629, IS-4759 and IS-209. Trays shall be of standard length of 3 m with max deflection not exceeding 1/400 of span with sufficient load bearing capacity. Wherever required, hot dip galvanized GI perforated tray shall also be provided.

All cable trays shall be hot dip galvanized GI trays ladder or perforated type as the case may be. Tenderer shall also include 900/450 bends of the cable trays at the bends as per actual site requirement.

All cable supporting structures including all accessories shall be under scope of the Tenderer.

### D. WELDING SOCKET

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Voltage rating</td>
<td>415V TPN, 50 Hz., 50KA.</td>
</tr>
<tr>
<td>2.0</td>
<td>Isolating switches</td>
<td>Load breaker isolating switch.</td>
</tr>
<tr>
<td>3.0</td>
<td>Current Rating</td>
<td>63 A</td>
</tr>
</tbody>
</table>
## Technical Specification for Ash Water Recirculation System

### 4.0 Duty category
AC23 category conforming to IS:13947 (Part-3)-1993

### 5.0 No. of pins
- 5 pins (three phase – neutral and one earth)
- Shall be supplied with metal clad plug.

### 6.0 Type
Heavy duty type.

### 7.0 Material
2.5 mm thick sheet steel (CRCA)

### 8.0 Enclosure
- Dust and weather proof.
- Minimum IP55 enclosure protection.

### 9.0 Mounting
Wall / structure mounting.

### 10.0 Interlocking
The switch socket shall be suitably interlocked so that it is not possible to insert or withdraw the plug without switching off the isolator.

### 11.0 Cable entry
Top and bottom both.

### 12.0 Cable gland plate
Removable undrilled cable gland plate (minimum 3 mm thick).

### 13.0 Terminal
Adequately sized for termination of 2 nos. welding cables of 3.5x70sq. mm aluminium either directly or through GI pipe

### 14.0 Paint

### 15.0 Earthing
Earthing studs shall be provided on two opposite sides.

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### E. 240V, 5 / 15A INDUSTRIAL TYPE SWITCH SOCKET OUTLETS

Socket outlets for 240V supply shall be of 3-pin (Two-pole and one earth), non-reversible, metal-clad, dustproof and shall be industrial type suitable for horizontal insertion. 240V Socket outlets shall be controlled by rotary type switch mounted flush in the socket outlet box. Operating handle of the rotary switch shall be fixed in such a manner that it shall not be possible either to insert or withdraw the plug without switching off the supply. All socket outlets shall be supplied with heavy-duty type plug and cap with chain. The isolating switches shall be manually operated industrial type of category AC 22 conforming to IS:13947 (Part 3) :1993. The isolator shall be housed in dust and vermin proof sheet steel enclosure suitable for terminating copper conductor cables either directly or through conduits. The current rating for the socket outlets shall be 5A and 15 Amp. 3 pin , 240V switch-socket outlets shall be provided with interlocked switches, scrapping earth connection, male and female units and cover .

Inscription plate shall be provided indicating the voltage and current rating of the switch socket outlet.
<table>
<thead>
<tr>
<th>Component</th>
<th>Preferred Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective relays</td>
<td>AREVA / ABB / SIEMENS</td>
</tr>
<tr>
<td>Auxiliary relays</td>
<td>ABB / ER / SIEMENS / AREVA / BCH</td>
</tr>
<tr>
<td>LT Motor</td>
<td>BHEL / CGL / KEC / ABB / ALSTOM / BBL / SIEMENS</td>
</tr>
<tr>
<td>Local control station (LCS)</td>
<td>ECC / BCH / GEMCO / ALSTOM / L&amp;T / MEDITRON / SIEMENS / SWITCHING CIRCUITS / TECHNOCRAT ENGINEERS</td>
</tr>
<tr>
<td>壨 CC/MCC</td>
<td>SIEMENS / L&amp;T / GE POWER / ABB</td>
</tr>
<tr>
<td>LT air circuit breaker</td>
<td>L&amp;T / ABB / SIEMENS / GE POWER</td>
</tr>
<tr>
<td>Current transformers</td>
<td>ABB / SILKANS / PRAGATI / AE / KAPPA / SIEMENS / L&amp;T / JYOTI / AEP</td>
</tr>
<tr>
<td>Potential transformer</td>
<td>ABB / BHEL / SILKANS / PRAGATI / KAPPA / SIEMENS / ABB</td>
</tr>
<tr>
<td>Moulded case circuit breaker (MCCB)</td>
<td>SIEMENS / ABB / L&amp;T / GEPOWER / ALSTOM / MERLIN GERIN</td>
</tr>
<tr>
<td>Motor protection circuit breaker (MPCB)</td>
<td>L&amp;T / GEPOWER / SIEMENS / MDS / SCHNEIDER</td>
</tr>
<tr>
<td>H.R.C. fuses</td>
<td>L&amp;T / SIEMENS / GEPOWER</td>
</tr>
<tr>
<td>AC power contactors</td>
<td>ABB / L&amp;T / SIEMENS / GE POWER / BCH / GE POWER</td>
</tr>
<tr>
<td>DC power contactors</td>
<td>BHEL / L&amp;T / SIEMENS / GE POWER</td>
</tr>
<tr>
<td>Bimetallic overload relays/auxiliary relays</td>
<td>ABB / BCH / L&amp;T / SCHNEIDER / GE POWER / SIEMENS / S&amp;S / TELEMECANIQUE</td>
</tr>
<tr>
<td>Miniature circuit breaker (MCB)</td>
<td>HAVELLS / MDS LEGRAND / HAGAR (L&amp;T) / ABB / SIEMENS</td>
</tr>
<tr>
<td>Transducer</td>
<td>ABB / MECO / RISHAB</td>
</tr>
<tr>
<td>Control desks/panels, control devices and field devices:</td>
<td></td>
</tr>
<tr>
<td>Control desks/control cabinets/contacts boxes</td>
<td>HINDUSTAN CONTROL / GEMCO / ABB / ALSTOM / BHEL / L&amp;T / SIEMENS</td>
</tr>
<tr>
<td>Control switches / Selector switches</td>
<td>ALSTOM / BCH / KAYCEE / GE POWER / SIEMENS</td>
</tr>
<tr>
<td>Push buttons</td>
<td>BCH / L&amp;T / SCHNEIDER / SIEMENS / GE POWER</td>
</tr>
<tr>
<td>Timers/time delay relay</td>
<td>ABB / BCH / L&amp;T / GEPOWER / SIEMENS</td>
</tr>
<tr>
<td>Control contactors</td>
<td>SIEMENS / L&amp;T / TM / CGL</td>
</tr>
<tr>
<td>Control transformers</td>
<td>INDCOIL / AE / GYRO / BCH</td>
</tr>
</tbody>
</table>
### Indicating/monitoring/annunciating devices:

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Manufacturer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicating lamp (led type)</td>
<td>BINAY/ ESSEN/ VAISHNO</td>
</tr>
<tr>
<td>Solid state annunciator</td>
<td>ADVANI OERLIKON / AREVA / APLAB / L&amp;T / MINILEC</td>
</tr>
<tr>
<td>Meters</td>
<td>IMP / AE / MECO / SECURE METERS / CONZERV / L&amp;T / RISHAV</td>
</tr>
<tr>
<td>Digital type multifunction meter</td>
<td>CONSERVE / L&amp;T / SECURE / ER / RISHAV</td>
</tr>
<tr>
<td>Watt-hour meter</td>
<td>BHEL/SIMCO/ABB</td>
</tr>
</tbody>
</table>

### Switch socket outlet:

| Switch / Welding socket              | BCH/ SCHNEIDER/ BEST & CROMPTON/ GE POWER/ HAVELL/ JAIBALAJI                   |

### Cables and cabling accessories:

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Manufacturer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power &amp; Control Cables</td>
<td>CCI/ UNIVERSAL/ NICCO/ RPG CABLES (ASIAN)/ POLYCAB</td>
</tr>
<tr>
<td>Terminal block</td>
<td>ESSEN/CONNECT WELL/ ELMEX/ PHOENIX</td>
</tr>
</tbody>
</table>

### ILLUMINATION:

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamps</td>
<td>BAJAJ/ CROMPTON GREAVES/ GE LIGHTING/ PHILIPS</td>
</tr>
<tr>
<td>Light fitting (fixtures) complete</td>
<td>BAJAJ/ CROMPTON GREAVES/ GE LIGHTING/ PHILIPS</td>
</tr>
<tr>
<td>with all accessories except lamp</td>
<td></td>
</tr>
<tr>
<td>Lighting wire (pvc)</td>
<td>CCI/ DELTON/ FINOLEX/ NICCO/ UNIVERSAL</td>
</tr>
<tr>
<td>5a/15A piano switch</td>
<td>ANCHOR/ ELLORA/ MDS LEGRAND/ PRECISION</td>
</tr>
<tr>
<td>Flame proof light fitting</td>
<td>BALIGA</td>
</tr>
<tr>
<td>Exhaust fans</td>
<td>CGL/ KHAITAN/ BAJAJ</td>
</tr>
<tr>
<td>Ceiling fans</td>
<td>CGL/ KHAITAN</td>
</tr>
</tbody>
</table>

**NOTE:** For items not indicated above, Tenderer shall have to obtain prior approval from the purchaser / consultant.
08.00 INSTRUMENTATION & CONTROL

08.01 General

01. This specification is intended to define the basic requirements for instrumentation system for “Ash Water recirculation system (AWRS)” at TTPS, Lalpania with a view to achieve smooth, efficient, safe and reliable operation of the process.

02. This specification, read together with General Conditions of Contract (GCC) and other commercial terms & conditions, shall form the Tender document, against which Tenderer (here-in-after called bidder) shall submit their complete & most competitive techno-commercial offers.

03. Measurement and control equipment, which will be offered for the process, shall be complete in all respect in line with this specification. Any equipment / accessories not explicitly indicated in this specification, but considered essential for proper functioning of technological equipment and process shall be included by Bidder in their scope of work and supply.

04. Monitoring, Alarm & Interlock functions for the process parameters & equipment of the Ash Water recirculation system (AWRS) shall be achieved through panel mounted type secondary instrumentation along with alarm annunciation system.

05. Remote monitoring instruments of the plant shall be in general Smart (HART) type and shall be interfaced with the panel mounted secondary Instrumentation system.

06. All the instrumentation equipment shall be brand new & supplied from the latest product ranges of reputed manufacturers as per the List of Preferred Makes.

07. Electromagnetic flow meters shall be supplied for all flow measurement. Suitable length of MS material pipes shall be supplied along with flow meters for proper installation of flow meter in the DI process pipeline.

08. Diaphragm seal type pressure gauges / switches shall be provided for local measurement / signaling of pressure.

09. Measurement signals from the field Instruments (switches/ transmitters) shall be hooked up to the Instrument panel for display & audio visual alarm annunciation. Instrument panel shall be located inside the MCC cum control room.
10. Bidder shall execute the Ash Water recirculation system (AWRS) package on a turnkey basis including its complete instrumentation & control system to the satisfaction of Purchaser.

11. Bidder shall comply with all the requirements indicated under General; Scope of Work and Supply; List of Measurement, control, alarm & interlock; MCC cum Control Room; control philosophy; Submission of Drawings & Documents, general technical specification & list of preferred make and other related clauses/ annexure included in this specification.

12. All correspondences / documents shall be in English language and for all the data, drawings & documentation metric or SI units shall be followed.

08.02 SCOPE OF WORK AND SUPPLY

Bidder’s scope of work and supply shall include design; engineering; manufacture/ procurement; assembly; calibration; shop testing; inspection at works & at site; painting; packing; transportation to site including loading, unloading, storage & handling of all Instrumentation equipment including electrical accessories, cables, pipes, erection accessories, panels/ cabinets and all associated hardware, as required for completeness of instrumentation system in all respect, site fabrication (Structural Items), erection, testing, commissioning of the complete Instrumentation system for completeness and satisfactory & stable operation of Plant for Ash Water recirculation system. The scope of work shall also include liquidation of defect points, participation in tests for establishment of plant performance guarantee (PG) and post commissioning activities till issue of final acceptance certificate (FAC) by TTPS.

The scope of work and supply shall also include, but not limited to, the following:

1) Instrumentation equipment as per the measurement list covered under clause number 13.03 of this specification.

2) Impulse pipes, isolation valves, fittings, trays, conduits, steel structures & frames, erection hardware & accessories, as required for this package.

3) All electrical accessories for instrumentation system and other instrument power supply equipment as applicable.

4) Power supply to instrumentation equipment shall be through UPS system.
5) Fully wired cabinets/ panels/ control desks, junction boxes, pull boxes, transmitter cabinets, etc., as applicable.

6) Galvanized trays, conduits, protection pipes, fittings, steel structures & frames, erection hardware & accessories, as required for this package.

7) Erection, testing, calibration and commissioning of the total equipment included in this specification. Successful Bidder shall arrange tools, tackles and consumables as may be required for erection, testing, calibration and commissioning activities.

8) Arrangement of and participation in inspection of Instrumentation equipment by Purchaser/ Consultant. Inspection and Testing shall be carried out in compliance with the Quality Assurance Plans, to be approved during detailed engineering stage.

9) All the instrumentation tapping points, sensors, field instruments, equipment etc. shall be located at safe and approachable locations. Provision of sufficient working space, suitable working platforms, safe & proper approach (monkey ladders shall be avoided) and lighting points shall be included.

10) All types of control, signal, RTD & LT power cables and special cables, as required for this package.

11) Preparation of earth pit for the Instrumentation system, supply of earthing materials including cables and installation of separate earthing system for Instrumentation system.

12) Fully wired cabinets/ panels, etc with MCBs, Fuses, CFL Lamps, Universal type service sockets, Earth strips, etc

13) Commissioning spares as required.

14) List of operation & maintenance spares for two years. Supply of 2 years operation & maintenance spares is not included in the scope of bidder.

08.03 LIST OF MEASUREMENTS AND CONTROLS

An indicative list of measurements, controls, alarms & interlocks for Ash Water recirculation system is given below and Bidder shall comply with the same. However, Bidder shall offer all the measurements, controls, alarms & interlocks as may be required for efficient & satisfactory operation of their process and equipment and are included in their scope of work & supply. Bidder shall indicate detailed list of the same in their offer.
Clear water Pumps:

1. Local indication of pressure at discharge side of each pump using pressure gauge.
2. Low pressure sensing at discharge side of each pump using pressure switch along with alarm annunciation and interlocking with pumps’ operation.
3. Remote indication, recording of pressure at common discharge header of pumps using pressure transmitter.
5. Remote indication, recording and totalisation of flow at common discharge header of pumps using magnetic type flow meter.
6. Remote indication, recording and totalisation of flow at common discharge of intermediate location (just inside the plant boundary on pipe rack) using magnetic type flow meter.
7. Level signaling of water at clear water sump along with low, very low, high & very high level alarms annunciation at MCC cum control room and necessary interlocking with pumps’ operation using level switch/transmitter.

08.04 **MCC cum Control Room:**

Monitoring, Control and other operational activities of the Ash Water recirculation system shall be carried out from MCC cum control room. Ventilation system shall be provided in the room with proper illumination arrangement.

As required, contacts for the alarm / interlocks for Instrumentation will be generated through microprocessor-based recorder/ directly hard wired for better operation & performance of the process.

Required capacity of UPS & all other electrical accessories shall be provided for Instrumentation items. UPS shall be located inside the MCC cum control room. Min. 50% spare capacity shall be considered for UPS.

Supply of following control room furniture (Godrej make) for control room:
- Operator’s chair (movable) – 2 nos
- Operator Table (3 feet X 2 feet) – 1 nos
- Almirah (3 feet X 6 feet) – 1 nos
08.05 Brief Control Philosophy:

1. Clear water pump house will be located near ash pond. Clear water pump (2W+1S) will receive water from clear water sump located near pump house and will pump the water to the existing ash water sump located inside the plant premises.

2. Clear water pump will be started from local control station of pumps and maintain 6 bar pressure (min.) & 330 m3/hr flow at the common delivery of the pumps.

3. Level switch will be installed at the clear water sump for dry running protection of pumps. Low level alarm & high level alarm will be displayed at alarm annunciation system. Low-Low level contact will be used by MCC for tripping the running motor and also low-low level alarm will be displayed in the alarm annunciation system.

4. Pressure switch will be installed at the delivery of each pump for monitoring of delivery pressure. Low pressure alarm will be generated in the annunciation system. Also, switching contact will be used by MCC for tripping the corresponding running motor. Further, same contact (duplicated through relay logic) will be used for auto start the standby pump.

5. Flow meter will be installed at the pump common delivery header and intermediate location (just inside the plant boundary on pipe rack). Low flow alarm will be generated by recorder and will be displayed in the annunciation system for both flow meters. Low flow contact from flow meter (Inside plant boundary) will be used by MCC for tripping of the running motor.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Remote Indication</th>
<th>Recording</th>
<th>Interlock</th>
<th>Alarm Low</th>
<th>Alarm Low-High</th>
<th>Alarm High</th>
<th>Alarm High-High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Switch</td>
<td>--</td>
<td>--</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Pressure Switch</td>
<td>--</td>
<td>--</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Meter (pump common delivery)</td>
<td>√</td>
<td>√</td>
<td>--</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Flow Meter (Just inside the plant boundary on pipe rack)</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

08.06 LIST OF DRAWINGS & DOCUMENTS
Following drawings and documents shall be submitted by Bidder for Instrumentation & automation system:

A) **ALONG WITH OFFER**

01 Process and instrumentation (P & I) diagram indicating all local & remote measurements, controls, alarms and interlock functions, using ISA symbols and suitable tag numbers against each instrumentation equipment.

