

SECTION -3

ENCLOSURES TO THE SPECIFICATION

(a) Customer Specification



SURATGARH SUPERCRITICAL EXTENSION PROJECT

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.

**2 x 660MW, STAGE- V, SURATGARH, UNIT 7 & 8, SUPER CRITICAL TPS,
DISTRICT- SRIGANGANAGAR, RAJASTHAN, INDIA**

SPECIFICATION NO. TCE.5750A-H-500-01

FOR

**ENGINEERING PROCUREMENT AND CONSTRUCTION (EPC)
CONTRACT**

VOLUME – VI

SPECIFIC TECHNICAL REQUIREMENTS – CIVIL WORKS



TATA CONSULTING ENGINEERS LIMITED

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JUNE 2012

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SECTION – D4.1
GENERAL

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D 4.1
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL	SHEET 1 of 3
GENERAL 1.0 This module of the specification covers design, preparation of general arrangement, construction as well as Fabrication drawings, supply of all labour as well as materials and construction of all civil, structural as well as architectural work on EPC basis for the proposed 2 x 660 MW Super critical Thermal Power Project being set up in Suratgarh, Sri Ganganagar District of Rajasthan, India for Rajasthan Rajya Vidhyut Utpadan Nigam Ltd (RRVUNL). 2.0 Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as CIVIL WORKS. The detailed scope of works covered under civil & Structural works are given in Section D4.2. Any dimensions or number mentioned in the document are the minimum required and if more than that is required for the satisfactory completion of the job the same shall be provided by the Contractor without any extra price. 3.0 The work to be performed under this specification consists of design, engineering as well as providing all labour, materials, consumables, equipment, tools and plants, temporary works, temporary labour and staff colony, constructional plant, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications, including revisions and amendments thereto as may be required during the execution of the work. 4.0 Supply of all materials including cement, reinforcement steel, structural steel, stone aggregates, sand and other materials are included in the scope of the Contractor. 5.0 All materials shall be offered for inspection by client/consultant before use at site. At every stage of work checks shall be made by client, consultant, third party inspectors and protocols signed by all parties before execution. All protocols shall be presented at least 24 hours or more before the actual planned time schedule in writing to the OWNER&CONSULTANT. But this shall not relieve the CONTRACTOR of his responsibility to execute the work as per drawings, designs and specifications. 6.0 All materials works and tests shall be according to relevant Indian standards or in absence of it other internationally acknowledged standards. CONTRACTOR shall make available to the OWNER copy of such standards. 7.0 The scope shall also include setting up by the CONTRACTOR a complete testing laboratory in the field to carry out all relevant tests as		
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per BIS or other international standards where BIS does not cover a particular test required for the civil works for the project. 8.0 The work shall be carried out according to the design / drawings to be developed by the CONTRACTOR and approved by the OWNER/CONSULTANTS. For all building and structures, foundations, etc., necessary layout, Loading particulars and details are to be developed by the CONTRACTOR keeping in view the statutory & functional requirements of the plant & facilities and providing enough space & access for operation, use & maintenance. Certain minimum requirements are indicated in this specification for guidance purpose only. However, the CONTRACTOR's offer shall cover the complete requirements as per the best prevailing practices and to the complete satisfaction of the OWNER. 9.0 CONTRACTOR shall inspect the site, examine and obtain all information required and satisfy himself regarding matters and things such as access to site, communications, transport, right of way, the type and number of equipment and facilities required for the work, availability of local labour, materials, water etc., and their rates, local working conditions, weather, flood levels, subsoil conditions, natural drainage, etc. Ignorance of the site conditions shall not be accepted by the Owner as basis for any claim for compensation or extension of time. The submission of a bid by the CONTRACTOR will be construed as evidence that such an examination was made and any later claims / disputes in this regard against prices quoted shall not be entertained or considered by the OWNER. 10.0 Geotechnical Investigation 10.1 The soil investigation has been carried out for Stage -IV and reports are available with Owner for reference, However bidder has to carry out detailed soil investigation for Stage - V BIDDER is advised to verify the content of report and if necessary make his own tests at site as per requirement before submission of bids. Alternatively, BIDDER may make his own assessment for the type of foundations envisaged based on this preliminary report at his own risk. In any case, the BIDDER has to carryout detailed geo-technical investigation after the award of contract, through some approved / reputed agency and submit geo-technical investigation report with recommendation for OWNER's review & approval. The recommendation given in approved final report becomes binding on the CONTRACTOR. The CONTRACTOR shall not be eligible for increase his price or demand any extension of time because the final report is in variance from preliminary report furnished by OWNER.		
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11.0	Survey data Preliminary topographical survey sheet is provided with tender documents for reference purpose. CONTRACTOR shall carry out survey of the whole plant on Award of Contract .Before submission of bid, it is the responsibility of the BIDDER to verify the various features at site along with other areas on his own. 12.0 Statutory requirement CONTRACTOR shall comply with all the latest applicable statutory rules pertaining to Factory act, mining department ,PF rules, Fire safety rule of Tariff Advisory Committee (TAC) of IRDA India, Water act for Pollution control Board, Explosives act etc and also state mining department latest rules regarding STP & royalty. Provisions of Safety, health and welfare according to Factories act shall also be complied with. Statutory clearances and norms of State Pollution Control Board/MOEF shall be followed. CONTRACTOR shall obtain approval of Civil / Architectural drawings from concerned authorities before taking up the construction work. 13.0 The contract or part shall not be assigned or sublet by the contractor without written permission of OWNER.	
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SECTION – D4.2
SCOPE OF WORK