02 List of measurements, controls, alarms & interlocks, along with Bill of Quantities.

03 Total requirement of electrical power and for instrumentation & control equipment.

B) **BY SUCCESSFUL BIDDER DURING DETAILED ENGINEERING:**

I) **FOR APPROVAL:**

01. Finalised process and instrumentation (P & I) diagram indicating all local & remote measurements, controls, alarms and interlock functions, using ISA symbols and using suitable tag numbers against each instrumentation equipment.

02. Instrument list indicating make, model number, scale range, quantity, application and tag number (as per P&I diagram) of each instrumentation item.

03. Detailed specification datasheet for each instrumentation item, filled in as per the format (eg. ISA format) finalized for this plant.

04. Overall General arrangement drawings & sectional views of various panels, etc., showing internal disposition of all components/ units, with dimensional details and bill of materials.

05. MCC room layout drawing showing disposition of panels, desks, etc with dimensional details.

06. Single line power supply diagram with specification and bill of quantities of electrical accessories.

07. Quality assurance plan for each instrument & control equipment.

II) **FOR SCRUTINY AND REFERENCE**
01. Detailed technical literature/catalogue for each instrumentation & control equipment with peripherals, highlighting the selected model numbers, which is required to check the data sheets.

02. Design data, sizing calculation & selection criteria along with all related charts, curves, tables and fabrication drawings of Flow meter/element.

03. Instrument Installation/Hook up diagrams with bill of materials.

04. Cable schedules.

05. Manufacturer's test, calibration and guarantee certificates for all instruments, control and automation equipment.

06. “As-built” documentation.

07. Soft copy of all the above drawings & documents in CDs / DVDs.

08.07 GENERAL TECHNICAL SPECIFICATION

The general technical specification shall be followed by the bidder for selection of field instruments:

08.07.01 Pressure measurement:

1. Either bourdon tube, bellows or diaphragm type sensing element shall be used in pressure gauges/switches, depending on the process service.

2. The pressure gauges shall be designed in accordance with IS: 3624, 1987 or BS EN 837 or ASME B40.100.

3. Pressure gauge accuracy shall be ±1.0% of span or better. Accuracy shall include the combined effect of linearity, hysteresis and repeatability.

4. The element and other wetted part materials of pressure gauges/switches shall be of AISI 316, unless process media necessitates use of other materials.

5. Movement material of gauges shall be of AISI 304. Outer casing and bezel material shall be made of stainless steel.

6. Pressure gauges shall have external zero adjustment facility and minimum IP55 housing.

7. The sensing element of pressure gauges/switches shall withstand the specified over-pressure (i.e., at least 125% of span) for at least 30 minutes, without affecting their elastic characteristics.
8. Pressure gauges shall have dial size of 150 mm diameter. Gauges of smaller dial size may be used for machine mounted applications. Pressure gauges shall have ½” NPT thread in general.

9. Pressure gauges/ switches used in pulsating pressure applications (e.g. delivery side of pumps, compressors, etc.) shall be provided with externally adjustable pulsation dampener or snubber. For machine mounted applications or in case of mechanical vibration at mounting location, either liquid (glycerin) filled gauges shall be used or standard gauges mounted away from tapping point shall be used. All pressure/ differential pressure gauges & switches for compressors & pumps shall be separately mounted on panel or stand and connected with SS braided Teflon hose.

10. Window material of the pressure gauge shall be of shatterproof glass.

11. For pressure measurement in slurries, viscous and corrosive fluids, diaphragm seals of suitable material shall be provided along with pressure sensing devices. Diaphragm seals shall be integral with the gauges /switches, unless otherwise specified.

12. The sealing liquid for diaphragm seal shall be an inert liquid compatible with process fluid and its temperature.

13. Depending on process application, suitable chemical seal along with capillary of required length shall be provided.

14. Diaphragm seal type pressure gauges / switches used in applications where the temperature exceeds 100°C, shall have bourdon / bellows type element. The bourdon / bellows shall be selected to withstand temperature upto 200°C.

15. The working range of pressure switches shall be selected in such a way that the set pressure is between 35% and 65% of the range.

16. The switch enclosure shall be weatherproof to IP 65. Additionally, in hazardous areas, switch enclosure shall be explosion-proof conforming to IS: 2148: 2004 /IEC 60079-1 : 2001 and suiting to the area-classification of the hazardous area.

17. Dry contact type micro switches with minimum rating of 240V AC, 5A / 110VDC, 0.4A shall be used for pressure switches in non-hazardous area applications.

18. In hazardous areas, hermetically sealed micro switches with minimum rating of 240 VAC, 5A / 110VDC, 0.25A shall be used.

19. Pressure switches shall have an accuracy of at least ±2% of span and repeatability of at least ± 1% of span.

20. Pressure gauges shall be supplied with three-way gauge cock. DP gauges shall be supplied with 3-valve manifolds of AISI 316 material of suitable pressure and temperature rating. The above items shall be in
addition to the process isolation valves/ root valves at the process tapping point.

08.07.02 Electro - magnetic flow meters:

Selection of Electromagnetic flow meters, shall be decided based on the following:

1. All electro-magnetic flow meters shall be field bus based or SMART type with HART protocol with 4-20 mA DC output.
2. Liner material shall be selected based on service. Generally, for liner material PTFE shall be used.
3. If gases are entrained in the liquid, meter shall be installed in vertical process line. While installation it shall be ensured that flow tube is always completely filled with liquid.
4. Straight length requirement of minimum 5 D in the upstream and 3 D in the downstream shall be provided for water services. However, for other services it shall be designed as per manufacturer’s recommendation.
5. Installation of electromagnetic flow meters shall be avoided near large conducting surface e.g. metal surfaces. (Large surface may interfere with magnetic field of instrument thus affecting accuracy).
6. Pulsed DC excitation or dual frequency shall be provided for field excitation of Electro-magnetic flow meter. Power & signal circuits of electro-magnetic flow meter shall be completely isolated from each other.
7. Minimum one no. of grounding ring for metallic pipelines and two nos. of grounding rings for non-metallic pipelines shall be provided for installing the electro-magnetic flow meters.
8. Selection and sizing of electro-magnetic flow meters flow characteristics published by the manufacturers shall be followed. Allowable flow velocity shall be considered based on the specific merit of the service, allowable pressure drop, cost effectiveness and as per manufacturers recommendation. However, 2 to 3 meter/sec flow velocity or as recommended by manufacturer shall be considered for optimum results.
9. In case tube sizes are lower than the process pipelines reducers and expanders constructed preferably from the same as pipeline material shall be used. Such reducers and expanders shall be designed with 8(eight) degree downward and 5(five) degree upward angle respectively.
10. Accuracy of electro-magnetic flow meter shall be ± 0.35 % or better. Local display shall be calibrated in engineering unit unless otherwise specified.
11. Separate sensor & transmitter type electro-magnetic flow meters shall be provided for line sizes > 400 mm and also, wherever there are installation/ approach problem for integral type.

12. Electro-magnetic flow meter shall be provided with built-in auto zero facility for ensuring stable zero point.

13. For dirty liquid application, replaceable type electrode shall be used.

14. Enclosure class of electro-magnetic flow meters shall be minimum IP 66.

08.07.03 Temperature Measurements

1. RTD shall generally be used for measurement in the temperature range of -200°C to 300°C.

2. For all applications, temperature transmitters shall be used. Head mounted type transmitters shall not be provided.

3. RTDs shall usually be three-wire type. Four-wire type RTDs shall be used, whenever specifically required.

4. For differential temperature measurement by RTDs, Pt-1000 elements shall be used.

5. Pt-100 or Pt-1000 RTDs shall have “;” of 0.00385 /°C.

6. All temperature transmitters shall be field bus based or SMART type HART compatible, as applicable.

7. All temperature transmitters shall be single channel.

8. RTD assembly shall be spring-loaded to ensure positive contact with thermowell.

9. Separate conduits or cable entries shall be provided where duplex thermocouples / RTD are used.

10. Thermowells shall be provided for all applications to enable maintenance work of temperature gauge / RTD without affecting production. Thermowells shall be bar stock type for upto 600 mm immersion length and fabricated type for immersion length more than 600mm.

11. AISI 316 shall be used as thermowell material, unless other special material is required due to process fluid and conditions.

12. Any pipe of less than 4” nominal diameter, shall be expanded to 4” size to install thermowell.

13. Bimetallic type thermometers having minimum dial size 150mm shall be used for local indication of temperature. Temperature gauges with smaller dial sizes may be used for machine mounted applications.
14. For bimetal type thermometers, external dial reset facility shall be provided for zero adjustment.

15. The temperature gauges shall be designed in accordance with ASME B40.200/ BS 5235/EN 13190 or other international standards.

08.07.04 Level Measurement

Selection of primary elements shall be based on the service conditions. A general guideline is given below. However, selection of particular type of sensor shall be decided on the basis of application requirement.

For sumps

i) Conductivity switches

ii) Capacitance switches

1. Level instruments shall have weatherproof, dust and corrosion resistant enclosures of minimum IP-65 grade.

2. Additionally, explosion-proof enclosures shall be provided for hazardous area applications.

Capacitance & conductivity type

1. Capacitance / conductivity type probes shall be as follows:
   ➢ Rod type: for lengths up to 2000 mm.
   ➢ Rope type with gravity weight: for length exceeding 2000 mm.

2. For level measurement in non-conducting tanks or sumps or when the tank profile is non-linear, capacitance type instruments shall be provided with a reference electrode / ground probe.

3. Capacitance type level probes may be used for both switching as well as for continuous level measurement in liquids.

4. Capacitance type level probe shall not be used for level measurement in solids when there is likelihood of material build-up on the probe. Capacitance type level probe shall not be used in liquid service where there is a chance of di-electric value change (due to oil spillage etc.).

08.07.05 INSTRUMENT PANELS / CABINETS

1. Panels shall be totally enclosed; flush-front, freestanding upright floor mounted type with welded construction. Panels shall be mounted on box-type base-frame.
2. Panels shall be made of cold rolled cold annealed (CRCA) sheet steel with thickness as follows:
   - Front face, gland plate, equipment mounting plate and other load-bearing sections: 3mm
   - Door, top, bottom and side faces: 2mm

3. Sizes of panels and cabinets, as approved by purchaser / consultant, shall only be supplied.

4. Panel height shall be 2200 mm, with an additional 100x50x6 mm base channel and 15 mm thick anti-vibration pad on top. The panel / cabinet shall have minimum depth of 800 mm. Height and colour of new panels, to be installed in any existing room, shall match with those of existing panels.

5. If the panel width exceeds 600 mm, double-door type construction shall be provided.

6. Panel doors shall have flush-type and lockable door-handles. Pockets for keeping drawings, shall be provided on inner side of the doors.

7. Panel doors shall have mesh-covered louvers at top & bottom, for air circulation. Additionally, wherever necessary, push-pull type circulating fans shall be provided for cooling of equipment inside.

8. In general, mounting height of instruments in the panel shall be as follows:
   - Miniature instruments (bottom levels matched):
     - Bottom row - 1000 mm
     - Middle row - 1350 mm
     - Top row - 1600 mm.
   - Annunciator: 1900 to 1950 mm (bottom levels matched):
   - Push buttons: 800 mm center line (excluding base channel)
   - Hooter (for alarm): Outside cabinet - preferably at panel top.

   Panel-mounted instruments conforming to DIN size and mounted in the same row shall have their bottom levels matching.

9. All equipment inside the panel shall be located in such a manner that their terminals and adjustments are readily accessible. Panels shall be dust and vermin proof. Panels installed in control rooms shall be weatherproof having minimum IP42 degree of protection. Suitable gaskets shall be provided, for this purpose.

10. Panel / cabinets located in the field shall have minimum IP-54 degree of protection. Pressurised local cabinets shall be installed in dusty areas.
Pressurisation shall be achieved inside the cabinet by introducing clean (i.e., dust-free) air.

11. A space of at least 1.5m shall be provided in front and behind panels / cabinets for ease of operation and maintenance.

12. If the length of a panel exceeds 5m, approach from both sides shall be provided.

13. No process fluid other than air shall be piped to the panel / cabinet.

14. Panels / cabinets / desks etc. shall be supplied in finish-painted, completely wired and tested condition.

15. Panels shall first be chemically de-greased, de-rusted and phosphate. Then, 2 coats of red-oxide shall be applied. Finally, 2 coats of synthetic enameled paint or epoxy-based paint shall be applied to have a non-glossy high class finish with aesthetically pleasing appearance and long life.

16. Colour shade of panels shall conform to RAL 7035. Outside shade of panels shall generally be RAL 7035, unless otherwise specified. The inside of panels shall be of brilliant-white. Panel base channel shall be painted black.

17. However, the supplier shall ensure uniformity of colour and height of all the panels as per customer's choice, wherever instrument panels are installed along with electrical or other panels in the same room, or also as per existing plant standard, wherever applicable.

18. Panels shall have lifting hooks or eyebolts on the top at the four corners, for ease of transportation.

19. Instrument power supply shall be through UPS.

20. The inside of panels / cabinets / local panels shall be illuminated, preferably using incandescent type lamp. The illumination lamp shall be switched on/off using either a door switch or a toggle switch.

21. An inscription plate (with white letters on a black background) containing the tag no. etc. shall be provided for each instrument / device mounted on the panel. Separate nameplates shall be provided for rear-panel mounted instruments.

22. Anti-vibration mounting or shock absorber shall be provided for panel-mounted instruments in vibration-prone areas.

23. ISA symbols shall be used in Mimic panels. Graphic design, colours, materials, etc. used in mimics shall be in accordance with existing plant standard or as per Purchaser's choice.

24. For panel wiring, following guidelines shall be followed:

Signal wiring 1.0mm2 PVC insulated, stranded Cu-wire: gray colour
Power supply wiring:

For 240/110V, 50 Hz (for power) 1.5 mm² PVC insulated stranded Cu-wire, colour code:
  ⇒ Live : red
  ⇒ Neutral : black
  ⇒ Earth : green

For 24V, DC signal 1.0 mm² PVC insulated stranded Cu-wire, colour code:
  ⇒ Positive : brown
  ⇒ Negative : blue

For 24V, DC solenoid valves 1.5 mm² PVC insulated stranded Cu-wire, colour code:
  ⇒ Positive : grey
  ⇒ Negative : yellow

- arth 4.0 mm² PVC insulated stranded Cu-conductor, colour code: green-yellow spiral

25. Screen wires of screened signal cables from the field shall be earthed at the electronic earth-pit of the control system, which shall be separate and independent with respect to the power supply earth grid.

26. The following points shall be taken care of while deciding the internal layout of instrument panels or cabinets:
   i. Electrical voltage higher than 240 V AC/DC shall not be brought inside the instrument panel / cabinet.
   ii. All internal wiring shall be housed in covered, non-flammable plastic raceways. Ferrule printing machines shall be used for ferruling.
   iii. Separate wiring raceways shall be used for power supply wiring, signal wiring and intrinsically safe circuits’ wiring.
   iv. Distance between the continuous edges of two adjacent terminal strips shall be minimum 100 mm.
   v. Separate terminal strips shall be provided for 24 V DC, 240/110 VAC and intrinsically safe terminals.
   vi. Distance between cable gland plates & bottom of terminal strips shall be minimum 300 mm.
   vii. Terminal blocks shall be screw-less clip-on type.
   viii. For signal wiring, 2.5 mm² size terminals shall be used.
   ix. For power wiring, 4.0 mm² terminals shall be used.
x. Terminal Blocks shall be of different colors for power, signal and earth.

xi. A minimum of 20% spare terminals shall be provided, for power, signal and intrinsically safe circuits’ wiring.

xii. Terminal blocks shall be mounted about 450 mm above bottom plate.

xiii. Power supply terminals (e.g. 240VAC or 110VAC or 24VDC) shall be labeled.

xiv. In case a bus bar is used for power supply distribution, the bus-bar shall be shrouded with a transparent Bakelite plate.

27. Panels or cabinets shall be provided with the following items:
   i. Power socket (of 240V AC, 15W rating) for soldering, etc.
   ii. Pair of earthing bolts on either side of the panel (at the bottom) for power earthing.
   iii. Copper bus-bar (of size 25x3mm.) mounted on an insulated base inside the panel with holes and nut-bolts - for instrument signal earthing (i.e., electronic earthing).

---

08.07.06 Instrument Signal Cable

1. Armoured & screened pair / triad cables shall be used for all instrumentation discrete & continuous signal applications. For each field instrument, pair / triad cable shall be used from field instrument to JB. From JB to control room, multi-pair/ triad cable shall be used. Looping of power at the junction box shall not be done. Separate JB shall be used for discrete & continuous signal. Cables can also directly run from field to MCC without using JB.

2. Instrumentation pair/triad cables shall conform to the following:
   i) All cables shall be screened &armoured.
   ii) Applicable standards: Latest revision of IS 8130, IS 5831, BS 5308
   iii) Conductor material shall be annealed, tinned, multi-stranded, electrolytic grade copper of size 1.0 mm2.
   iv) Number of strands and strand size of conductor shall be 7/0.43.
   v) Primary insulation material shall be of Extruded HRPVC type C of thickness (nom) 0.6 mm.
   vi) Individual pair/triad shall be shielded by aluminum mylar tape, helical type, 0.06 mm thick (nom) with 100% coverage and 25% overlapping.
   vii) Drain wire shall be of annealed tinned copper, 0.5 mm2, and 7 strands continuously in contact with the shield. Drain wires shall be provided for each pair/ triad screen.
viii) Inner sheath shall be Extruded HRPVC (ST2 type). Thickness (nom) shall be
➢ 0.8 mm for single pair
➢ 1.1mm for 2 to 3 pair & for 1 to 2 triad
➢ 1.2mm thick for 4 to 7 pair & for 3 to 4 triad
➢ 1.3mm thick for 8 to 14 pair & for 5 to 9 triad
➢ 1.5mm thick for 15 to 20 pair & 10 to 13 triad
Inner sheath colour shall be black.

ix) Overall shielding shall be helical type 0.075 mm thick aluminum Mylar tape with 100% coverage and 25% overlapping.

tax) Overall drain wire shall be of annealed tinned copper, 0.5 mm2, and 7 strands continuously in contact with the shield.

xi) Ripcord shall be provided & shall be non-metallic type under sheath.

xii) Armour material shall be galvanized round steel wire.

xiii) Armour size shall be 0.9mm up to 3-pair/2 triad, 1.25mm for 4 to 7 pair & for 3 to 4 triad, 1.6mm for 8 to 20 pair & 5 to 13 triad.

xiv) Outer sheath shall be HRPVC/ FRLS (as applicable) Extruded ST2 type. Thickness (nom) shall be
➢ 1.4mm upto 3 pair/ 2 triad
➢ 1.6mm for 4 to 7 pair & for 3 to 4 triad
➢ 1.8mm for 8 to 14 pair & for 5 to 9 triad
➢ 1.9mm for 15 to 19 pair & 10 to 12 triad
➢ 2.0mm for 20 pair/13 triad
Outer sheath colour shall be blue.

xv) Tests shall be carried out according to following standards of latest revision:
   a) General: IS: 1554 (Part I) except for thick nesses of insulation & sheath.
   b) Insulation: IS: 5831except insulation resistance, Voltage and Spark tests, which shall be as per BS 5308 Part II
   c) Armour: IS: 3975
   d) Armour Galvanisation: IS: 2633
   e) FRLS properties test
      ➢ Oxygen Index According to: ASTM D2863
      ➢ Temperature Index According to ASTM D2863
      ➢ HCl Emission According to IEC 754-1
      ➢ Smoke density According to ASTM D2843
      ➢ Flame Retardant test According to IEC-332 Part III Cat A
xvi) Pair/ Triad shall be identified with numbers as per BS 5308.

xvii) Electrical characteristics, values like, resistance at 20 0C, Mutual capacitance (core to core), mutual capacitance (core to screen), mutual inductance, L/R ratio shall be indicated in the specification datasheets.

xviii) A durable marking provided on the surface of the cable at regular intervals not exceeding 625 mm. The marking shall include manufacturer’s name, conductor material and size, no. of pair, insulating material etc. as per IS: 1554 (Part I).

3. Instrumentation Power supply cable:
   i) All cables shall be armoured. For 240 VAC/ 110VAC power supply to field instruments, directly 3-core cable from control room/ power distribution board to individual instrument through individual MCB shall be used.
   ii) Conductor material shall be annealed, tinned, multi-stranded electrolytic copper of 1.5 mm2.
   iii) Number of strands and strand size shall be min 7/0.53.
   iv) Primary insulation material shall be of Extruded HRPVC type C. Thickness (nom) shall be 0.8 mm.
   v) Inner sheath shall be Extruded HRPVC (ST2 type). Thickness (nom) shall be 0.3mm. Inner sheath colour shall be black.
   vi) Armouring shall be of galvanized round steel wire or galvanized steel strip as per IS 1554 (Part 1).
   vii) Outer sheath shall be Extruded HRPVC (ST2 type). Thickness (nom) shall be 1.24 mm, 1.4 mm, 1.56 mm as applicable & conforming to IS 1554. Outer sheath colour shall be black.
   viii) Tests shall be carried out according to following standards of latest revision:
   a) General: IS: 1554 (Part I).
   b) Insulation: IS: 5831
   c) Armour: IS: 3975
   d) Armour Galvanisation: IS: 2633
   e) FRLS properties test
      ➢ Oxygen Index According to: ASTM D2863
      ➢ Temperature Index According to ASTM D2863
      ➢ HCl Emission According to IEC 754-1
      ➢ Smoke density According to ASTM D2843
      ➢ Flame Retardant test According to IEC-332 Part III Cat A
   ix) Core identification shall be as per IS 1554 (Part I).
x) Electrical characteristics, values like, resistance at 20°C, Mutual capacitance (core to core), mutual inductance, L/R ratio shall be indicated in the specification datasheets.

xi) A durable marking provided on the surface of the cable at regular intervals not exceeding 625 mm. The marking shall include manufacturer’s name, conductor material and size, no. of pair, insulating material etc. as per IS: 1554 (Part I).

4. Shield shall be kept open at the instrument end and to be connected to the electronic earth pit at the control room end.

5. All instrumentation cables (pair/triad) shall be numbered as per BS 5308, Part 1.

6. All cables, from field JBs to panels/ marshalling rack in the control room shall have at least 10% (minimum 1 no.) spare cores.

08.07.07 Recorder

All recorders shall be 6/12-channel high speed chart-less type with SVGA/TFT screen and multiple display formats. Specification of recorder shall comply the following:

- **Input signal**
  - Universal and all are freely configurable

- **Accuracy**
  - +/- 0.1 % FS

- **Power supply**
  - 85 - 265 VAC, 50 Hz

- **Panel cut out**
  - 138 x 138 mm

- **Input signal sampling rate**
  - Adjustable from 125 msec and onward

- **Internal memory**
  - Exceeding 50 MB or more or data storage without battery back up having continuous historical trend data storage (with 20mm grid division of historical trend equal to 60 minutes interval) readable and retrievable wrt time by scrolling at least for 90 days whichever is more. Auto memory update. Information storage in history by input key preferable.

- **Display**
  - Colour TFT/SVGA size 5 inch or larger; Selectable Vertical/ Horizontal/ Partial/ Zone/ Zooming/ Compressed/ Expanded etc.; Selectable Trend with digital/ Bar with digital/ Digital/ Trend & Bar together with digital/ Circular trend & alarms etc. Selectable Ch. Grouping single or multiple.
  - Selectable 24 no. of colours at least; Adjustable contrast & brightness
➢ Auto and manual channel & group scan for each channel & parameters with adjustable timing with channel description.
➢ Channel skip by programming; Channel description at least 12 character
➢ Number of decimal places freely programmable Adjustable clock

Configuration ➢ Through front panel key pad and provision for upload & download from PC system through USB port.

External storage/ Archive ➢ USB pen drive of size 8 GB or more, software compatible to MS windows and user-friendly to be provided in CD for displaying trend & analysing retrieved data in PC. Option for hourly, daily, weekly, monthly etc.

Communication ➢ Ethernet with TCP/IP Network communication of cable length - 50 Metre and USB ports.

Mathematical function ➢ All math. functions like Constant, Addition, Subtraction, Multiplication, Division, Square root, Logical, Totalisation with programmable or manual reset (totalised PV up to 10 digit or more by ten raised to the power also acceptable), Counter, Timer, Rolling average, Non-linear to linearsation for non linear inputs. All math. functions to be displayed in separate math. channels on programme.

Alarm event functions ➢ Independent HI & LO Potn. Free contact, H-HH, L-LL for each ch. by configuration with acknowledgment. Relay contact rating 2 - 3A, 250 VAC. Programmable delay for each alarm contact from 100 msec. to 5 sec. preferable.

PV Scale/ display range ➢ Large scale or preferably scientific notation with freely selectable decimal point. Configurable PV unit.

Security ➢ Pass word protected

Message display ➢ To be available on programme

08.08 PREFERRED LIST OF MAKES

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>ITEM DESCRIPTION</th>
<th>PREFERRED MAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td><strong>Field Instruments:</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Pressure / Differential Pressure / Temperature gauge

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIKA, Ashcroft (Precision Industries), Forbes Marshall, Gauges Bourdon (GIC), A.N. Instruments, Waaree instruments, Tiwac (Walchandnagar), Hirlekar (DP gauge) Manometer India, H.Guru</td>
<td></td>
</tr>
</tbody>
</table>

## Pressure / Differential Pressure switches.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ifm, WIKA, Switzer, Indfoss, Gauges Bourdon (GIC), Waaree instruments, Ashcroft (Precision Industries), Orion (Kasturba)</td>
<td></td>
</tr>
</tbody>
</table>

## Pressure / Differential Pressure Transmitters

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerson, Fuji (Chemtrols), Honeywell, Yokogawa, ABB, Siemens</td>
<td></td>
</tr>
</tbody>
</table>

## RTD / thermowell

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>General Instruments, Toshniwal Industries, Tempsens, Pyro-electric Instruments, Industrial Instrumentation, Waree.</td>
<td></td>
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</tbody>
</table>

## Electromagnetic flow meter

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yokogawa, Emerson, ABB, Siemens, Endress&amp;Hauser, Krohne-Marshall</td>
<td></td>
</tr>
</tbody>
</table>

## Level Switch (Conductivity type)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endress&amp;Hauser, Vega (WIKA), Switzer Instruments, SB Electro-mechanical, Techtrol, Level-Tech, Nivo Controls</td>
<td></td>
</tr>
</tbody>
</table>

## Level Switch (Capacitance/RF type)

<table>
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<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endress&amp;Hauser, WIKA (Vega), K-TEK, SB Electro-mechanical, Switzer Instruments, Techtrol, Nivo Controls</td>
<td></td>
</tr>
</tbody>
</table>

## Instrument Panel/ Junction boxes

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
</table>

## Control room Instrumentation

### Digital Indicator

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrotech Electronics, Lectrotrek, Chino, Micro systems, Master Electronics, Masibus Instruments, Ranutrol, Honeywell, PEPL</td>
<td></td>
</tr>
</tbody>
</table>

### Recorders (Chart Less)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eurotherm, Yokogawa, Chino, Honeywell, Siemens, ABB.</td>
<td></td>
</tr>
</tbody>
</table>

### Annunciation system

<table>
<thead>
<tr>
<th>Brand</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIC, Procon, Micro Systems &amp; Controls, Minilec, Instrumentation Ltd, Lectrotrek, Piri systems, Pyrotech Electronics, MB controls</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Instrumentation Cable (Screened, paired, triad etc.) &amp; Power cable</td>
</tr>
<tr>
<td>---</td>
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</tbody>
</table>

4. Instrumentation Cable (Screened, paired, triad etc.) & Power cable

& Systems, Semuda.
09. CIVIL WORK

09.01 SCOPE & GENERAL INSTRUCTION

1. The Tenderer’s scope shall include complete engineering and construction on a turnkey basis inclusive of design, basic engineering, detailed engineering, supply of all materials, construction and testing in respect of all facilities required for completion and handing over of the work as per technical specification.

This section of the specification covers entire civil engineering work for Ash Water Recirculation System with pump house, pipe line, MCC room, and other related works including equipment foundations for building and Plant & equipment, and all other miscellaneous civil engineering works as shall be necessary for completing this package on a Turnkey Basis within the battery limit.

2. All civil works for the structures, equipment foundations, facilities and miscellaneous civil works to be provided for the project shall include but not be limited to the following:

a) RCC Sump: On ground sump of minimum capacity: 2640 m³ shall be provided. Suitable slope shall be provided inside the sump and drain pit to be provided at one end for dewatering purpose. There shall be 2 compartments in the sump which will receive water from common distribution channel. The distribution channel and compartments shall be connected with Sluice gates.

b) Pump house: Pump house shall be of civil RCC framed structure with RCC column, roof and necessary cladding/ filler brick work for pump house with provision of minimum 1 no. of rolling shutter, door and windows. Monorail hanging from roof, supported on beams for handling of pump and motor during maintenance.

c) Pump Foundations: RCC pump foundations for the clear water pumps inside the pump house.

d) Electrical Panel room: Panel cum control room shall be of civil RCC framed structure with RCC column, roof and necessary cladding/ filler brick work for pump house with provision of door and windows. Panel cum control room shall be located adjacent to pump house.

e) Toilet Block: A toilet block shall be provided adjacent to the pump house with all plumbing arrangements.

f) RCC pedestals for pipe: Pedestals for pipes shall be provided @8m span. Load to be considered for pedestal design shall be 450 kg/m (considering 2 pipes of DN 400, 1 for future provision).
**g) Foundations for pipe rack:** Pipe rack foundations to be considered with pipe load of 450 kg/m and structural load to be obtained from structural section.

**h) RCC garland drains around all units and connection of the same to sump.**

All other civil works necessary to complete the work in all respects. RCC stairs to be provided to access sump roof and roof of pump house. Four manholes (1500 X 1500) to be provided for maintenance at roof of sump.

3. All necessary water proofing and anticorrosive treatment to structures/ reinforcements/ foundations including underground construction.

4. All temporary facilities, structures, offices, cement stores, labour colonies, staff quarters, approach roads and services for construction for this package are under the scope of the Tenderer at his own cost.

5. Micro leveling of the site upto 20m all-round the battery limit is within the scope of Tenderer prior to completion of work at his own cost. The successful Tenderer shall remove the construction debris, scrap, dust etc. on regular basis, preferably weekly / or as directed by Engineer from time to time to meet the requirement of environmental policies till completion of the work failing which the same will be carried out through other agency at his Risk and cost with a single notice.

6. Dismantling of buried/ semi-buried structures, if any, encountered within the battery limit and disposal of it within plant boundary as directed by the Owner at the cost of tenderer.

7. Carrying out detailed soil investigation and geo data survey at the proper site and prepare report for obtaining approval of purchaser.

09.01.01

**The materials and services shall include but not limited to the following:**

1. Earthwork for structures and equipment foundations, trenches, pits, and other construction work including control blasting of soft rock or hard strata as required. If at all blasting is required, it shall be done at no extra cost with the prior approval of Owner.

2. Site clearing, dressing, leveling and grading of formation to required levels and soil compaction as necessary.

3. Backfilling, soling and sub grade work for all foundation, grouting, flooring, trenches, pits and other underground structures.

4. Foundations as required for building and equipment. DPC course at plinth level and Anti termite treatment of excavation pit and premises shall be provided as per technical specification.
5. Concrete and reinforced concrete work in columns, tie beams, beams, slabs, frames and other superstructures.

6. All masonry work with bricks in substructure and superstructure including plastering as required.

7. All finishing work to flooring, walling, ceiling, as required.

8. All finishing and painting work to masonry, buildings, concrete structures, steel works and wood works.

9. Doors, windows, ventilators, rolling shutters etc.

10. All necessary technological and equipment supporting structures.

11. Hand railings, inserts, kerb angles, bolt etc.

12. All MS/GI inserts, GI conduits, bolts, handrailings, Kerbs etc as required to be embedded in concrete / masonry for supporting platforms, sitting of trench covers, cable galleries pipelines structure etc.

13. Providing Chequered plate/ removable grating over the pipe and cable trench.

14. Pavement around the building (excluding plinth Protection) along with surface drains connected to sump and any other item of civil work required for proper functioning of system.

15. Any extra depth excavated beyond the depth specified in the construction drawing/design drawing shall be filled with PCC M-7.5, by the successful tenderer at his own cost.

09.01.03 The Successful Tenderer shall not make any additional claim if the total concrete quantity or quantity of any of the civil engineering items required for completion of the entire package as per terms of contract exceed the quantity/Nos. indicated by the Tenderer in Annexure-I of this section.

09.01.04 The Tenderer shall undertake within the battery limits any change in the location of units/ items and/or building numbers/ parameters, sizes etc which may be necessary during engineering/ execution from those indicated by the Successful Tenderer in their drawings at no additional cost to the Owner.

09.01.05 The Successful Tenderer shall submit architectural plan and elevation of the structures for approval of Owner.

09.01.06 For civil work, the Tenderer shall submit drawings, documents and design calculations for approval/ information as listed and enclosed in Annexure-2 of
this section.

09.01.07 Protection of existing service lines beyond battery limits, if required, shall be done while executing the work within battery limit.

09.01.08 The drain inside the structure, if required, shall have the top level 100 mm below the finished floor level.

09.01.09 **Site and local condition**

The Tenderer, before submission of his offer, shall visit the site and ascertain site and local condition, entry and exit restrictions of equipments, availability of material and labour, obstruction in the area in all site conditions. Tenderer shall locate the space for their construction facilities i.e. store, fabrication yard, workshop, batching plants etc., offices, staff quarter, labour camp etc. No claim shall be entertained on these accounts from the tenderer after submission of Tender under any circumstances whatsoever.

09.01.10 **Safety**

The Successful Tenderer shall take adequate precautions to ensure complete safety and prevention of accidents at site. The safety precautions shall be conforming to the relevant IS codes. The Tenderer shall also abide by the safety regulations of the Employer and other directives given by the Engineer In charge from time to time. The Successful Tenderer shall depute his safety engineers exclusively to ensure the safety at his own cost. Necessary first aid treatment shall be made available at site by the Tenderer.

09.01.11 **Keeping works free from water**

The Successful Tenderer shall provide and maintain at his own cost labour, pumps and other equipments to keep the entire work site free from water and continue to do so until the completion of the work. No water to be allowed to flow over areas beyond the battery limit. Proper drain is to be connected to nearby drainage system/sump.

09.01.12 **Rubbish**

The Successful Tenderer shall keep the site clean on continuous basis. All rubbish which may be generated during the course of work shall be disposed suitably in the designated area within the plant boundary at his cost. The frequency of removal may be weekly or as directed by E.I.C/Owner.

09.01.13 **Secrecy of information**

The Tenderer shall not divulge any information that he may obtain regarding the Tenughat Thermal Power Station project to any other party.
09.01.14  Progress report

The Successful Tenderer shall furnish the daily/weekly/monthly progress report of work to owner/consultant covering all activities such as procurement of materials, deployment of men and machineries etc. in the approved format of Owner/Consultant.