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.2
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 1 of 9
SCOPE OF WORK 1.0 The work covered in this section consists of collection of all site related data, conducting site investigations, development of loading drawings design, preparation of all construction drawings, supply of all labour and materials, construction, fabrication, erection and testing where necessary, of all structures required for housing all equipment and civil works for all services required for Power Plant in the Bid document. The Civil works shall also include those required for Installation, Commissioning , testing, operation and maintenance of the Power Plant. The Scope shall cover but not limited to the following buildings / structure / systems / facilities. 1.1 Site related investigations including topographical survey, establishing bench mark and grid marking ,Detailed Geotechnical investigations, Detailed Study of Hydro geological aspects of plant area and preparation of report as per MOEF Norms. 1.2 Site development works Site clearance including diversion of existing services. Site grading of the area as identified in the Property plan including railway marshalling yard area. Earth work in marshalling yard upto required grade as indicated in plot plan. Roads, drains and cross drainage works with in the palnt boundary Temporary roads/drains required for construction/pre-commissioning purpose. 1.3 Construction enabling works 1.4 Steam Turbine and Generator building including associated /auxiliary equipment building 1.5 Control room / Electrical bay structures including interconnection if any with TG building 1.6 Foundations for Steam generator / ESP / Flue gas &air Duct supporting structures up to Chimney ,ID fan, FD fan, PA Fan foundations as well as foundations for all equipment in this area . 1.7 Mill and Bunker building Super structure and associated equipment foundations sub structure and supports for laying conveyor . In case of front mill arrangement tripper floors of both the units to be connected such that the tripper can traverse in both units. Scope also includes all necessary interconnecting /supporting structures for connection with Conveyor TP, coal pipes flue gas & air ducts etc... complete with all civil works for foundations /floors ,roofs Etc. 1.8 Steam Generator elevator supporting structure including associated structural /Civil works		
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SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.2
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 2 of 9
1.9 ESP Control / Switch gear rooms including service transformer foundations 1.10 Paving for Steam Generator area from 'C' row to road behind chimney and in transverse direction from first column to gable end of power house building upto 5m from last foundation on each side 1.11 Miscellaneous tanks including, Condensate storage tank ,service water tank, DM water tanks ,Fuel oil tanks, Potable water tanks on roof of bunker building& main powerhouse building. 1.12 Grouting below all Equipment, columns, pipe/duct supports, BFP, steam turbine generator and fan foundations. 1.13 Design &Construction of Bottom ash hopper foundation. 1.14 Railway track in service bay for unloading and further rail track from B row up to edge of chimney road for train movement including all civil works and Rail tracks of wagon tippler area 1.15 Construction of Rail Track from existing Railway siding to Maintenance bay of Power House building of Unit 7th & 8th Unit. 1.16 Transformer yard structures and foundations including all Civil /Structural works and rail track for placing & movement of transformers track extending from transformer yard to service bay in STG building approachable by EOT crane. Minimum 150mmthk RCC paving shall be provided in transformer yard 1.17 Switch yard & Switch yard control room. 1.18 Twin flue RCC Chimney of 275 m height 1.19 Civil /structural works for Coal handling system including wagon tippler complex. 1.20 Inline weigh bridge. 1.21 Ash handling system and mill reject handling system, excluding construction of ash pond. 1.22 The existing ash dyke is used to dispose the ash by raising the ash dyke which is by others. However ash pipe supporting structures, foundations from plant to the Ash dyke and all associated Civil works to the complete system are in Bidder's scope of work. 1.23 Fuel oil handling system 1.24 D. M. Plant, Day Oil Tank, Fuel Oil Pump House, DM Make up Pump House, Boiler Fill Pump House etc. 1.25 Condenser cooling water system including CW pump house, acid dosing systems, side stream filter connecting basin outlet to plant main drain ,CW chlorination system.		
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Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 3 of 9
1.26 Natural draft Cooling towers 1.27 Miscellaneous plant buildings, consisting of a) Air Washer Building b) Compressor house c) AC plant building d) Clean Oil and Dirty oil Tank rooms e) Condensate transfer pump shelter f) Diesel generator house g) Work shop building h) Chemical laboratory building. i) Water testing building j) Coal sampling and oil testing building k) General laboratory l) Environmental laboratory Note: For above buildings, general toilet blocks shall be provided for ladies and gents with dress change rooms. Further, garbage bins with janitor room for storage of cleaning articles and materials shall be provided (3 nos). 1.28 Non Plant buildings a) Service building including first aid Centre b) Fire station complex c) In-motion rail Weigh bridge and control rooms d) Administration building e) Canteen buildings with separate dining areas for workers and executives f) Gate/Security House/Time office g) Security Barrack h) Parking sheds/Area. i) Bull dozer shed j) Loco shed		
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SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.2
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 4 of 9
k) Primary health centre /Dispensary l) Sick wagon shed with associated building as per RDSO Norms m) Separate Hostels with mess facility should be provided for accommodating 25Nos officers and 50Nos Junior cadre staff within plant premises. n) A separate two storey building for railway staff. o) Watch towers each at every 500m distance along the perimeter of the boundary line of expansion project site along with one each of the corners. Height of the each watch tower shall be 8m from FGL Note: For all the non-plant buildings, general toilet blocks shall be provided for ladies and gents with dress change rooms further, Garbage bins with janitor room for storage of cleaning articles and materials shall be provided 1.29 Complete system for effluent treatment plant includes collection, conveying, treating & recycling of effluents, sewage treatment plant includes collection, conveying, treating & recycling of sewage and solid wastes of plant area and non plant buildings 1.30 Pipe and cable racks 1.31 Raw water system including Raw water reservoir of capacity not less than 35lakh cum and pump House. Raw water pre treatment plant works,Clarifiers,Filtered water storage tank,Clarified water Pump house,/Clarified water Tank to cater to the requirements of not only the power plant but also for the colony. Scope also includes filtration plant , filter water pump house , chemicals, chlorine and acid storage facilities. 1.32 Hydrogen Generation Plant 1.33 All civil works for fire protection system and complete sewage treatment plant. 1.34 Horticulture and Landscaping Works. 1.35 Drainage system for plant, building, roads including surface/sub surface drains and rain water harvesting/reuse system 1.36 Extension of grid 1100 (E) Bituminous approach road from stage IV to stage V for A-A class loading		
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Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 5 of 9
1.37 Storage sheds (permanent)-12 Nos (10M X 20M), suitable size store shall also be provided for maintenance inventory in switchyard. 1.38 Boundary wall around power plant area and entrance detail, including dismantling of portion of existing wall and clearing the debris as directed by Owner. 1.39 Civil works for Raw water Intake system from IG Canal head works consisting Desilting chamber, Link canal / intake channel from head works to desilting chamber, Pump house etc & Piping up to Reservoir including Parshall flume for flow measurement at intake. 1.40 All civil works for Sub stations and Service transformer yards as required in plant area / new colony area. 1.41 Operator cabins of approximately 2.40x2.40m size with insulated metal sheet enclosure with furniture shall be provided at operating floors, main switchgear rooms, Mill area, ID fan area, pump houses etc. The number of such cabins shall be at least 12 and the furniture shall include writing desk , space for hand tools , desert coolers, PBX phone and PA system. The exact locations and buildings to be provided with these cabins shall be finalised during the Detailed engineering stage. 1.42 In addition of service building ,an air conditioned site office block of minimum 50sqm plan area with office furniture, ceiling fans,PBX phone and LAN for CMMS system comprising of two rooms, store and toilet shall be provided for maintenance staff/ service engineers at operating floor of power house(2 Blocks) ,PRDS floor(2 Blocks) ,Maintenance bay(2 Blocks), Mill area, ID fan area , CW pump house ,DM plant ,Intake pump house, wagon tippler control room area. 1.43 Road from existing gate no 2 of existing plant to the proposed plant (Unit 7 & 8) main gate along the plant boundary and bitumen topping.shall be included in Scope. Road shall be 7m wide with flexible paving 1.44 Scope also includes Construction of temporary office accommodation with a/c rooms of total area not less than 200sqm each at two locations in plant area for Owner s use. 2.0 This specification covers entire civil engineering work including design, supply and construction for all buildings, technological structures and facilities for all production, auxiliary units, foundations for buildings, structures and equipment, roads, ramps, paving, parking areas, Construction /connection of storm water drainage and faecal sewers to the plant main net work and all other miscellaneous civil engineering work as will be necessary for completing this package on a turnkey basis within the project Boundaries.		
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SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.2
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 6 of 9
3.0 All civil works for the buildings, equipment foundations, facilities and miscellaneous civil works to be provided for the project will include but not be limited to the following: 4.0 Cable trenches, racks, duct banks, manhole and pipe trenches including trench /Manhole covers. 5.0 Permanent access road from plant main gate to the plant main road , permanent RCC road in main plant area and pavements for the various facilities including bituminous peripheral road. 6.0 Surface drains and storm water drainage system of the plant. 6.1 Suitable Diversion of Natural Nalah with permanent construction. 7.0 Supporting structures and platforms with access for utility pipelines, ventilation ducts and Bus ducts. 8.0 Stairs and exits for all buildings meeting TAC norms 9.0 All water supply including service water, process water & potable water pipe lines ,tanks , plumbing and sanitary works, including all fixtures , storm water drainage, sewage disposal as well as disposal of industrial effluents are covered under the scope of the contract 10.0 All necessary waterproofing, damp proofing and anticorrosive treatment to buildings, structures and foundations, including underground construction. 