09.01.15  Site Instruction Book

For issuing site instructions to successful Tenderer by Purchaser/Consultant, the successful Tenderer shall maintain triplicate order books with pages numbered. All written site instruction shall be given on this book which shall be signed by the successful Tenderer as token of his acceptance of the same. One carbon copy of the instruction shall be left in the book for successful Tenderer for his taking necessary action and record. Any instruction given to the successful Tenderer in the order book shall have the same force as that of any instruction conveyed to the successful Tenderer through a letter.

09.01.06  Dimensions

Figured dimensions shall prevail in preference to scaled dimension. Large scale details will supersede small scale details shown in drawings. In case of discrepancy between the two, the successful Tenderer shall obtain clearance of purchaser/consultant before proceeding with work.

09.01.17  Deployment of Manpower/ machinery

The Successful Tenderer shall submit the manpower deployment schedule and machinery deployment schedule along with price bid. Any mobilization/demobilization of machinery and manpower should be done with prior approval of Owner/Consultant.

09.01.18  Sequence of work

Tenderer shall plan the sequence of all works so as to achieve the desired progress keeping in mind overall safety and stability at all points of time. If due to a particular design or specification or availability of machines or any other reason, a particular sequence of operation is demanded by the engineer due to which some interruptions are inherent to any one or more types of work or items of execution, then no claim for such interruption shall be entertained and Tenderer shall have to follow the sequence as instructed by the engineer.

09.02  Material and workmanship

09.02.01  Earthwork

i) Earthwork and control blasting of soft rock/hard strata (if required) shall be
carried out generally as per specification for civil engineering works. The Successful Tenderer shall adopt a suitable dewatering system, if required, for carrying out earthwork, concrete and shuttering work, and other underground work. Site tests shall be carried out by the Successful Tenderer at his own cost prior to finalization of the dewatering system. For discharge of sub-soil water pumping arrangement with a suitable piping system shall be provided. All water bailed out during dewatering shall be disposed off suitably to existing drainage system. The Successful Tenderer shall take the approval of Owner for routing and levels of discharge pipeline inside the battery limits. The Successful Tenderer shall also carry out any further compaction of sub-grade necessary to achieve the design criteria of floors and foundations taking into consideration the settlement limits. Method of compaction shall depend upon the materials to be used and verified by the Successful Tenderer by site testing at his own cost. Surplus and unsuitable materials shall be disposed suitably at locations within plant boundary indicated by the Owner. If required the backfilling material shall be brought to the site by the Successful Tenderer at no additional cost. Availability of dumping yard and borrow pit shall be outside the plant boundary. Dozing, compaction and spreading of the dumped earth, if necessary, shall be done by the Successful Tenderer at no additional cost to the Owner.

ii) Apart from shoring and temporary supports all other necessary measures like use of sheet piling etc. shall be provided, if necessary, for protection of existing underground services at no additional cost to the Owner.

iii) Within the battery limit dismantling, diversion, relocation and protection of all underground structures and services shall be done at no extra cost to the owner.

iv) The checking and correctness of all main centre lines is the responsibility of the successful Tenderer irrespective of any checking by the Owner.

v) All serviceable hard rock (if any) will be the property of the Owner. The successful Tenderer has to stack the same after making the hard rock in serviceable sizes of 150 to 300 mm at designated area within the plant boundary at his own cost.

09.02.02 Concrete and reinforced concrete structure

i) All concrete and reinforced concrete structures shall be constructed as per specification.

ii) The mix design adopted shall be suitable for proper strength, workability and service condition of the structure. Minimum cement content and maximum water cement ratio shall be normally as per specification for civil engineering works. However, in case of exposure to aggressive environments, the mix design adopted shall be suitable to ensure durability of the concrete under that condition.
iii) Unless specifically approved by the Engineer the maximum nominal size of coarse aggregates for different grades of concrete shall be as under:

<table>
<thead>
<tr>
<th>Description</th>
<th>Nominal Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. For pre-cast concrete members of thickness not more than 100 mm and in cast-in-situ RCC members of thickness not more than 75 mm</td>
<td>12 mm.</td>
</tr>
<tr>
<td>b. For all reinforced concrete work and plain cement work except as specified under (a) or (c)</td>
<td>20 mm.</td>
</tr>
<tr>
<td>c. For plain cement concrete of grade M-10 and M-5 of thickness more than 150mm</td>
<td>40 mm.</td>
</tr>
</tbody>
</table>

iv) Steel reinforcement to be used shall be as per specification for civil engineering works and Indian Standard Codes.

v) Test on Harden concrete:

In case the concrete quality falls under “Doubtful” category in view of the Owner. The Successful Tenderer shall further investigate the in-situ strength of concrete by carrying out non destructive test as follows:

1. Taking out the concrete core and testing in accordance to IS 516.

2. Ultrasonic Pulse velocity and rebound hammer tests as per IS 13311.

The successful Tenderer shall take necessary measures to restore the quality of concrete to acceptable level without any additional cost implication to the owner implication if required.

09.02.03 Service Lines and Plumbing

All service pipelines, water supply, plumbing and other utility pipelines within the auxiliary structures of RC/ masonry construction shall be concealed within the masonry, concrete work etc or by removable wooden panels. All electrical wiring shall be concealed either within RC/masonry construction or by false ceiling.

09.02.04 Reference grid points and bench marks shall be made available to the Successful Tenderer at one place. The Successful Tenderer shall do other necessary work for controlling reference grid.

09.02.05 Hand railings – All hand railing shall be of GI pipes and no welding of joints permitted. Use of bend, socket, and elbow is must.

09.02.06 Water proofing works shall have 10 yrs Guarantee Bond and Performa of the same shall be collected from the Owner/ Consultant.
09.02.07 The successful Tenderer has to mobilize a well qualified survey team along with survey equipment for day to day survey work. They should use high precision survey equipments for this purpose. The Successful Tenderer has to facilitate the Owner/Consultant for checking of accuracy of survey work as and when desired by the Owner/Consultant at no extra cost to the Owner.

09.02.08 The Successful Tenderer has to set up his own laboratory to facilitate the checking quality of the civil work e.g., for checking aggregate, sand, bricks, ash, water, earth etc. as per relevant Indian Standards at his own cost. The Successful Tenderer has to facilitate the Owner/Consultant for checking quality of material/work etc. as and when desired by the Owner/Consultant at no extra cost to the Owner. The Successful Tenderer shall depute well qualified quality engineers exclusively to ensure the quality of works at his own cost. The quality certificate duly signed by E.I.C must be enclosed in each R.A bills.

09.02.09 Load Condition

i) All foundations and concrete structures shall be designed to resist full operating dead and live loads, with appropriate combination of wind and seismic forces and with due allowance for impact, vibration etc. as secondary effects of live loads, temperature variation etc. While designing structures and foundations either the effect of seismic forces or wind loads, whichever produces the worst effect, shall be considered along with usual load conditions.

ii) Apart from the operating loads indicated by the equipment manufacturers, the design of buildings and structures shall be based on dead and imposed loads calculated according to IS: 875, subject to minimum imposed loads indicated in para (iv) below.

iii) Concentrated and uniformly distributed live load on floors and platforms shall be considered depending upon the usage and in accordance with maximum expected process requirements, to be indicated by the equipment manufacturers. When the loads are movable, they shall be so placed as to get worst effect in moment, shear, axial loads etc. for which the elements shall be designed. Due allowance shall be made, wherever necessary, for installation and operation of any equipment as per equipment manufacturer's data and recommendations. The design shall be based on the maximum loading due to uniform live load and/or equipment loading including impact, vibrations etc.

iv) The live loads listed hereunder are minimum loads for the areas involved. Special use areas shall be investigated and loading revised upward as necessary. Additional loading due to electrical cables, ventilation and air conditioning, piping etc. shall be considered as per technological requirements. Dust loads of minimum 50 Kg/m² shall be considered additionally for all roofs.
All buildings (except as noted separately):

- Roofs: 150 kg/m² (excluding dust load)
- Floor: 500 kg/m²
- On ladders: 120 kg at centre of rung
- On removable covers over trenches & manholes: 1,500 kg/m²

**Electrical Building**

- On floor slab of: 1,000 kg/m²

v) Design wind pressure and forces shall be as per the provisions of IS:875. Basic wind speed at Lalpania shall be considered as 50 metres per second. Stresses induced due to dynamic effect of wind shall be considered in design as per relevant IS codes.

vi) Seismic forces shall be considered according to the provisions of IS: 1893. Lalpania falls under seismic zone III.

vii) Members subjected to temperature variations shall be designed to withstand the stresses arising out of such temperature variations.

viii) Design of structures shall provide for temporary loads which may be lifted during erection and maintenance of plant and equipment. Consideration shall be given in the design of structures to the contributing loads from piping and cabling including provisions for piping anchors and dead endings of electrical conductors.

ix) In case of moving loads, full load under worst operating condition together with minimum 25 per cent vertical impact factor shall be considered for vehicles and machinery travelling on tracks (rails). Horizontal forces along and transverse to the rails as per equipment manufacturers’ data and recommendations shall be considered in design of the track supporting structures and foundations.

x) The design of buildings and structures shall take into account the loadings due to future extension of units and installation of additional equipment, where necessary, in future in the units.

09.02.10 **Permissible Stresses**

Allowable stresses for all reinforced concrete structures shall be as per IS:456 and for prestressed concrete structures as per IS:1343.

09.02.11 **Foundations**
i) Foundations for structures and equipment shall be proportioned to resist the worst conditions of loadings and shall be generally designed as per the provisions of IS: 1904.

ii) The depth of foundation shall be determined based on loadings on foundation, safe bearing capacity at the founding level, constructional and technological requirements. The maximum allowable bearing pressure for design of foundation shall correspond to values confirmed by results of detailed soil investigation taking into account limits of allowable settlement considered for design of structures and equipment. Generally the foundation shall be taken down to at least 1000 mm below natural ground level in case of soil and 200 mm in case of rocky strata. However, some minor foundations can be laid on well compacted filled up soil with approval of Owner.

iii) Generally foundation for buildings & equipment shall not be structurally connected to ground floor slab. The top level of the stem for building column foundations shall be so provided that no part of the steel column base assembly protrudes over finished floor level. The column base assemblies shall be encased with concrete up to floor level.

iv) Foundations of equipment subjected to dynamic loading shall be isolated from adjoining floors/foundations to prevent propagation of vibration to adjoining structures.

v) Supporting structures and foundations for equipment which may cause vibration, shall be designed for the dynamic effect of equipment together with the direct loads. The dynamic loads and other relevant data required for analyzing the dynamic effect shall be taken as per manufacturers’ data and recommendations.

vi) Structures and foundations supporting vibrating equipment shall be proportioned to avoid resonant frequencies. The dynamic analysis shall be done as per the stipulations as recommended by respective IS codes as well as the stipulations recommended by equipment manufacturer.

09.02.12 Underground Structures

i) Based on the data on subsoil and underground water, adequate precautions shall be taken for design of foundation and underground structure. All underground structures such as sumps, pits, trenches, etc. shall be designed considering soil, water and surcharge pressure from the surrounding areas. Adequate precautions against floatation shall be taken.

ii) Water tightness of expansion and construction joints shall be ensured by provision of PVC water bars of approved type with all necessary fittings and clippings to keep it in position during concreting. Water proofing compound as admixture must be used in concrete.
iii) In case of underground structures, sumps with pumping arrangements shall be provided at suitable location to collect and pump out any incidental water collection to nearest storm water drainage outlet.

iv) For the purpose of design of underground structures, ground water table shall be considered at finished ground level.

v) Proper considerations in design shall be taken to prevent any possibility of flotation due to upward thrust caused by underground water. Pressure release valves of any form or type which allow ingress of water into the structure shall not be permitted. Special care shall also be taken to prevent flotation during construction period.

09.02.13 Chemical Protection to Structures and Foundation

Concrete structures, floors and foundation coming in contact with acid / alkalies / other corrosive chemicals shall be provided with acid proof treatment / lining as stipulated under finishing details separately.

09.02.14 Concrete and Reinforced Concrete for Structures and Foundations

09.02.14.1 General

i) Concrete work shall secure a dense, homogeneous, smooth mass including required finishes, possessing required strength and resistance to weathering and abrasion for the structures and foundations.

ii) Design of all reinforced concrete structures shall be as per the IS: 456 and of pre-stressed concrete structures as per IS:1343. The structural safety of all foundations on soil shall, in general, be based on IS: 1904. The design of water retaining structures shall be according to IS: 3370.

iii) For calculation purpose "Working Stress Design" or "Limit State Design" methods may be adopted, but design shall be consistent throughout.

iv) Unless otherwise specified, minimum grades of concrete to be used shall be as follows:

<table>
<thead>
<tr>
<th>Concrete Type</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinding concrete (mudmat)</td>
<td>M7.5</td>
</tr>
<tr>
<td>Reinforced cement concrete for roads, pavements,</td>
<td>M25</td>
</tr>
<tr>
<td>column foundations, precast covers, Roofs etc.</td>
<td></td>
</tr>
<tr>
<td>Floors (resting on ground), trenches, channels,</td>
<td>M20</td>
</tr>
<tr>
<td>pits with columns, channels, pits</td>
<td></td>
</tr>
<tr>
<td>Underground/Over ground water retaining structures</td>
<td>M30</td>
</tr>
</tbody>
</table>
v) The mix-design shall be adopted for proper strength, workability and service requirement.

vi) Additives and retarding agents for concreting, floor hardening additives, acid resisting and integral waterproofing compounds shall be added to the concrete depending upon requirements.

09.02.14.2 Grouting below machine/equipment bases and pockets shall be of non-shrinking grout of adequate thickness and strength and as approved by owner/consultant.

09.02.15.3 Quality Assurance

a) To ensure quality of construction, the Tenderer shall ensure inspection and testing of all materials and works at his own cost conforming to specifications.

b) All certificates and guarantees obtained by the Tenderer from different suppliers of materials, subcontractors doing part job, manufacturers of doors, windows etc. shall be passed on to the purchaser.

c) All defective materials / works which do not conform to the specifications shall be rejected / dismantled and removed from site by the Tenderer at his own cost.

d) The Tenderer shall provide a site laboratory with equipment and shall maintain and engage qualified technical personnel at site to run the laboratory at his own cost. All routine tests of cement, aggregates, sand, bricks, concrete cubes, etc. shall be conducted at site, and equipment required for accelerated concrete cube test should also be provided in the laboratory for predicting the strength of concrete early.

e) For those tests which are not possible to be carried out at site laboratory, Tenderer shall arrange to send requisite samples to approved laboratory outside the site and get those tested as required entirely at his cost at the laboratory approved by the purchaser.

f) Before starting any concreting or erection work at site, the stage passing certificates have to be obtained from the engineer in the formats prepared after mutual discussion and agreement.

g) As-built survey details marking location of all bolts and inserts shall be submitted by the Tenderer so as to enable further structural/equipment erection without any loss of time.

h) Before covering up any work within excavated pits, clearance has to be taken from engineer in respect of completion of said works as per drawing and specification.
09.03 PRINCIPAL FEATURES OF STRUCTURES AND OTHER FACILITIES

09.03.1 GENERAL

Design and construction of structures etc. shall take into account requirement for operation and maintenance of all equipments and its users. The structures will have good architectural features. The surrounding areas shall be properly micro-levelled, graded and paved with concrete within the battery limit.

09.03.2 Architectural Concepts for Structures

The architectural design concept of structures shall be evolved considering the functional, technological and other requirements for efficient operation ensuring comfortable working environment for personnel, satisfying the aesthetic requirements. Special care shall be taken to provide elegance and aesthetics, with effective use of appropriate treatment, materials fittings and finishes. To achieve above objective, successful Tenderer shall employ a qualified architect/architectural firm to carry out all design and hold all other architectural responsibilities for the project.

The successful Tenderer shall obtain and be conversant with all laws, by-laws, and regulations of local and Statutory Bodies as applicable to the project. The architectural concept evolved should also take care of these requirements. The drawings and documents for such statutory approvals shall be provided by the successful Tenderer.

09.03.3 Principal Features of structures, facilities etc. have been outlined below:

Pump house, Sump of required size shall be provided to accommodate all equipments, service facilities and maintenance/operational requirements. Minimal size wherever mentioned shall be provided unless the actual requirement is more than minimal size.

Pump house shall be of civil RCC Construction with RCC column, roof and necessary brick work for pump house with provision of 1 rolling shutter, door and windows.

Ground floor shall have 200 thick M-20 grade RCC. Base course shall be 230mm thick compact stone boulders over which building paper and 50mm thick blinding concrete shall be provided.

PCC apron shall be provided with side drains around periphery of RCC floor area.

Plinth level shall be 300mm above surrounding terrace level with suitable RCC ramps.

Exposed surface of Sump walls & cover slab shall have two coats of approved water repellent paint.
All cable trenches shall be of leak proof RCC construction with necessary waterproofing arrangement. The trenches shall be complete with inserts for installation of cable trays.

Accumulation of water inside the trench shall be drained by providing proper drains with slopes and sump with sump pumps.

09.03.4 Miscellaneous structures and facilities

All foundations for structures and equipments, access facilities, drains etc. as well as any other items not mentioned herein but will be necessary for the process requirement and facilities shall be provided.

All structures shall have good architectural facade. Necessary paved areas shall be provided around the pump house for parking of mobilised equipments and vehicles.