11.0 All necessary civil works for crossing pipes/cables below for roadways and other services inside the plant boundaries 12.0 All temporary facilities, building, offices, labour colonies, staff quarters, roads and services for construction for this package. 13.0 Removal of debris, micro levelling of the site all-round buildings and premises within the scope of contract prior to completion of work. 14.0 All necessary civil work required for Fire fighting system, Lighting, Communication, Effluent Treatment system and road lighting within the plant boundaries. Further, watch towers shall be constructed at suitable intervals all along the boundary which shall also be provided with suitable lighting. 15.0 Dismantling of buried/semi-buried structures, if any, encountered within the plant limits and disposal of it within a distance of 8 km from the site as directed by the Purchaser. 16.0 The materials and services will include but not be limited to the following: a) Site clearing, dressing, levelling and grading of formation to required levels and soil compaction, disposal of surplus soil as necessary within the plant limits including marshalling yard as shown in the bid drawing.		
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b) Earthwork for buildings and equipment foundations, trenches, pits, sewers and other construction work and disposal of surplus soil with in a lead of 8 km from plant boundary .Scope also includes dewatering due to sub soil or surface water encountered during excavation and disposal of water at safe reach. c) Back filling, soling and sub-grade work for all foundation, grouting, flooring, trenches, pits and other underground structures. d) Encasing structural steel column bases as well as wall beams with RCC at the locations of sun shade sills and other locations as required e) Concrete and reinforced concrete work in foundations, sumps, pits, trenches and other underground structures f) Concrete and reinforced concrete work in columns tie beams, beams slabs frames and other superstructures. g) All masonry work in sub structure and super structure including plastering as required. h) All finishing work to flooring, walling, ceiling, false flooring and false ceiling as required. i) All finishing and painting work to masonry, concrete structures, steel works and wood works. j) All Chain link fencing /barbed wire fencing and gates as required. k) Aluminium Doors, windows, ventilators, Steel doors /windows /steel rolling shutters, fire check doors, gates shutters etc. l) All necessary technological and equipment supporting structures m) Hand railing, inserts, kerb angles, bolts, Grating ,chequered plates etc n) Colour coated permanent profile sheets as per the Architectural elevations of powerhouse and other buildings o) All concrete chipping work/ drilling holes etc p) Civil works for area lighting as per required illumination standards including marshalling yard . q) Black bituminous painting of all foundations and underground structures in touch with earth. r) 150mm of total thickness of gravel filling in two layers of each 75mm thick in switchyard. Details elsewhere mentioned in the specification.		
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Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 8 of 9
17.0	It is not the intent to specify herein all the works in the scope of this contract. The scope also includes all other buildings, structures and works necessary which are not specifically mentioned here but required for construction, operation and maintenance of the power plant are deemed to be included in the scope of the CONTRACTOR. All works shall conform to the specification. The works shall conform to high standards of design, engineering and workmanship. Design and construction shall conform in every respect to all local and state regulations governing such works and to stipulations of Indian Standards unless stipulated otherwise in detail specification.	
18.0	Road shall be provided along boundary wall around existing and proposed units except at gate1 and gate 2 (i.e. from admin gate to gate 2 of existing plan)	
19.0	Proof Checking of design Scope also include proof checking of design submitted by CONTRACTOR approved by OWNER/CONSULTANT for adequacy of structural design and connection for following structures by an independent agency preferably by SERC, Chennai at His own cost. a) Design of TG Foundation including NDT testing of TG column and Deck slab after construction b) Design and connection for Power House Building Main structural Framework c) Design and connection of Mill/Bunker building main structural frame work including design of bunkers. d) Design of 275 m High RCC chimney e) NDCT f) Wind tunnel test for RCC chimney and natural draft cooling tower. (This shall be conducted by an independent agency which would be subject to approval of RVUN)	
20.0	Third Party Inspection The bidder shall reimburse all payments made to the agency deployed by RRVUNL for third party inspection of fabrication and erection of structural steel work under this contract, as per requirement of RRVUNL	
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Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SCOPE OF WORK	SHEET 9 of 9
EXCLUSIONS a) Colony b) Rail tracks for marshalling yard, c) Head works at IG Canal. d) Development of ash pond NOTE: “As all the required systems, structures and buildings are not elaborated in Section D 4.5, Section D 4.2 Scope of work is to be read together with Section D 4.5 Specific Building/Structure requirement” “If there is a difference in General Technical Specifications, Scope of work and Specific Building/Structure requirement shall prevail” ISSUE R1		

SECTION – D4.3
DOCUMENTS TO BE SUBMITTED BY
BIDDER WITH EPC BID PERTAINING TO
CIVIL WORKS

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.3																						
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DOCUMENTS TO BE SUBMITTED BY BIDDER WITH EPC BID PERTAINING TO CIVIL WORKS	SHEET 1 OF 2																						
SECTION III - DOCUMENTS TO BE SUBMITTED BY BIDDER WITH EPC BID PERTAINING TO CIVIL WORKS <table border="0"> <tr> <td style="vertical-align: top; padding-right: 20px;">1.0</td> <td>Suggested plot plan locating all buildings, structures, facilities roads, temporary site office, etc., with their plan dimensions and the grading levels proposed in the plant area</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">2.0</td> <td>Write-up on proposed storm water drainage system.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">3.0</td> <td>Write-up on proposed sewage disposal system for the toilets& disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">4.0</td> <td>Write-up on proposed treatment and disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">5.0</td> <td>A detailed write-up on Condenser cooling water system along with schematic drawing showing preliminary sizing and details of Cooling towers, channels, forebay and pump house, cold and hot water conduits and the method of construction.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">6.0</td> <td>A detailed write-up on raw water system from canal and make up water system for the cooling tower blowdown</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">7.0</td> <td>A report on foundation proposed for various structures, buildings and facilities based on the data furnished by OWNER and further data collected by the CONTRACTOR. Allowable safe bearing capacity for open foundation, depth of foundation, need for pile foundations, soil improvement if any required, special precaution against aggressive soil etc., shall also be covered in the report.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">8.0</td> <td>A write-up on dewatering system proposed at the time of construction where deep construction such as for Wagon tippler hoppers, Reclaim hoppers pit, conveyor tunnels, CW forebay and pumphouse etc. are to be executed..</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">9.0</td> <td>General arrangement drawings for all major buildings and structures showing dimensions, levels, plans, sections, elevations, materials proposed, types of framings, wall / cladding, floors, roofs, types of finishes etc.</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">10.0</td> <td>A write up on the sizing and constructional details of RCC chimney with sketch showing detail of foundations, wind shield and liners along with list of appurtenances</td> </tr> <tr> <td style="vertical-align: top; padding-right: 20px;">11.0</td> <td>Detailed design criteria proposed to be adopted for each building, structures, foundations, facilities etc.</td> </tr> </table>			1.0	Suggested plot plan locating all buildings, structures, facilities roads, temporary site office, etc., with their plan dimensions and the grading levels proposed in the plant area	2.0	Write-up on proposed storm water drainage system.	3.0	Write-up on proposed sewage disposal system for the toilets& disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.	4.0	Write-up on proposed treatment and disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.	5.0	A detailed write-up on Condenser cooling water system along with schematic drawing showing preliminary sizing and details of Cooling towers, channels, forebay and pump house, cold and hot water conduits and the method of construction.	6.0	A detailed write-up on raw water system from canal and make up water system for the cooling tower blowdown	7.0	A report on foundation proposed for various structures, buildings and facilities based on the data furnished by OWNER and further data collected by the CONTRACTOR. 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3.0	Write-up on proposed sewage disposal system for the toilets& disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.																							
4.0	Write-up on proposed treatment and disposal of effluent / waste water generated in the plant and scheme for usage / disposal of clear water.																							
5.0	A detailed write-up on Condenser cooling water system along with schematic drawing showing preliminary sizing and details of Cooling towers, channels, forebay and pump house, cold and hot water conduits and the method of construction.																							
6.0	A detailed write-up on raw water system from canal and make up water system for the cooling tower blowdown																							
7.0	A report on foundation proposed for various structures, buildings and facilities based on the data furnished by OWNER and further data collected by the CONTRACTOR. Allowable safe bearing capacity for open foundation, depth of foundation, need for pile foundations, soil improvement if any required, special precaution against aggressive soil etc., shall also be covered in the report.																							
8.0	A write-up on dewatering system proposed at the time of construction where deep construction such as for Wagon tippler hoppers, Reclaim hoppers pit, conveyor tunnels, CW forebay and pumphouse etc. are to be executed..																							
9.0	General arrangement drawings for all major buildings and structures showing dimensions, levels, plans, sections, elevations, materials proposed, types of framings, wall / cladding, floors, roofs, types of finishes etc.																							
10.0	A write up on the sizing and constructional details of RCC chimney with sketch showing detail of foundations, wind shield and liners along with list of appurtenances																							
11.0	Detailed design criteria proposed to be adopted for each building, structures, foundations, facilities etc.																							
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SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION :D 4.3
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DOCUMENTS TO BE SUBMITTED BY BIDDER WITH EPC BID PERTAINING TO CIVIL WORKS	SHEET 2 OF 2
12.0 List of software proposed to be used in various areas for analysis, design, drafting as well as project monitoring along with their sources and validation report for software. 13.0 List of all specialised sub-contractors that the CONTRACTOR proposes to employ, in case the contract is awarded to him, indicating their addresses with telephone number, experience on similar jobs, name, qualification and experience of persons who shall be employed in the job on behalf of the sub-contractor etc. shall be submitted to the OWNER. Only the Sub-Contractor, approved by OWNER shall be engaged by the CONTRACTOR on the job. Sub contractor will not be allowed to further sub let the work in any case. 14.0 A write up on quality plan for both design and construction along with details of quality control laboratory with a list of testing equipment shall be furnished 15.0 List of equipments/ special tools and plants to be deployed on this project. 16.0 List of approved brands and grades of cement, structural steel, reinforcement steel, pipe lines welding material to be used in the works 17.0 List of key staff to be deployed for the project. 18.0 A write up on broad proposal for Horticulture and landscaping works.		
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SECTION – D4.4
DOCUMENTS TO BE SUBMITTED BY
CONTRACTOR AFTER THE AWARD OF
CONTRACT