09.04 DESIGN CALCULATIONS, DRAWINGS AND DOCUMENTS

09.04.1 Design calculations

The design calculations to be submitted by successful Tenderer prior to submission of construction drawing shall include but not be limited to the following:

09.04.1.1 Architectural design

The Tenderer shall follow the norms and basic schemes indicated in the Technical Specification. The Tenderer shall submit all catalogues/ specifications for various floors and wall finishes, painting, doors and windows, etc.

09.04.1.2 Building Structural and foundation design

i) The design calculations for all the structures and foundations including miscellaneous structures, all equipment foundations etc. shall be furnished. The design calculations shall include static design calculations for all structures and foundations, dynamic analysis for all important structures and foundation subjected to impact, vibrations etc. induced by equipment and other external forces.

ii) Building Structure data sheet showing specifications of materials, design standards followed, load data assumed including the loading on roof, walkways, different floors, bulk material density, crane and hoist loading, wind and seismic loading, wind thrusts and vibration considerations, deflection, etc.
shall be furnished. Also, types of flooring, roofing are to be indicated. The loading combinations and other design assumptions made in design are to be furnished.

iii) Load combination shall be made as per IS 875. The wind load & seismic loads shall be mutually exclusive. The structure/foundation shall be designed for the combination giving severest effect.

iv) Measures required for the safety of the structures and foundations.

09.04.2 Drawings

09.04.2.1 Drawings for concrete reinforced concrete and other civil work.

i) The successful Tenderer shall prepare general layout drawings giving salient levels and dimensions of the whole area showing all over ground and underground services and facilities, structures, roadways, etc. Detailed working drawings shall be prepared on the basis of the general layout drawings considering overall structural system. The successful Tenderer shall ensure that no further drawing shall be required to be prepared by any other agency for successful implementation of the project. The successful Tenderer shall submit a comprehensive and complete unit wise classified list of drawings.

ii) The successful Tenderer shall supply integrated drawings for different facilities.

iii) The successful Tenderer shall submit for approval or information as the case may be as per annexure-2, general arrangement and detailed working drawings for all concrete, reinforced concrete and other civil works as follows:

- Excavation drawings.

- Foundation plans and sections for structure columns and equipment incorporating trenches, pipes etc.

- Loading drawings indicating superstructure loading, equipment loading, floor loadings, etc.

- Reinforcement details with bar bending schedule for all reinforced concrete works.

- Drawings for all types of bolts, inserts, embedments, miscellaneous steel works, etc.

- All drawings for masonry work, flooring, floor finishes, partitions, false ceiling/ floors, if any, etc.
- Drawings for approach roads, pavements, drainage including culverts, if any etc.

- Storm water drainage drawings for areas and structures within the battery limit.

- Drawings for roadways, paved areas and parking areas, etc. along with culverts, bridges etc. as required.

- Painting schedule shall be provided for all structures.

- Detailed bill of materials of all items of work.

iii) All drawings required for obtaining approval from statutory bodies/local authorities etc. shall be prepared by the Tenderer.

iv) The Successful Tenderer shall submit as-built drawings incorporating all site modifications as mentioned in the commercial part.

09.05 General Sub-soil Conditions

The sub-soil conditions may deviate at site. It is the sole responsibility of the successful Tenderer to provide foundations as required based on actual site conditions. The successful Tenderer shall carry out sub-soil investigation for the purpose at no additional cost to the Owner. The investigation work (both field & laboratory) shall be carried out following relevant IS: Codes through approved agency and will be supervised by the Owner. The scope of soil investigation work, data and recommendation derived from the soil investigation (carried out by the successful Tenderer) shall have to be approved by the Owner before implementation in design and/or construction.

09.06 Site conditions

09.06.1 The area selected for the ash water recirculation system is within the existing plant area.

09.06.2 Site clearance of muck, debris, concrete blocks, stones, masonry blocks, structural scraps etc. and disposal of the same shall be included in the Scope of Tenderer's work.

09.06.3 Existing wells, pits etc., if any, shall be filled up with sand of approved quality. Also any loose materials from wells, pits etc. shall be removed and subsequently filled up with sand of approved quality.

09.06.4 The Tenderer shall be deemed to have visited and carefully examined the site and surroundings, to have satisfied himself about the nature of all existing structures, existing underground services, general site conditions, the site for
disposal of surplus materials, debris etc. and all other matters affecting the work. Claims and objections due to ignorance of site conditions shall not be considered after submission of the tender.

09.06.5 The Tenderer has to make approach road to worksites at their own cost with prior approval of EIC/Owner. They should also make their own arrangements to drain out storm water with the approval of EIC/Owner accumulated at their site by pumping to suitable locations at their own cost.

09.06.6 The Tenderer has to make arrangements for segregation of ferrous and non-ferrous scrap materials as per requirement of ISO: 14000 and also as and when instructed/directed by the Owner to deposit the scraps at designated places and for which no separate payments shall be made.

09.07 WATER-PROOFING AND DAMP-PROOFING

09.07.1 Water proofing admixtures e.g., ‘SEALCON’ /or any other approved make has to be added in concrete for all underground RCC structure like sump, pits, trenches etc. For any leaking underground pits, tunnels or trenches, the successful Tenderer shall rectify the same by means of injection of non-shrink polymeric water proof grouting compound like ‘SEAL GROUT’ /or any other approved make from inside along with an application of water proof plaster with ‘SEALCON’ /or similar approved material. In addition, PVC water bars of approved quality and make shall be provided at construction joints and expansions joints.

09.07.2 Roof Water proofing treatment using latest Polymer based cementitious material of approved reputed manufacturer like CICO,SIKA,FOSROC or equivalent consisting of minimum 2 coats of acrylic polymer based cementitious slurry coating with one layer of fiber glass cloth in between shall be done as per manufacturers specification.

09.07.3 Rain water from the roof shall be laid into rainwater pipes of adequate sizes at suitable intervals/locations and discharged into the Sump. Rain water pipes shall be of UPVC. Minimum diameter of RW pipe shall be 150 mm.

09.07.4 All ground floor walls shall be provided with damp-proofing course.

09.08 Miscellaneous

09.08.1 Plinth Protection

Minimum 1200mm wide PCC apron, M-20 in slope around the building with concrete side drains, sump pits etc. shall be provided. Top of apron shall be finished with 15mm thick cement mortar (1:4) with neat cement finish (chequered).
09.08.2 **Cable and Pipe Trenches**

All cable, pipe trenches etc. shall be made of reinforced water tight concrete and shall be covered with chequred plate suitably designed taking into account loading conditions etc. The outdoor trenches shall be covered with pre-cast RCC slabs with necessary lifting arrangement.

All electrical cables at road crossing shall be taken through conduit pipes or cable ducts as per electrical specification.

09.08.3 **Sufficient areas shall be paved around Pump house so as to facilitate parking of vehicles.**

09.08.4 **DRAINS**

09.08.4.1 **All drains shall be made of RCC or PCC depending on depth and surcharge loading and provided with pre-cast RCC covers with lifting arrangements as per requirement. All crossing under roads, RCC box culverts or pipe culverts shall be provided.**

09.08.4.2 **All manholes, inspection pits, collection pits etc. shall be of reinforced concrete construction with covers for access.**

09.08.4.3 **Generally minimum earth coverage of one metre shall be provided over underground drainage sewer pipe lines.**

09.09 **EXTERNAL CLADDING, INTERNAL PARTITIONS AND FINISHES**

09.09.1 **This section deals with cladding, internal partitions and finishes for Pump House Building.**

09.09.2 **External cladding for buildings shall be constructed of brick masonry with bricks of IS class 10. The thickness of brick masonry walls shall be minimum 230 mm. Design of masonry walls shall conform to IS: 1905. External cladding shall be made of brick masonry.**

09.09.3 **Internal non load bearing partition walls shall be minimum 125 mm. thick brick masonry for office, toilet etc.**

09.09.4 **Masonry walls of thickness 230 mm. or more shall be constructed in cement-sand mortar not leaner than 1:6. Partition walls of half brick walls of 115 mm. thick shall be constructed in 1:4 cement-sand mortars with suitable reinforcement.**

09.09.5 **All brick shall be plastered on both sides. Thickness of plaster shall be minimum 20 mm. in two layers for unfair faces and for all external surfaces and 15 mm. for...**
internal walls with fair faces. Thickness of plaster for ceiling shall be minimum 6 mm.

09.09.6  Cement sand mortar mix for plasters shall be 1:4. 20 mm thick plastering shall be done in two layers.

09.09.7  All outside plastered surfaces of masonry walls shall be applied with snowcem or equivalent cement based paint and to be applied as per manufacturer's specification.

09.09.8  Painting on ceilings shall be of oil bound distemper or plastic emulsion paint matching with wall finish.

09.09.9  Inside surfaces of masonry walls shall be treated with oil bound distemper (with wall putty) or plastic emulsion paint of approved quality, make and colour, or to be tiled as the case may be, on the basis of technological and/or aesthetic requirements. Wherever plastic emulsion paint is used, the walls shall be treated with putty. The internal finishes to be provided are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Pump house</th>
<th>:</th>
<th>Two coats of oil bound distemper over a coat of primer</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Control rooms</td>
<td>:</td>
<td>Two finishing coats of 1 st. quality plastic emulsion paint of approved shade over a coat of primer and wall putty of minimum thickness 3 mm (other than those subject to acid spillage)</td>
</tr>
<tr>
<td>ii)</td>
<td>Toilet</td>
<td>:</td>
<td>Two coats of oil bound distemper over a coat of primer except the portion of glazed tiles in walls of minimum height of 2.1 m.</td>
</tr>
</tbody>
</table>

09.09.10 In premises subject to attack due to acid emissions, the walls shall be faced with acid proof tiles of approved make to a minimum height of 2.1 m. and acid resistant paint above 2.1 m level including ceiling.

09.09.11 1st quality paint of approved brand must be used for all painting works.

09.09.12 150 mm high skirting shall be provided in all rooms except where there is a provision for dado.

09.09.13  **Internal Flexible Partitions**

09.09.13.1 Internal flexible partitions shall be made of anodised aluminium box section framing of suitable dimensions depending on the design requirement. The partition may be partly glazed and partly solid or fully glazed depending on the architectural design of the interior.
09.09.13.2 The solid panels for the partitions shall be of decorative laminated particle boards in designs matching with the interior decoration of the particular room.

09.09.13.3 Fixing of glass/particle board panels to aluminium framing shall be with snap on aluminium fixing clips beveled or squared depending on architectural designs of the portions.

09.09.13.4 Generally finish of all the aluminium members of the partition shall be satin mat finish. However, other anodised finish may be provided, if required, from interior decoration point of view.

09.09.14 False Ceilings

09.09.14.1 Standard aluminum false ceiling with anodised aluminum T-bars inter-locking ceiling system.

i) In control room and other areas where false ceilings are required, standard aluminum false ceiling system in modular grids shall be provided.

ii) The false ceiling shall consist of standard anodised aluminum main and cross T-runners of size 38 mm x 38 mm x 1.5mm thick spaced 610mm centers both ways with 12 mm thick (approx.) E-board classic or similar material (termite proof, moisture resistant and fire resistant) of approved shade along with necessary suspension arrangement for the false ceiling system.

iii) Lighting, fittings and ventilation grills, A/C defuser, smoke detector etc. shall be flush mounted with the false ceiling bottom and aesthetically pleasant.

iv) In computer rooms' and other rooms accommodating electronic equipment and requiring dust-free atmosphere, the wall surfaces shall be painted with two coats of epoxy based paint over a coat of primer, unexposed ceiling boards shall have fire retardant paint and true ceiling shall have minimum 50 mm. thick under deck insulation with phenotherm or equivalent material.

v) Sides and corners must be finished with garnish and mouldings of approved design.

09.09.15 FLOORS AND FLOOR FINISHES

09.09.15.1 Floors

a) In general, all floors on ground except in area like offices and toilets shall be made of minimum M-20 reinforced concrete of 150mm thickness. For pump house proper, the design of floor shall also take into consideration technological requirements imposed loading and other service condition etc. In case of toilet, tea room and offices, floor slab on ground shall be PCC of Grade M-15 with minimum thickness of floor slab of 100mm.
b) The sub-grade below the floor slab shall be minimum 150 mm thick compacted sand filling. On top of sub-grade building paper shall be provided for plain cement concrete floor & 50 mm. thick blinding concrete shall be provided for reinforced cement concrete floor.

c) All sub-grade shall be laid on well compacted soil.

d) Paving shall generally consist of 125 mm thick cement concrete grade M-20 over 230mm thick boulders (hard granite) soiling with and sand admixture 50:50 as filler material. A layer of waterproof paper of approved type shall be laid over granite soiling before placing of concrete. Paving shall be laid to slope to drain rain water to nearby surface drain.

09.09.15.2 Floor finishes

Floor finishes for the pump house shall be provided according to technological and functional requirements, service conditions and duty and as per manufacturer's instruction as and when applicable. However, the following types of finishes are suggested:

<table>
<thead>
<tr>
<th></th>
<th>General areas of Pump house</th>
<th>40 mm thick granolithic cement concrete flooring with concrete hardener additive of approved make on reinforced concrete floor slabs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Control room, MCC Room</td>
<td>20 mm thick 2.5 m x 1.0 m granite with brass dividers of 25 x 6 mm size at joints of colour as approved by Owner/Consultant fixed with recommended fixing compound/adhesive.</td>
</tr>
<tr>
<td></td>
<td>Toilet</td>
<td>Antiskid ceramic tile finish over a minimum 15 mm thick base of cement mortar 1 : 3 (1 cement : 3 sand)</td>
</tr>
</tbody>
</table>

09.09.16 DOORS AND WINDOWS

09.09.16.1 Relevant provisions of the BIS specification shall be applicable in design and selection of doors and windows (List of IS codes referred in the document) with due consideration of the salient aspect of various buildings, units etc.

09.09.16.2 Standard types of doors and windows shall be used to the extent possible. The doors and windows shall be of approved make, quality and colour. Non-standard doors and windows shall be used only where there is a specific requirement for such doors and windows.

09.09.16.3 Doors
i) Main entry doors to the building shall be steel doors or steel rolling shutters of width and height to suit the requirements. Unless otherwise specified, rolling shutters with area up to 8 sq m shall be pull and push type hand operated, between 8 sq m to 12 sq m pull and push type with ball bearings. Rolling shutters with areas larger than 12 sq m shall be mechanical gear type or electrically operated.

ii) The control room which is air-conditioned and pressurized, the door shall be glazed type and made of anodized aluminum box section of “HINDAL” make or similar approved manufacturer and shall be air tight.

iii) Width and height of door shall be decided based on various technical requirements like taking in and out of equipment during erection as well as maintenance purpose. However the minimum height of the door shall be kept at 2100 mm.

iv) All door shall be provided with proper hydraulic door closers.

09.09.16.4 Windows

In Buildings

Steel window with side hung shutter shall be generally be used in building and shall be fully glazed. They shall generally be standard type and size conforming to IS 1361. The glazing shall be of 5.5mm thick wired glass fitted with aluminum beading with rubber gasket for fixed type. For openable window 4 mm thick plain sheet glass shall be provided. All openable window, safety bars/ aluminum safety grills shall be provided.

Window for specific areas like control room etc. shall be anodized aluminum designed to suit technological requirement.

In office, toilet and store

Fully glazed steel window of standard sizes and types conforming to IS 1038 shall generally be used. The glazing shall be 5.5mm thick wired glass fitted with aluminum beading with rubber gasket for fixed type. For openable window 4 mm thick plain sheet glass shall be provided. All openable window, safety bars/ aluminum safety grills shall be provided.

Exhaust fans of suitable ventilation capacity shall be provided in toilets etc. and in places where force ventilation is required.

09.10 ARCHITECTURAL GUIDELINES & NORMS

09.10.1 The successful Tenderer shall prepare all detailed architectural, internal w/s & sanitary drawings necessary to execute the building works.
09.10.2 Services and facilities

09.10.2.1 Fire Protection Facilities

Building shall be provided with fire protection facilities as per technical rules.

09.10.2.2 Illumination

Buildings shall be provided with illumination facilities as per technical specification of electrics.

09.10.2.3 Safety measures

Necessary grills, railing, protective paint coatings shall be provided as per requirements.

09.10.2.4 Toilet facilities

Toilet block shall be provided with toilets, drinking water connection, space for water coolers. Toilets will be properly vented. Minimum one set of fittings shall be provided in each toilet. Sanitary facilities shall be as per following norms.

Fittings / facilities

<table>
<thead>
<tr>
<th>WC (water/closet)</th>
<th>1 for 25 persons or part thereof.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablution taps</td>
<td>1 in each WC; 1 water tap (for every 50 persons or part thereof) in the vicinity of WC &amp; urinals.</td>
</tr>
<tr>
<td>Urinals</td>
<td>1 upto 6 persons; 2 for (7 to 20 persons); 3 for (21 to 45 persons); 4 (for 46 to 70 persons) 5 for (71 to 100 persons); and @ 3% for (101 to 200 persons) and @ 2.5% (above 200).</td>
</tr>
<tr>
<td>Wash basins</td>
<td>1 for every 25 persons or (part thereof).</td>
</tr>
<tr>
<td>Drinking fountain water</td>
<td>1 for every 100 persons.</td>
</tr>
</tbody>
</table>

1) Wash Basin Set

Coloured glazed ceramic basin of 55cm x 40cm. with CP pillar tap, waste pipe, glass shelf, towel rail, CP brass soap container, 600cm x 450cm x 5.5mm thick bevelled edged mirror with 6mm thick asbestos backing etc shall be of good quality material with approval of EIC/Owner.
2) Water Closet
Coloured glazed ceramic IWC of size 58 cm. long provided in all floors and in ladies toilet along with low level flushing cistern. Coloured glazed ceramic EWC of size 40 cm. long shall be provided at specified locations with low level ceramic flushing cistern including all necessary fittings.

3) Urinal
White glazed vitreous china large flat back lipped urinals with CP brass flush pipe along with other necessary fittings including automatic flushing cistern. Urinal's partitions shall be of 20mm thick marble slab with 1500mm x 600mm.

4) Antiskid ceramic floor tiles of make like Jhonson, Somani, Kajeria or equivalent and approved quality designer's tile on walls upto a height of 2.1 m to be made.

09.10.2.5 Environmental Norms
The building design has to be evolved taking into account the climatic and environmental factors prevailing in the Project site. The building fenestrations have to be designed to provide adequate protection to window/door openings etc. (like chajjas, fins, roof projections) against sun and rain.

09.10.2.6 Natural light and ventilations
(i) Natural lighting
Windows : The area of windows shall be minimum 15% of the area of floor.

(ii) Ventilations
Electrical fans shall be provided in general offices as per standard norms. Offices of the senior executives (E6 and above) shall be provided with A/C units (window type) as per standard norms. All toilets, printing room, battery rooms shall be provided with exhaust fans for ventilation as per standard requirements. Technical premises requiring air-conditioning shall be provided with unit/central A/C units with cut off lobbies having double doors, wherever required.

09.10.2.7 Water supply of building
(i) Capacity of O.H. Tank : One day's storage with 1500 ltr.

(ii) Per capita/per day requirements
   a) For office = 45 liters
   b) For firefighting : Separate provision as per norms.

(iii) Pipes & specials : Galvanised iron pipes & specials shall be used. G.I. pipes in the building wherever concealed shall be of...
09.10.2.8 Internal sanitary works and Storm water drainage

(i) System
Two stack system, waste stack discharging in Gully and soil stack directly connected to manhole shall be followed. Gully trap shall be connected to manhole. Anti siphonage pipes shall be provided for buildings having more than two storey height.

(ii) Inspection:
System shall provide for inspection and maintenance facilities of all branch, waste and soil pipes by providing inspection eye on Junction of waste and soil stack and respective branch mains.

(iii) Ventilation:
The sewerage system shall be provided with adequate ventilation for the pipe work and manhole.

(iv) Pipes:
All pipes for soil and waste stack shall be of Heavy Cast Iron pipe. The minimum diameter of waste stack shall be 80 mm and for soil stack shall be 100 mm.

09.10.2.9 Hardware fittings for doors & windows

<table>
<thead>
<tr>
<th>Doors</th>
<th>Fittings for each wooden door</th>
<th>Nos. for Single leaf</th>
<th>Nos. for Double leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anodised Aluminium :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tower Bolt 300 mm for top</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tower Bolt 150 mm for bottom</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Aldrop 300 mm long with 16 mm sliding bolt</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Door handles with continuous plate 150 X 38 X 12 mm rod</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Butt hinge (125 X 63 X 4mm ) with cadmium plated MS screws</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Butt hinge (75 X 45 X 3.2 mm) for door cleat with cadmium plated MS screws</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Fittings for each Steel Door :</td>
<td>M.S. Aldrop</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>M.S. Tower Bolt for top</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>M.S. Tower Bolt for bottom</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>M.S. Hinge</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>M.S. Door handle ( one on each face)</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
All doors for officers cubicles shall have hydraulic door closers, mortice lock (4 Levers) with handle and door stopper (heavy type).

All doors except office/cubicle shall be provided with 6 levers mortice latch locks with handle of ‘Godrej’ make or approved equivalent and door stopper (heavy type).

All openable steel windows and ventilators shall be provided with brass handles and brass peg stays.

09.11 LIST OF APPROVED MAKES: CIVIL & ARCHITECTURAL WORKS

09.11.1 General

The makes and manufacturers shall be from the following list. In case, the same is not available in the market or in case of a change in trade name, equivalent makes/ re-designated manufacturer shall be used with prior approval of Engineer In charge.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>MATERIALS</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Anti Termite Treatment</td>
<td>Pest Control India ltd., Mysodet Limited or approved equivalent make</td>
</tr>
<tr>
<td>1.</td>
<td>Anti Termite Treatment</td>
<td>ACC, Ultratech, JK, Grasim, L&amp;T (Ultra Tech Cement), Maha Shakti, Priya Raasi, Coromandel</td>
</tr>
<tr>
<td>B</td>
<td>Concrete &amp; Masonry works</td>
<td>SAIL, RINL, TISCO, IISCO</td>
</tr>
<tr>
<td>1</td>
<td>Cement</td>
<td>Cico, Jubliant Organosys, Roffe, Pidilite, Krishna Conchem, Fosroc, Sika, MBT, HSW</td>
</tr>
<tr>
<td>2</td>
<td>Reinforcement Steel/Structural Steel</td>
<td>Birla White, J.K. or approved equivalent make</td>
</tr>
<tr>
<td>3</td>
<td>Admixtures for concrete (Plasticisers and Water proofing compounds)</td>
<td>Nitco, BasantBeton, Tile Italia, Ultra, Stone Crate, Duracrut, Eurocone</td>
</tr>
<tr>
<td>4</td>
<td>PCC Water Stops</td>
<td>Anchor, Associate or approved equivalent make</td>
</tr>
<tr>
<td>5</td>
<td>Autoclaved aerated Blocks (AEROCON)</td>
<td>Hyderabad Industries Ltd. or approved equivalent make</td>
</tr>
<tr>
<td>6</td>
<td>Film faced plywood</td>
<td>Anchor, Associate or approved equivalent make</td>
</tr>
<tr>
<td>C</td>
<td>Flooring</td>
<td>Restile, Euro, Asian, RAK, CENGRES</td>
</tr>
<tr>
<td>1</td>
<td>Vitrified Tiles</td>
<td>Nitco, BasantBeton, Tile Italia, Ultra, Stone Crate, Duracrut, Eurocone</td>
</tr>
</tbody>
</table>
3. **Acid Alkali Proof lining / tiles**: Coromandel Prodorite, Kothari Corrosion Controllers, Rstile, Jhonson

4. **Concrete Paver Blocks**: BasantBeton, Pavestone Marketing, Designers Pavings and Tiles Pvt. Ltd.

5. **Metallic Floor Hardener**: M/s. Triveni Color Industries (Floornate) M/s. Heatly& Gresham (India) Ltd M/s. De-Rust Chemical Corporation of India (Ferronite), M/s. Cement Research Corporation Pvt Ltd. (Stilonite)

6. **Non Metallic Floor Hardener**: Fosroc, Sika or approved equivalent make

7. **Concrete Paver Blocks**: BasantBeton, Pavestone Marketing, Designers Pavings and Tiles Pvt. Ltd.

8. **Cavity flooring**: Unilite, Cani-Microtac, Hyderabad Industries Ltd.

9. **Sunken Portion Treatment**: Choksey, Roffe, Krytone, Sika, Pidilite, HSW


11. **Glass Mosaic Tiles**: Italica, Bisazza, Palladio

12. **Antistatic Epoxy Floor**: Pidilite, Fosroc, Beck, STP, Degussa, Huntsman, Sika, HSW

13. **Epoxy Coating**: Pidilite, Fosroc, Asian Paints, Huntsman, Degussa, Sika, HSW

**D. Wood Works**

1. **Laminates**: Formica, Decolam, Century, Marino, National, Green Ply, Durian

2. **Pre-Laminated Particle Board/Particle Board / Wooden Doors**: Greenlam, Kitlam, Bhutan Board, Indian Plywood Mfg, Co. Ltd., Indian Wood and Wood Products, Mangalore, Mysore Plywood Limited, Mis Western India Plywood, Orchid Ply

3. **Flush Door Shutters**: Kitply, Navapan, Green Ply, Kutty Flush Doors, Anchor, Anand

4. **Ply Board**: Greenply, Kitply, Century

5. **Prelaminated MDF Board**: Mangalam Timber (Dura Tuff), Century or approved equivalent make

6. **35mm thick exterior grade panel door (both side laminated door)**: -do-

7. **35mm thick exterior grade flush door**: -do-

**E. Steel Works**

1. **M.S. Pipe**: Jindal Hisar, Kalinga, TATA

2. **Steel Doors, Windows, MS rolling**: Sen Harvic; AGEW; Deccan Structural
### Technical Specification for Ash Water Recirculation System

<table>
<thead>
<tr>
<th>Component</th>
<th>Supplier Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutters, Pressed Steel Door Frames</td>
<td>System, Multiwyn, NCL Seccolor Ltd., Madhu Industries, Swastic Rolling Shutters &amp; Engineering Works, Basic Arch Products, Perfect Industrial Products.</td>
</tr>
<tr>
<td>Metal Fire Check Doors</td>
<td>: Godrej or approved equivalent make</td>
</tr>
<tr>
<td>Stainless Steel Bolts, Screws, Washers, Nuts</td>
<td>: Kundan, Puja, Atul</td>
</tr>
<tr>
<td>Stainless Steel Pipes/Flats</td>
<td>: Jindal, Salem Steel, HILTI</td>
</tr>
<tr>
<td>Stainless Steel Pipes/Flats</td>
<td>: Jindal, Salem Steel, HILTI</td>
</tr>
<tr>
<td>Stainless Steel Pipes/Flats</td>
<td>: Jindal, Salem Steel, HILTI</td>
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<td>: Jindal, Salem Steel, HILTI</td>
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<tr>
<td>Stainless Steel Pipes/Flats</td>
<td>: Jindal, Salem Steel, HILTI</td>
</tr>
<tr>
<td>Stainless Steel Pipes/Flats</td>
<td>: Jindal, Salem Steel, HILTI</td>
</tr>
<tr>
<td>Aluminium Sections</td>
<td>: Indal, Bhoruka, Hindalco, Jindal</td>
</tr>
<tr>
<td>Aluminium Cleat arrangement for Glazings</td>
<td>: Deco or approved equivalent</td>
</tr>
<tr>
<td>Aluminium Composite Panel</td>
<td>: Alstrong, Alpolic, Alucobond, or approved equivalent make</td>
</tr>
<tr>
<td>Door Seal – Woolpile Weather Strip</td>
<td>: Anand – Reddiplex or approved equivalent make</td>
</tr>
<tr>
<td>E.P.D.M. Gaskets</td>
<td>: Anand Reddiplex, Enviro Seals or approved equivalent make</td>
</tr>
<tr>
<td>Stainless Steel Door handles, butt hinges (with and without ball bearings), Floor stoppers, Cabinet handles, knobs</td>
<td>: KICH, ARCH, NEKI</td>
</tr>
<tr>
<td>Stainless Steel Tower bolts, Sliding Bolts</td>
<td>: GARG, ARCH, KICH</td>
</tr>
<tr>
<td>Door Closer / Floor spring</td>
<td>: Everite, Hardwyn, Earl Bihari, Garnish, Crown, Jyothi, Godrej &amp; Boyce, Secur Industries, Hafele</td>
</tr>
<tr>
<td>Door Locks</td>
<td>: ACME, Godrej, Harrison, PAG, Hafele</td>
</tr>
<tr>
<td>Stainless Steel Friction Stay</td>
<td>: Securistyle, Hafele, Dorma, Hitech, Kich or approved equivalent make</td>
</tr>
<tr>
<td>Aluminium Die-cast handles &amp; two point locking kit.</td>
<td>: Giesse, Securistyle, Alu-alpha</td>
</tr>
<tr>
<td>Stainless Steel -handles</td>
<td>: KICH, Hafele or approved equivalent make</td>
</tr>
<tr>
<td>Stainless Steel Handrails, Balustrade</td>
<td>: KICH, Ozone, ARCH or approved equivalent make</td>
</tr>
<tr>
<td>PVC/FRP Doors</td>
<td>: ACCUCEL, Thermodeck, Rajashree</td>
</tr>
</tbody>
</table>
## 2. FRP Doors
- Omega Fibres or approved equivalent make

### I. Painting Works

1. Synthetic Enamel Paints
   - Berger, Asian Paints, Kansai Nerolac, Jenson & Nicholson, Shalimar
2. Oil Bound Distemper
3. Cement Paint
   - Snowcem Plus, Berger, Nerolac, Jenson & Nicholson, Shalimar, ICI Dulex
4. Exterior Emulsion Paint
   - ICI, Asian, Berger, Johnson & Nicholson, Shalimar
5. Exterior Emulsion Paint
   - ICI, Asian, Berger, Johnson & Nicholson, Shalimar
6. Epoxy Paint
   - Nerolac, Shalimar, Asian Paints, Roto Polymer and Chemicals, Avcon Technics Pvt. Ltd., Huntsman
7. Wall Putty
   - Birla, JK or approved equivalent make
8. Other Paints / Premiers
   - ICI, Dulux, Asian, Berger, Nerolac

### J. Glass Works / Polycarbonate Sheet Works

1. Clear Float Glass / Toughened Glass
   - Modi (GG), AIS (Tata), Saint Gobain (SG), Hindustan Pilkington, Asahi
2. Reflective Glass
   - Glaverbel, Glavermas, Saint Gobain
3. Polycarbonate Sheets
   - GE Plastics, Everest, Sunlite or approved equivalent make

### K. False Ceiling Works

1. False ceiling – Gypsum Board System
   - India Gypsum, Laffarge, Boral
2. False ceiling – Aluminium Panel System
   - Hunter Douglas (Luxalon), Armstrong or approved equivalent make

### L. Sealants

1. Polysulphide sealant
   - Pidilite, FosrocChoksey, Degussa Sikka
2. False ceiling – Aluminium panel system
   - GE-Silicon, Pidilite, Choksey, Wacker, Fosroc, Dow Corning, Bostik, INTERARCH

### M. Expansion Joint Treatment

1. Expansion Joint Treatment
   - VSIL (Sanfield (India) Ltd., Pidilite, Sika, Crysil or approved equivalent make

### N. Water Proofing Treatment

1. Water modified Bitumen water proofing membrane
   - STP, Bitumat, SIKA, Texsa
2. App modified bitumen water proofing membrane
   - STP, Bitumat, SIKA, Texsa

### O. Sanitary & Plumbing Works

1. Vitreous China Sanitary ware
   - Hindware, Parryware, Kohler, Gabriel
<table>
<thead>
<tr>
<th></th>
<th>Item Description</th>
<th>Brand(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>White Glazed Fire Clay Sink</td>
<td>Sanfire, Cera, Neycer, Hindware</td>
</tr>
<tr>
<td>3.</td>
<td>Stainless Steel Sink</td>
<td>AMC, Orient, Nirali, Suhag, Dayana, Commander</td>
</tr>
<tr>
<td>4.</td>
<td>Plastic Seat Cover of W.C.</td>
<td>Commander, Bestolite, Diplomat, Jaquar, Sona, Gabriel</td>
</tr>
<tr>
<td>5.</td>
<td>C.P. Fittings mixer / pillar taps, washers, C.P. Brass accessories</td>
<td>Jaquar, EssEss, MARC, Kohler, Gabriel</td>
</tr>
<tr>
<td>7.</td>
<td>G.I. Pipes</td>
<td>Tata, Jindal or approved equivalent make</td>
</tr>
<tr>
<td>8.</td>
<td>G.I. Fittings</td>
<td>Unik, K.S., Zoloto</td>
</tr>
<tr>
<td>9.</td>
<td>Gunmetal Valves</td>
<td>Zoloto, Leader, Sant, Kilburn, Neta</td>
</tr>
<tr>
<td>10.</td>
<td>CP Brass stop &amp; Bib Cock</td>
<td>Jaquar, EssEss, MARC, Kohler</td>
</tr>
<tr>
<td>11.</td>
<td>Ball valve with floats</td>
<td>Zoloto, Leader, Sant, Jayco</td>
</tr>
<tr>
<td>12.</td>
<td>Stoneware pipes &amp; Gully Traps</td>
<td>Tassel, Indo Pipes, South India Corporation, PerfecrKashmira or any BIS Marked Pipes</td>
</tr>
<tr>
<td>13.</td>
<td>R.C.C. Pipes</td>
<td>Indian Hime Pipes, Canera Cement Pipes, Karnataka Cement Pipes or any BIS Marked Pipes</td>
</tr>
<tr>
<td>14.</td>
<td>C.I. Manhole Covers</td>
<td>RIF, NECO, B.C., B.I.C.</td>
</tr>
<tr>
<td>15.</td>
<td>PVC Water Tankl</td>
<td>Sintex, Polycon, Infra</td>
</tr>
<tr>
<td>16.</td>
<td>Mirror</td>
<td>Atul, Modi Guard, Saint Gobain</td>
</tr>
<tr>
<td>17.</td>
<td>Hand Drier</td>
<td>Kopal, Automat, Euronics</td>
</tr>
<tr>
<td>18.</td>
<td>PVC flushing cistern</td>
<td>Commander, Parryware, Duralite, Hindware</td>
</tr>
<tr>
<td>19.</td>
<td>PVC Rain Water Pipes</td>
<td>Supreme, Prince, Finolex, Oriplast, Kisan</td>
</tr>
<tr>
<td>20.</td>
<td>C.I. Pipes Class LA and fittings</td>
<td>Keso-spun, supra, Electrosteele</td>
</tr>
<tr>
<td>21.</td>
<td>UPVC/HDPE Pipes &amp; fittings</td>
<td>Finolex, prince, supreme, kitec, oriplast, Polyfab</td>
</tr>
<tr>
<td>22.</td>
<td>C.P. Flush Valves</td>
<td>Jaquar, Roca, MARC</td>
</tr>
<tr>
<td>23.</td>
<td>C.P. Angle Valves (Ball valve type)</td>
<td>ITAP : Italy, Bugatti, Italy</td>
</tr>
<tr>
<td>24.</td>
<td>Gratings, Strainers, Cleanouts etc.</td>
<td>Near Brand (Sage Metals) or approved equivalent make</td>
</tr>
<tr>
<td>25.</td>
<td>GI Plaster mesh</td>
<td>M/s Arpitha Exports or approved equivalent make</td>
</tr>
</tbody>
</table>