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D4.4
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DOCUMENTS TO BE SUBMITTED BY CONTRACTOR AFTER THE AWARD OF CONTRACT	SHEET 1 OF 3

SECTION – IV DOCUMENTS TO BE SUBMITTED BY CONTRACTOR AFTER THE AWARD OF CONTRACT

The following documents are to be submitted for the approval of the OWNER, prior to commencement of fabrication & erection / construction. All drawings shall be of standard sizes (Metric system) and shall be made on AUTOCAD. Software used for design shall be validated and established ones like STAAD Pro or STRAAP. Hard and soft copies to be furnished to the OWNER. The list is not exhaustive but indicative only.

- 1.0 General plant layout drawing with topographical survey reports, coordinates of roads, boundary wall, watch tower buildings and facilities, piping / cable corridors, pipe and cable trestles, provision of landscaping and green belt development, diversion roads and drains, equipment lay down areas etc.
- 2.0 Drawing showing underground facilities with coordinates of these facilities like buried pipes, buried cables, trenches, ducts, sewer, drains, sumps pits, culverts, foundations etc.
- 3.0 Soil investigation report based on additional geo-technical investigation carried out by CONTRACTOR along with foundation recommendation for various buildings / structures / facilities.
- 4.0 Site Grading and Storm water drainage study furnishing levels of various terraces arrangement and details of drains, culverts etc for storm water drainage system
- 5.0 Study note on disposal of sewage and other effluent from the plant to satisfy the statutory requirement.
- 6.0 Design basis memorandum for all buildings, facilities, services and structures.
- 7.0 Drawing showing loading data at various levels for all buildings and structures.
- 8.0 Architectural floor plans, elevations, cross sections and perspective view in colour of main plant buildings. For main plant building CONTRACTOR shall submit two different schemes along with a report elaborating the underlying philosophy of the proposed architectural concepts.
- 9.0 Design calculations and drawings for foundations / substructure and superstructure of all buildings and pump houses.
- 10.0 Design calculations including dynamic analysis and drawings for all foundations subjected to dynamic loads like foundations for TG, BFP, Mill, Fans (PA, FD, ID).

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Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DOCUMENTS TO BE SUBMITTED BY CONTRACTOR AFTER THE AWARD OF CONTRACT	SHEET 2 OF 3
11.0 Design calculations and drawings for all facilities and services like roads, culverts, bridges, pavings, road / rail crossings, drainage pump house (if required), drains, sewers, sewage pump house, sewage treatment plant, water supply, water tank, sumps, tunnels, trenches, ducts etc. 12.0 Drawings of all architectural works including finishing schedule, colour schemes (both internal and external), doors & windows, flooring and false ceiling, etc. 13.0 Design calculations and drawings for switchyard structures, transformer yard, etc. 14.0 Design calculations and drawings for structures pertaining to condenser Cooling water system. 15.0 Design calculation and document for the Make up water system structures covered in the scope of the Contractor Such as but not limited to ,Raw water reservoir, Pump Houses, pre-treatment plant structures,clarifiers,Clarified water tank and pump house, Over Head water Tank etc. 16.0 Design calculations and drawings for civil structures / works associated with fuel oil handling system, ash handling system, coal handling system, Ash disposal system, etc. 17.0 All design and drawings for the Cooling towers. 18.0 All design and drawings for RCC Bi flue chimney. 19.0 Design calculations and drawings for plumbing and building drainage. 20.0 All other designs, details / drawings or any other submissions as indicated elsewhere in this specification and as required by the OWNER. 21.0 Total quantity of concrete (grade wise), reinforcement steel (diameter wise) and structural steel (section wise) shall be indicated in all construction drawings. 22.0 All design calculations and drawings for foundation of Boiler and ESP area structures. 23.0 Shop drawings / fabrications of all structural steel works and design calculations for important joint connections. 24.0 Construction and erection procedure for all major structure with specific reference to main plant building, bunker structures, TG foundation and other machine foundations. 25.0 Write up on various statutory requirements and their compliance for various buildings and facilities. 26.0 Quality assurance and Quality Control procedures.		
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27.0 Copies of all reports on investigation and studies carried out by the CONTRACTOR as per the scope. 28.0 Contractor shall provide 8 hard copies of approved drawings along with soft copy for execution and supervision purpose. Soft copies of all design calculation shall be submitted for records after approval of the OWNER. After job completion 4 hard copies and 3 sets of soft copies in Auto cad format shall be submitted for AS BUILT drawings on DVD. Licensed Copies (Multi user) of all software used for design drawing shall be provided to department on award of contract to enable the OWNER to check design /drawings. A licensed soft copy of complete IS Codes is also to be provided to OWNER at commencement of project. 29.0 Contractor shall install facilities for plotting full scale drawings at site .The drawings shall be received by E mail and prints shall be distributed at site by Contractor's site office. ISSUE R1		

SECTION – D4.5
DESCRIPTION OF BUILDINGS,
STRUCTURES & FACILITIES

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D 4.5
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DESCRIPTION OF BUILDINGS, STRUCTURES AND FACILITIES	SHEET 1 OF 57
DESCRIPTION OF BUILDINGS, STRUCTURES AND FACILITIES Following structures / buildings / areas / facilities are to be included in the contract. The description against each building / system is indicative only and not exhaustive. Although almost all the systems are covered here but any other system (Civil, Structural and Architectural) required for successful completion of the project shall form a part of this contract and shall deemed to be included in the scope of works. Contractor shall provide proper and safe temporary approach for work man and also checking staff of OWNER/CONSULTANT /THIRD PARTY INSPECTOR. Any defective /inaccurate work shall be dismantled and rebuilt as per specification at Cost of Contractor. Approval of Owner /Consultant will not absolve Contractor of his responsibility. 1.0 SITE RELATED INVESTIGATION 1.1 Topographical Surveying 1.1.1 CONTRACTOR has to do detailed survey of the plant at his own cost. 1.1.2 CONTRACTOR has to carry out survey as per requirement such as for Layout of Buildings, Fixing centre lines, Fixing Layouts etc. and for planning and constructing efficient storm water disposal system by gravity to nearest storm water net work. 1.1.3 One permanent benchmark and two baselines, North-South line and East-West line at right angles to each other will be provided to the CONTRACTOR. It will be the responsibility of the CONTRACTOR to ensure that the base lines are identified with grid pillars constructed at 200 meters c/c in both directions in such a way that these pillars will not be disturbed during construction. Coordinates shall be painted on these grid pillars. It will also be the responsibility of the CONTRACTOR to transfer the levels from the benchmark provided to the site. Benchmark pillars shall be provided at least at 6 locations. These pillars shall be properly protected to prevent their disturbance during construction activities. BM shall be distinguished from grid pillars with different type of painting. 1.1.4 Contour survey shall be carried extending 500m beyond boundary wall/ property of the proposed plant 1.2 Geotechnical Investigations Detailed geo-technical investigation shall be carried out by the CONTRACTOR on award of work. Based on the plot plan developed, the CONTRACTOR shall identify proposed borehole locations and obtain the		
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approval of OWNER prior to commencing the investigation. In the power block bore holes shall be provided and spread judiciously to cover all major building as well as equipment foundations. Generally, a grid of 50 metres c/c both ways is recommended .Drawings for soil investigation works shall be prepared before taking up the work. 1.2.1 Following field tests shall be conducted: a) Bore Holes b) Static Plate load tests c) Cyclic Plate load tests / Block vibration tests d) Field Permeability tests e) Vane shear tests f) Field Density tests g) Static Cone Penetration tests. h) Electrical resistivity tests 1.2.2 Bore holes shall be located to cover the entire area. All bore hole shall be sunk up to a depth of 30.0 m or 5 m continuous into hard rock whichever is earlier 1.2.3 Standard penetration tests (SPT) and collection of undisturbed soil samples (UDS) shall be carried out alternatively at 1.0m intervals and at significant change of strata. The interval shall be increased to 1.5m below 5m depth of boring. UDS shall be replaced by SPT in cohesionless strata. Even in highly weathered / disintegrated rock, where core recovery is poor, SPT shall be conducted. The first SPT in any borehole shall be conducted at 1m depth. 1.2.4 In rock strata, core recovery and Rock Quality Designation (RQD) shall be noted carefully for each run, immediately after cores are taken out of barrel. 1.2.5 During boring, the level at which ground water is struck shall be carefully noted. Ground water samples shall be collected for chemical analysis. Boring shall be carried out without the use of water or drilling mud up to the depth of ground water table. 1.2.6 Following laboratory tests shall be conducted: i. Grain size analysis a) Hydrometer analysis b) Sieve analysis ii. Field Density and Moisture Content		
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iii. Specific Gravity iv. Chemical Analysis of soil and Ground water including Sulphates, Chlorides, pH value, etc. v. Chemical Analysis of 2:1, Water: Soil extract of the samples giving SO₃ content. vi. Consistency Index: Liquid Limit, Plastic Limit, Plasticity Index, Shrinkage Limit and Shrinkage ratio. vii. Consolidation test giving all relevant information. viii. Swelling pressure and free swell index for expansive soils. ix. Unconfined Compressive Strength on undisturbed soil samples x. Direct Shear Test xi. Triaxial Compressive Strength Tests: a) Unconsolidated Undrained Test b) Consolidated Undrained Test c) Consolidated Drained Test (xii) Moisture-density relations for Standard Proctor and Modified Proctor tests. (xiii) Crushing Strength of rock on specimens of NX size. (xiv) Test for determining CBR value for design of pavements at various locations. 1.2.7 The soil investigation report shall necessarily include but not be limited to the following information. a) Recommended types of foundation. b) Allowable safe bearing capacities and settlement values in different strata for shallow foundations indicating relevant design criteria adopted, method of analysis adopted etc. c) Recommendations for values for modulus of subgrade reaction for foundation design by elastic method. d) Recommendation for protection of concrete substructures and brick masonry foundations with reference to the chemical nature of subsoil and ground water. e) Recommendations regarding excavations (shallow & deep), embankment, Safe sides slopes for excavation and embankment, dewatering, site drainage, etc.		