09.11.2 In case of items not covered in the above list, the material shall procured after approval of TVNL as per the standard material available in the market and having BIS certification mark.
09.12 Estimated Quantities for Civil Works

1) Excavation in
   a) Soil (of all kinds)
   b) Rock
2) Piling
3) PCC
4) RCC
5) Reinforcement
6) Masonry work
7) Doors and windows including fitting and fixtures
8) Flooring
9) Plastering, painting and other finishes
10) Roofing including water proofing
11) Roads and drainage including culverts etc.
12) Area development including paving.
13) Plumbing and sanitary works including internal and external water supply and sewerage system

Note: All quantities for civil works as indicated above are non-binding
09.13 List of Civil Engineering Drawings and Documents for Approval/Information

Group – 1: For Approval

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Drawing numbering system</td>
</tr>
<tr>
<td>2.</td>
<td>List of drawings, with drawing Nos. and title</td>
</tr>
<tr>
<td>3.</td>
<td>Basic design criteria and loading for all buildings, structures and foundations.</td>
</tr>
<tr>
<td>4.</td>
<td>Site plan/layout drawing with battery limit in 1:500 scale</td>
</tr>
<tr>
<td>5.</td>
<td>Design calculations in editable soft copies and hard copies along with soft copies of STAAD analysis and load data for buildings, foundations for equipment and structures, auxiliary etc, (design calculations shall be submitted along with or before submission of G.A. and RCC drawings). In case software is used for analysis and design of structures, latest version of STAAD Pro shall be used. All hard copies of design documents, calculations etc shall be submitted in very clear, legible and presentable format and in bound pattern in requisite numbers. Also cl 3.3.06. sl.no. (x) shall be referred. In specific cases where any established theory is not available in IS: codes for supporting the design calculations, reference of established literature/ books may be used in consultation with consultant/ purchaser before submitting it as supporting document and in those cases the photocopy of the relevant pages of reference literature/ book shall be enclosed by the Tenderer along with design documents.</td>
</tr>
<tr>
<td>6.</td>
<td>General arrangement, plan and sectional drawings with all dimensions and details for foundation of equipment and structures, auxiliary facilities etc.</td>
</tr>
<tr>
<td>7.</td>
<td>Layout and sectional details of drainage, sewerage network with all invert levels slopes, sizes, dimensions, manholes top level etc.</td>
</tr>
</tbody>
</table>

Group – 2: For information and comments, if any

<table>
<thead>
<tr>
<th>It No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Detail reinforcement drawings.</td>
</tr>
<tr>
<td>2.</td>
<td>Detail of bolts, inserts/ embedment, coverings, etc.</td>
</tr>
<tr>
<td>I.S CODE NO.</td>
<td>TITLE</td>
</tr>
<tr>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>IS:458 – 1988</td>
<td>Specification for precast concrete pipes (with or without reinforcement).</td>
</tr>
<tr>
<td>IS:771 – 1963</td>
<td>Specification for glazed earthenware sanitary appliance (line water closets and urinals wash basins, sink etc.)</td>
</tr>
<tr>
<td>IS:875 (PART-1) – 1987</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures - dead loads.</td>
</tr>
<tr>
<td>IS:875 (PART-2) – 1987</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures- imposed loads.</td>
</tr>
<tr>
<td>IS:875 (PART-3) – 1987</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures - wind loads.</td>
</tr>
<tr>
<td>IS:875 (PART-5) – 1987</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures - special loads and load combinations.</td>
</tr>
<tr>
<td>IS:1172 – 1993</td>
<td>Code of basic requirements for water supply, drainage and sanitation.</td>
</tr>
<tr>
<td>IS:1230 – 1979</td>
<td>Cast iron rain water pipes and fittings.</td>
</tr>
<tr>
<td>IS:1542 – 1992</td>
<td>Specification for sand for plaster (second revision)</td>
</tr>
<tr>
<td>IS:1580 – 1991</td>
<td>Bituminous compounds for water proofing and caulking purposes.</td>
</tr>
<tr>
<td>IS:2191(PART-1) – 1983</td>
<td>Specification for wooden flush door shutters (cellular and hollow core type)-plywood face panels</td>
</tr>
<tr>
<td>IS:2202 (PART-1) – 1991</td>
<td>Specification for wooden flush door shutters (solid core type) - plywood face panels.</td>
</tr>
<tr>
<td>IS:2202 (PART-2) – 1983</td>
<td>Specification for wooden flush door shutters (solid core type) - particle board and hard board face panels.</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-1: Methods of Test for aggregates for concrete: Part-1 Particle size and shape (Amendments 3).</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-2: Methods of Test for aggregates for concrete: Part-2 Estimation of deleterious materials and organic impurities (Amendment 1).</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-3: Methods of Test for aggregates for concrete: Part-3 Specific gravity, density voids, absorption and bulking.</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-4: Methods of Test for aggregates for concrete Part-4 Mechanical properties (Amendments 3).</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-5: Methods of Test for aggregates for concrete Part-5 Soundness.</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-6: Methods of Test for aggregates for concrete: Part-6 Measuring mortar making properties of fine aggregates (Amendments 2).</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-7: Methods of Test for aggregates for concrete: Part-7 Alkali aggregate reactivity (Amendment 1).</td>
</tr>
<tr>
<td>IS2386 (Part- 1 to 8)-1963</td>
<td>Part-8: Methods of Test for aggregates for concrete Part-8 Petrographic examination (Amendment 1).</td>
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<tr>
<td>IS:2430-1986</td>
<td>Methods of sampling of aggregates for concrete (first revision)</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IS:3495 (Part-1 to 4)-1992</td>
<td>Methods of test of burnt clay building bricks (third revision)</td>
</tr>
<tr>
<td></td>
<td>Part-1 : Determination of compressive strength</td>
</tr>
<tr>
<td></td>
<td>Part-2 : Determination of water absorption</td>
</tr>
<tr>
<td></td>
<td>Part-3 : Determination of efflorescence</td>
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<tr>
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<td>Part-4: Determination of warpage</td>
</tr>
<tr>
<td>IS:5454-1978</td>
<td>Methods of sampling of clay building bricks.</td>
</tr>
<tr>
<td>IS:6163 – 1978</td>
<td>Centrifugally cast (spun) iron low pressure pipes for water, gas, sewage.</td>
</tr>
<tr>
<td>IS:7452 – 1990</td>
<td>Hot rolled steel sections for doors, windows and ventilators.</td>
</tr>
<tr>
<td>IS:12894-2002</td>
<td>Pulverized fuel ash (fly ash) lime bricks – Specification (first revision)</td>
</tr>
</tbody>
</table>
10.00 STEEL STRUCTURES

10.01 Steel structural work shall cover trestles, beams, platforms, monorails, bracings, ladders, staircases, handrails, etc. Total structural work shall be complete in all respects for proper functioning of all the plants and equipment.

Structural elements
- Columns (rolled section or built-up), Column bracings.
- Stairs, ladders and crossovers
- Handrails,
- Walkways with chequered plate / gratings
- Monorail Beams & Supports.

10.02 Design Considerations

General
Design of steel structures shall be done in accordance with IS: 800 - 2007 or any equivalent international code of practice. The following loads shall be considered while designing the structures:

- All live loads shall be in accordance with IS: 875 in addition to the technological loads indicated by the equipment manufacturer / supplier.
- Wind loads shall be in accordance with IS: 875(Part-3) -2015
- Seismic loads shall be in accordance with IS: 1893-2015 part IV

Resonance in Structures
Structures supporting vibratory / reciprocating equipment shall be designed so as to obviate occurrence of resonance. The ratio of applied frequency to natural frequency shall not lie within the range of 0.7 to 1.4.

10.03 Material of Construction

The material for the structures to be designed shall be as follows:

i) All rolled sections and plates up to 20 mm thick shall conform to Grade-E250 & quality A of IS:2062-2011 and shall generally be of tested quality( semi-killed ).

ii) Plates beyond 20 mm thick and up to 40 mm thick subjected to dynamic loading shall conform to Grade-E 250 & quality BR as per IS:2062-2011. (rolled in killed condition )

iii) Plates beyond 40mm shall conform to Grade-E 250 & quality BR as per IS: 2062-2011 in normalized and ultrasonically tested quality.
iv) High strength micro-alloyed steel shall conform to SAIL-MA 350 HYA/HYB (SAIL product).

Steel sheets shall conform to IS: 1079-2009.

Chequered plates shall conform to IS: 3502-2009. All gratings shall be of MS pressure locked electro forged.

The electro-forged gratings shall be of approved brand and of approved manufacturer unless otherwise agreed by purchaser. The type of grating selected shall be based on the loading, for the area in which the grating is provided and shall be subject to approval of purchaser.

Steel tubes for structural purposes shall conform to IS: 1161-2014 Grade YSt-240).

10.04 Method of Construction
Steel structures to be fabricated shall generally be of welded construction. Covered electrodes will conform to IS: 814–1991. Elements will be fabricated in largest possible dimensions optimal with the transport requirement so as to minimize site work. Site connection will be by permanent bolts.

10.05 Fabrication
Fabrication of all structural steel works shall be in accordance with IS: 800. Fabricated structures shall conform to tolerance as specified in IS: 7215–1974.

10.06 Inspection
All structures will be offered for inspection by the client. Material certificate for the fabricated structures will also be provided.

10.07 Erection of Steel Structures
Erection of structures, alignment of all structures, Tolerances for erection of steel structures shall be as per IS: 12843–1989. Erection shall be carried out in accordance with IS: 800.

10.08 Painting
Painting system to adopt shall be as follows:

Surface preparation: — As per Grade St-3 according to Swedish Standard SIS055900

Primer paint: - Two coats of zinc phosphate in phenolic alkyd medium (DFT = 35 microns/coat).

Finishing paint: - Two coats of Polyurethane (DFT=50 microns/coat)

Total DFT of paint after finishing shall be 170 microns.
11.00 GENERAL LAYOUT & FIRE PROTECTION SYSTEM

11.01 General Layout

11.01.1 General

The proposed Pump house & Electrical substation for the Ash water recirculation system have been planned on Western corner of the Existing Tenughat Thermal Power Station. The proposed Ash water pipeline have been planned from West (Near Existing ash pond) to East (near Existing pump house). This thermal power station is situated near Tenughat Dam at Lalpania in the district of Bokaro, Jharkhand. The nearest Railway station is Gomia, which is about 22 kms from the Power station. The Power station is very well connected by Road from Ramgarh and Gomia. The Power station is around 91 Km from Ranchi city, the capital of Jharkhand. Birsa Munda Airport is the nearest airport at around 100 km from the proposed site.

11.01.2 General information about land

The land levels for the proposed Pump house and Electrical substation building is varying in the range of around 268 to 272 m absolute level. The ground level of the pipeline varies and therefore the final level shall be decided during detail engineering considering minimum earthwork and other design consideration. Cutting and filling required for all civil work, structural footing work during Pipe erection, Pump house & Electrical building construction shall be in the scope of the contractor. Approach road and inspection road for Pump house, electrical building & pipe laying respectively shall be in the scope of contractor.

Plant Levels for this package:
The Finished Ground Level (FGL) for the Pump house and electrical building for the proposed Ash water Recirculation system shall be considered at 270 m.

The Finished Road Top Level (FRL) is around 270.4 m. Finished Floor Level (FFL) is around 270.5 m which is +/- 0.0.

11.01.3 General Layout of the plant
General layout of proposed Ash water recirculation system comprising pipe routes, Pump house and electrical building locations for the proposed Ash water recirculation system is shown in drawing no. The Tenderer is required to visit the site, access the site condition, get clarified any doubt about scope and nature of work during pre bid discussion. Based on the above drawing, the contractor is required to do the survey, basic engineering and detail engineering drawing for client’s approval before the start of work.

All existing approach roads, drains etc shall be repaired and made motorable wherever required for executing the facilities. However, paving and fencing all along the pump house & electrical building is in scope of Tenderer. New Drains to be connected to natural drainage system. The road width shall be 4 m wide with 2 m berms on either side.

11.02 FIRE PROTECTION SYSTEM

Technical Specification for Complete fire protection system to be provided for the Pump house and electrical buildings under this package is given below.

11.02.01 INTRODUCTION

An elaborate system of fire protection shall be provided to fight as well as to reduce any occurrence of fire in various areas/units of the proposed Ash water recirculation plant. The system shall be planned in conformity with Tariff Advisory Committee’ guidelines, BIS, NFPA and other relevant standard/codes

Major Facilities envisaged are as following:

**Portable fire extinguishers**

Scope of work and services

The scope of work & services to be rendered by the tenderer covers Design & engineering, supply, handling at site, preparation of erection drawings, fabrication and erection as per approved drawings, site testing, painting, obtaining approvals from TAC/ TAC certified agency, commissioning and fulfillment of guarantee of all fire protection systems, sub-systems and integrated systems.

Major work comprises of following:
Portable fire extinguishers.
Different types of portable fire extinguishers (Mechanical foam, DCP, CO₂, water type and fire bucket) shall be deployed in various area of the complex as a measure of first-aid fire fighting. Portable fire extinguishers shall cover all the working/equipment areas, including electrical and cable premises, control rooms, pump houses, office buildings etc. Selection, quantity and distribution of the fire extinguishers shall be as per IS: 2190 (latest revision).
Portable extinguishers will conform to IS codes mentioned below.

All fire extinguishers & fire buckets shall bear ISI mark. The testing parameters of the portable extinguishers shall conform to as mentioned in IS: 15683-2006. The material of construction of Mechanical foam (portable), water type (gas cartridge type) and the caps of the extinguishers (except CO₂) shall be of stainless steel only.
Tenderer will provide Initial fill of gas and other fire extinguishing media (including quantity required for PG test) and demonstration.

11.03 DRAWINGS AND DOCUMENTS
For Approval by purchaser / consultant after placement of order drawings and document shall be submitted prior to placement of purchase order.

Drawings / documents to be furnished for information by the Tenderer as per TS.

The Tenderer shall submit As Built drawings/documents as per TS.

Performance guarantee
The performance guarantee tests shall be completed within a time schedule to be mutually agreed upon between the Purchaser and the Tenderer. Details of the performance tests, test procedures and test schedules for the demonstration of the performance guarantee on NFPA Codes/TAC Regulations shall be submitted to the Purchaser and shall be mutually agreed
The Tenderer shall conduct the operation during the performance tests and shall take full responsibility of the operations.

If the Tenderer is unable to achieve the performance values as a whole or in part during the performance tests, the Tenderer shall repeat the tests for demonstrating the performance values. Before repeating the tests the Tenderer shall take any and all measures as may be needed, at his own cost in order that the performance values can be achieved.

The observations of each performance test shall be recorded and signed by the Purchaser and the Tenderer. If such data conform to the performance test values, the Tenderer shall be entitled for the "Final Acceptance Certificate" from the Purchaser.

If even after two repetitive tests, the performance values are not reached the Tenderer shall undertake at his own cost such modification or replacement as are considered necessary to obtain the performance guarantee values and the responsibility to demonstrate performance guarantee shall continue to remain with the Tenderer till so established.
12.00 IMPLEMENTATION SCHEDULE AND PROGRESS MONITORING

12.01 The proposed Ash water re-circulating water system shall be commissioned in **10 months** from the Zero Date which will be reckoned as effective date of contract on a TURNKEY supplier. Zero Date and Commissioning as mentioned above and shown in schedule shall be same as defined in the technical and commercial part of the specification.

An indicative Implementation schedule, in line with the total time period and indicating the major activities, is shown in drg. no. MEC/11/PY/Q7GR/TS/01/001(R0) for reference.

12.02 Project Schedule

The Tenderer shall submit the following along with the tender.

   i) **Overall bar-chart schedule**

   The overall bar-chart schedule should be planned in weeks and shall show the major activities of the project. The major milestones for the project are also to be highlighted in the schedule.

   ii) Off-site / On-site organization charts for execution of the project.

12.03 The Tenderer shall note the following:

   i) **Construction Water**: Decanted water from the ash pond shall be used as a source of Construction water. The same shall be collected in temporary tank and shall be utilized suitably for the construction work.

   ii) **Construction Power**: Construction power shall be made available by client at a single point at a distance of 100m from the proposed pump house area free of cost inside plant premises.
iii) Construction & Storage Area: Battery limit area shall be utilized for construction and storage. However, if any area outside the battery limit is available, successful Tenderer may utilize it with the permission of the client.

12.04 The tenderer shall submit the following documents before finalization of contract:

i) Deployment of construction man power.

ii) Details of deployment of equipment and machinery, tools & tackles, etc.

12.05 The Successful Tenderer shall have to submit the following after signing of contract:

i) The Detailed project schedule covering further details of activities area-wise, for the total scope of the package, within a week from effective date of contract for approval and finalization by the Purchaser / Consultant.

ii) Progress reports (daily, weekly & monthly) in approved format, to be submitted regularly.

12.06 Progress Monitoring

An effective system of progress monitoring is to be evolved to ensure timely completion of all project activities. In general, progress of the following major activities is to be reported.

- The successful Tenderer shall submit a fortnightly schedule for site-execution, along with quantitative program in terms of physical targets for various disciplines of work.
● A fortnightly progress report showing current status of various activities like supply, construction etc. shall be submitted to the Purchaser / consultant.
● The fortnightly progress report shall indicate progress of activities against targeted dates and targeted quantities. Reasons for shortfalls, if any, shall be clearly brought out and proposed remedial measures to arrest the delays shall be indicated by the successful Tenderer in the progress report, wherever applicable.
● The successful Tenderer shall furnish information on site activities viz: daily, weekly and monthly progress reports. The successful Tenderer shall also indicate resource deployment at site, highlights of critical areas and constraints in the progress reports.
● Other information related to site activities as may be required by the Purchaser / his consultants shall also be submitted by the successful Tenderer.

12.07 The Purchaser / Consultant shall also have the right to:

● Invite the successful Tenderer for daily / weekly / monthly meetings to review the progress of the project.
● Depute Purchaser’s authorized representatives for ascertaining / expediting progress at successful Tenderer’s works.
● Suggest remedial actions to bridge-up time gap between planned progress & observed progress.
13.00 COMMISSIONING & PERFORMANCE GUARANTEE

13.01 Trial Run

Upon completion of erection, mechanical check and tests shall be carried out on each equipment and system according to the check list to be prepared by the Tenderer. Mechanical check and tests shall be performed to establish the following:

i) The system is erected in accordance with the approved drawings for the system.
ii) Applicable codes and standards are followed for materials and Workmanship.

Bearings for drives and driven equipment shall be checked, cleaned and lubricated.

Stuffing boxes and glands shall be checked for sufficient rings or packing and tightness of packing gland. Seal oil system wherever provided shall be checked for cleanliness and proper operation.

All flanges, inlet and outlet connections shall be checked for tightness. Connections requiring gaskets shall be tightened evenly all round to ensure equal stress over the entire gasket area.

In case of motor driven machinery, motors shall be decoupled and turned over to the electrical team for testing and no-load running of motors. After no-load runs of motors, the Tenderer shall recouple the motors to the equipment and recheck the alignment.

All protective and safety guards shall be installed and equipment shall be checked for free movement by hand rotation. Rotating equipment shall be checked for proper direction of rotation and shaft alignment.

Sequence checking of all control systems, cable connections, checking of all interlocks and protective devices shall be done by the Tenderer.

As per the observations recorded during trial runs, the Tenderer shall perform the following activities or other necessary actions as required to set right the system:

i) Realignment of machines and components, as required.
ii) Checking, changing or adding lubricants.
iii) Retightening of foundation and other fixing bolts.
iv) Adjustment and tuning of the machine.

Trail run for the system will be considered successful once all services have
been completed by the tenderer and met his obligations as per the approved drawings and successful trial run of individual equipment/unit.

Preliminary acceptance certificate (PAC) shall be issued on completion of trial run.

13.02 Commissioning

After the successful trial run, the tenderer shall liquidate outstanding defects/deficiencies, if any. Thereafter, the tenderer shall start-up and commission the facilities.

Commissioning of the system will be considered once the system will run smoothly for duration of 72 hours.

13.03 Performance guarantee

The performance guarantee tests shall be completed within a time schedule to be mutually agreed upon between the TVNL and the successful Tenderer after issue of successful commissioning certificate. Details of the performance tests, test procedures and test schedules for the demonstration of the performance guarantee shall be submitted to TVNL and shall be mutually agreed upon.

The tenderer shall guarantee performance parameters as specified below:

1) Duration of performance guarantee test shall be 24 hours.
2) Pumps shall be delivering the requisite flow upto sump of existing ash water pump house uninterruptedly for 24 hours.

13.04 Final Acceptance Certificate

The final acceptance certificate (FAC) shall be issued to the bidder on achieving the PG parameters and fulfillment of defect liability period. The defect liability period shall be of 12 months from the date of successful completion of PG test.

13.05 Liquidated Damage

Should the performance values falls below acceptable levels, the system will be rejected by TVNL and the successful Tenderer shall be liable, either to replace the units/sub-units/equipments or to pay compensation in addition to the liquidated damage as per contract or as may be mutually agreed upon.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Guaranteed figure</th>
<th>Acceptable limit with LD</th>
<th>Rate of LD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Availability of requisite flow at sump of Existing</td>
<td>660 m3/hr</td>
<td>Acceptable tolerance for flow (-) 5 % with LD beyond which Upto (-) 1 % flow = 1% LD Upto (-) 2 % flow = 2%</td>
<td></td>
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</tbody>
</table>
Ash water pump house & plant will be rejected LD
Upto (-) 3% flow = 3% LD
Upto (-) 4% flow = 4% LD
Upto (-) 5% flow = 5% LD

14.00 PREFERRED MAKE LIST

14.01 Mechanical equipments

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item Description</th>
<th>Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Horizontal centrifugal pumps</td>
<td>Kirloskar Brothers, Mather &amp; Platt (WILO), Sulzer, KSB Pumps, Flowserve</td>
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<tr>
<td>2</td>
<td>Slurry pumps</td>
<td>Sam Turbo, MBE, KBL, WEIR, GEHO, Metso, Akay</td>
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<td>3</td>
<td>Carbon steel pipes</td>
<td>SAIL, TATA, Jindal, Zenith, Man, SAW, Surindra, Bansal Skipper, Utkarsh, Bhushan, Ajantha Pipes, Venketesh Udyog, Maharashtra Seamless</td>
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<tr>
<td>4</td>
<td>Ductile Iron pipes &amp; fittings</td>
<td>Electro Steel Casting, Jindal Saw, Srikalahasti Pipes (Lanco Industries), Kubota</td>
</tr>
<tr>
<td>6</td>
<td>Gate valves</td>
<td>L&amp;T Valves, KSB, Steam &amp; Mining, BDK, KBL, Virgo, Oswal, Fouress, Intevalve Poonawala</td>
</tr>
<tr>
<td>8</td>
<td>Non-return valves</td>
<td>L&amp;T Valves, KSB, Steam &amp; Mining, BDK, KBL, Virgo, Oswal, Fouress, Intevalve Poonawala</td>
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<tr>
<td>9</td>
<td>Butterfly valve</td>
<td>L&amp;T Valves, Fouress, Kirloskar Brothers, VIRGO, BDK, XOMOX, Jash Engineering, Delval flow control, Intevalve Poonawala</td>
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<tr>
<td>10</td>
<td>Globe valve</td>
<td>L&amp;T Valves, KSB, Steam &amp; Mining, BDK, KBL, Virgo, Oswal, Fouress, Intevalve Poonawala, Delval flow control</td>
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<td>12</td>
<td>Air Release valve</td>
<td>KBL, Steam &amp; Mining, Schroder Duncum, Fluid Line Valves, Intevalve Poonawala</td>
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<td>13</td>
<td>Ball Valve</td>
<td>L&amp;T Valves, KSB, AL Saunders, Xomox, BDK, Virgo,</td>
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<td>14</td>
<td>Sluice gate</td>
<td>Oswal, Delval flow control</td>
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<td>15</td>
<td>Propeller Fans</td>
<td>Flow Link, ALMONARD, ACCEL, KHAITAN, AEROVENT, INDFAN, Marathon</td>
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<td>16</td>
<td>Hoist</td>
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<td>17</td>
<td>Fire Extinguishers</td>
<td>Techno fire controls, Gunnebo (India), Safex fire services ltd., KanadiaFyrFyter Pvt. Ltd., Life Guard, Gunnebo (India), Deflame (India), Supremax Equipment, Integrated Fire Protection Pvt. Ltd., Seal Fire Appliances Pvt. Ltd. Etc.</td>
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<tr>
<td>18</td>
<td>Fire hydrants</td>
<td>New Age Industries Surendranagar, SteelageIndustires, ASCO Strumech, Firex, Upadhya valves, Minimax, Vijay Fire.</td>
</tr>
<tr>
<td>19</td>
<td>Rubber expansion joints</td>
<td>CORI Engineers, D.Wren, Aphrodite</td>
</tr>
</tbody>
</table>

**14.02 Electrical Equipments:**
Shall be as per the preferred make list mentioned in chapter No. 07.

**14.03 Instrumentation Equipments:**
Shall be as per the preferred make list mentioned in chapter No. 08.

**14.04 Civil Items**
Shall be as per the preferred make list mentioned in chapter No. 09.
QUESTIONNAIRE TO BE FILLED IN BY TENDERER

The tenderer shall fill this questionnaire and submit with his offer. This information in this form is to facilitate tender processing even though it may be duplicate information presented elsewhere in his offer.

1.0 General:

1.1 Tenderer’s name and address:

1.2 Quotation No. & Date:

1.3 Previous experience for similar project

1.5 Deviation from technical specification:

1.6 Time schedule in the form of bar chart for Basic Engineering, Design Engineering, Manufacture, Supply, Erection, Testing, commissioning.

1.8 List of drawings furnished with tender:

1.9 List of testing equipment envisaged for site testing:

1.11 List of commissioning spares as will be required:

1.13 List of construction & erection equipment to be brought to site.

1.14 List of special Tools & Tackles

1.15 Fabrication & erection procedure to be followed.

1.16 Power requirement for construction.

1.17 List of spares for 2 years operation for fabricated and bought out items.

1.18 Tenderer to indicate list of drawings/document to be submitted under approval/reference category after being awarded the contract.

1.19 Organisation chart for Design & Engineering, Project monitoring and site activities including technical personnel, skilled & unskilled employees.

1.23 Estimated Quantities for Pipe-works, Civil, Structural, Electrical, Instrumentation & Control

1.22 Any other relevant information.

Signature of Tenderer
### TENDERER TO INDICATE THE LIST OF DEVIATIONS

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>REF. CLAUSE OF TS</th>
<th>DETAILS OF DEVIATIONS</th>
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TENDERER TO INDICATE LIST OF COMMISSIONING SPARES

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<th>EQUIPMENT</th>
<th>DESCRIPTION OF SPARE</th>
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## TENDERER TO INDICATE LIST OF SPECIAL TOOLS & TACKLES

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>TOOLS/ TACKLES</th>
<th>DESCRIPTION / SPECIFICATION</th>
<th>APPLICATION</th>
<th>QUANTITY</th>
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DECLARATION OF SITE VISIT
(To be filled up by the Bidder)

I, hereby, declare that I have visited the site to understand the site conditions, and acquainted myself with atmosphere prevalent therein. I have also understood the extent of total works involved for this package.

Signature of the Bidder:
Name:
Designation:

Seal of company
APPENDIX-V

TENDERER TO INDICATE LIST OF SPARES FOR TWO YEARS OF OPERATION & MAINTENANCE

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>EQUIPMENT</th>
<th>DESCRIPTION OF SPARE</th>
<th>QTY INSTALLED</th>
<th>RECOMMENDED QUANTITY</th>
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ADDITIONAL OBLIGATIONS (OF PURCHASER) DESIRED BY THE TENDERER

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>NATURE OF WORK/ FACILITIES DESIRED</th>
<th>REASONS</th>
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<tbody>
<tr>
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TENDERER TO INDICATE REQUIREMENT OF CONSTRUCTION POWER, WATER, OFFICE SPACE, STORAGE AREA

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>DESCRIPTION</th>
<th>REQUIREMENT</th>
<th>REMARKS</th>
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<tr>
<td>1</td>
<td>POWER</td>
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<td></td>
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<tr>
<td>2</td>
<td>WATER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AREA OF OFFICE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>STORAGE AREA</td>
<td></td>
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TENDERER TO INDICATE ESTIMATED QUANTITIES

I. ESTIMATED QUANTITIES FOR EQUIPMENT

MECHANICAL, ELECTRICAL & INSTRUMENTS

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>DESCRIPTION/EQUIPMENT</th>
<th>MATERIAL/SPECIFICATION</th>
<th>QTY.</th>
<th>TOTAL WT. (IN TONS)</th>
<th>UNIT RATE</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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</table>

*
## ESTIMATED QUANTITIES FOR PIPE WORKS

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<thead>
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<th>SL. NO.</th>
<th>DESCRIPTION/EQUIPMENT</th>
<th>MATERIAL/SPECIFICATION</th>
<th>QTY</th>
<th>TOTAL WT. (IN TONS)</th>
<th>UNIT RATE</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pipes</td>
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<tr>
<td>2.</td>
<td>Pipe Supports</td>
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<tr>
<td>3.</td>
<td>Pipe Fittings</td>
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</tr>
<tr>
<td>4.</td>
<td>Valves</td>
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</tr>
<tr>
<td>5.</td>
<td>Miscellaneous</td>
<td></td>
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</tbody>
</table>

## ESTIMATED QUANTITIES FOR STRUCTURAL WORKS:

[Blank space for data entry]
## INSPECTION CALL PROFORMA

<table>
<thead>
<tr>
<th>Inspection Call No.</th>
<th>Date :</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>AWRS AT TTPS</td>
</tr>
<tr>
<td>Successful tenderer</td>
<td>Successful tenderer’s Order No. &amp; Date</td>
</tr>
<tr>
<td>Sub-Successful tender with address, Fax &amp; Ph. No.</td>
<td>Place of Inspection with address, Fax &amp; Ph. No.</td>
</tr>
<tr>
<td>Proposed Date of Inspection</td>
<td>Name &amp; Designation of Contact Person with Ph. No.</td>
</tr>
<tr>
<td>Manufacturer’s Off-day</td>
<td></td>
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</tbody>
</table>

### List of items offered for inspection

<table>
<thead>
<tr>
<th>Item Identification No.</th>
<th>Item Description</th>
<th>Drawing No. with Revision</th>
<th>Drawing Approval Status A/AAN/INF</th>
<th>QAP No. &amp; Status</th>
<th>Quantity (No./M) with tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>Total Ordered Accepted Offered</td>
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<tr>
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</tbody>
</table>

A = Approved, AAN = Approved as Noted, INF = Information Category

### List of documents & Test Certificates enclosed in four (4) sets.

<table>
<thead>
<tr>
<th>Description</th>
<th>Ref No. &amp; Date</th>
<th>Description</th>
<th>Ref No. &amp; Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>for Successful tenderer/ Sub- Successful tenderer</td>
<td></td>
</tr>
</tbody>
</table>
TENUGHAT VIDUYT NIGAM LIMITED,
LALPANIA JHARKHAND
TECHNICAL SPECIFICATION FOR
ASH WATER RECIRCULATION SYSTEM

### QUALITY ASSURANCE PLAN

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>ORDER NO. &amp; DATE</th>
<th>SUB-CONTRACTOR</th>
<th>PACKAGE NO.</th>
<th>PACKAGE NAME</th>
</tr>
</thead>
</table>

### INSTRUCTIONS FOR FILING UP:

1. SAF shall be submitted for each of the equipment manufactured with breakdown of assembly/sub-assembly & certification by the manufacturer having same specification.

2. Use numerical codes as indicated for extent of inspection, tests and submission of test certificates & documents. Additional codes & description to extent of inspection/tests may be added as applicable for the plant and equipment.

3. Separate certification number with quantity for equipment shall be indicated wherever equipment having same specification belonging to different facilities are grouped together.

4. Estimated weights may be indicated wherever actual weights are not available.

### EQUIPMENT DETAILS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Identification</th>
<th>Quantity</th>
<th>Manufacturer's Name and Address</th>
<th>Expected Schedule of Final Inspection</th>
<th>Final Inspection Test by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

### INSPECTION AND TESTS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Test Certificate</th>
<th>Acceptance System Standards/BSES</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

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For CONTRACTOR / SUB-CONTRACTOR

For MECON (Stamp & Signature)

D.A.P. NO TO BE ALLOATED BY MECON

NO. / M

REV.

Sheet: 1 of 2

Technical Specification
ASH WATER RECIRCULATION SYSTEM

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<table>
<thead>
<tr>
<th>No.</th>
<th>Description of equipment</th>
<th>Certificate No.</th>
<th>Quantity</th>
<th>Manufacturers</th>
<th>Expiry Date of Certificate</th>
<th>Formal Inspection</th>
<th>Final Inspection/Terms</th>
<th>Accepted Criteria</th>
<th>Documents</th>
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</thead>
<tbody>
<tr>
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ASH WATER RECIRCULATION SYSTEM
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### TECHNICAL SPECIFICATION FOR ASH WATER RECIRCULATION SYSTEM

<table>
<thead>
<tr>
<th>EQUIMENT DETAILS</th>
<th>ASH WATER RECIRCULATION SYSTEM</th>
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### TABLE

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Code</th>
<th>Quantity</th>
<th>Identification No.</th>
<th>Serial No.</th>
<th>Manufacturer</th>
<th>Date of Order</th>
<th>Date of Inspection</th>
<th>Test Inspection</th>
<th>Remarks</th>
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ASH WATER RECIRCULATION SYSTEM
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[Technical Specification]
ASH WATER RECIRCULATION SYSTEM
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## Ash Water Recirculating System

### Indicative Implementation Schedule

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Duration</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TVNL - Ash Water Recirculating System</td>
<td>43 w</td>
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<tr>
<td>2</td>
<td>Effective date of Contract (Zero-date)</td>
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<td>3</td>
<td>Design &amp; Engineering</td>
<td>13 w</td>
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<td>4</td>
<td>Site mobilization</td>
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<td>5</td>
<td>Civil Works</td>
<td>22 w</td>
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<tr>
<td>6</td>
<td>Procurement and Supply of structures, equipment, piping, cables, etc.</td>
<td>22 w</td>
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<tr>
<td>7</td>
<td>Erection of structures, equipment, piping, cables, etc.</td>
<td>22 w</td>
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<tr>
<td>8</td>
<td>Testing &amp; Commissioning</td>
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