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f) Recommended soil properties such as density, specific gravity, cohesion, angle of internal friction etc. for design. g) Precautions to be taken for design of lightly loaded structures when expansive soil is encountered with respect to swelling pressure and free swell index values obtained. h) Recommendation on CBR values to be adopted for design of Roads. 2.0 SITE DEVELOPMENT WORK 2.1 Site clearance 2.1.1 The plant areas in the site shall be cleared of all trees, shrubs or other vegetation, rubbish, slush etc and other objectionable matters. If any roots or stumps of trees are met during excavation, they shall also be removed. Where earth fill is intended, the area shall be stripped of all loose / soft patches or top soil containing objectionable matter before filling commences. Any structure or services existing at the site shall be removed / rerouted with the permission of the OWNER. Existing wells, pits, marshy areas etc shall be filled up with earth of approved quality. 2.1.2 The CONTRACTOR shall be deemed to have visited and carefully examined the site and surroundings and to have satisfied himself about the nature of the existing structures, underground services, general site conditions, the site for disposal of surplus materials, debris etc and all other items affecting the work. Claims due to ignorance of site conditions will not be considered after submission of Bid. 2.2 Site grading 2.2.1 The CONTRACTOR shall arrive at site grading levels for various areas based on the detailed topographical survey conducted by the contractor in line with existing plant areas. The various levels indicated on the Bid drawing are indicative only. Exact area to be graded is identified in the Property Plan drawing including railway marshalling yard which is a part of the specification. 2.2.2 Fills shall normally be made up of Cohesive Non Swelling material capable of being compacted up to 95% Modified Proctor density. In case earth has to be borrowed from outside the plant boundary, the same shall be arranged by the CONTRACTOR himself. Earth from Swamps, marshy as well as lagoons, expansive type of clays, peats, organic material, material susceptible for combustion, material which will react with other material		
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already used in work shall not be used as borrow material. A minimum side slope of 1 vertical: 2 horizontal shall be maintained at all slopes. 2.2.3 Slopes shall be provided with 230 thick stone pitching in cement mortar 1:4 to prevent erosion. 2.2.4 Contractor shall dispose any extra soil within plant boundary as directed by OWNER or in case soil has to be disposed outside plant area the same shall be arranged by the CONTRACTOR himself within a distance of 8km from plant boundary as directed by OWNER. 2.3 Roads, Drains and Culverts: 2.3.1 All roads From Gate House to power block area and roads in the power block area (Area from Transformer yard to chimney) shall be rigid pavement with RCC and designed and constructed as per relevant IRC codes. All other roads and vehicular parking areas shall be of flexible pavement type with water bound macadam base and bituminous topping on prepared surface. 2.3.2 The access road from gate house to power block shall be 10m wide. The road shall be designed to cater to the load and needs of construction and maintenance of heavy trucks carrying machinery and heavy cranes. All other major roads providing access to buildings / structures / systems requiring maintenance by vehicles shall be 7 m wide. Peripheral roads inside boundary wall shall be 4 m wide with WBM base and bituminous topping. 1500 mm wide road shoulder shall be provided on either side of two / four lane wide road. For 7m wide road shoulder shall consisting of 75mm thick medium duty interlocking paver blocks laid on 40 mm thick sand bedding over 150 mm thick PCC of grade M15. On either side of the roads open drains shall be provided. Minimum clear width of the drain shall be 300 mm. The drains shall be of RCC Construction. Drainage lines and other underground services shall be located at least 1 m clear from the edge of the road. All service and utility lines crossing the roads shall be taken up through NP3 class RCC pipe designed for impact loading. Culvert shall also be generally using NP3 class pipe. In case the diameter of the pipe required is more than 600 mm, cast-in-place RCC box culverts shall be provided 2.3.3 Water bound macadam base with bituminous topping shall be provided in areas requiring parking facilities. Bituminous topping of all plant roads and parking areas shall be taken up after construction of the plant is completed. On either side of the roads open drains shall be provided. Minimum clear width of the drain shall be 300 mm. The drains shall be designed using brick masonry or RCC. Drainage lines and other underground services		
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shall be located at least 1 m clear from the edge of the road. All service and utility lines crossing the roads shall be taken up through NP3 class RCC pipe designed for impact loading. Culvert shall also be generally using NP3 class pipe. In case the diameter of the pipe required is more than 600 mm, cast-in-place RCC box culverts shall be provided. 2.3.4 The Contractor shall construct 7.5m wide bituminous road from existing stage- I road to Gate hose designed to cater to load of heavy trucks carrying machinery and heavy cranes with 1.5m shoulder on both sides with drains on both sides. 2.4 Storm water drainage: 2.4.1 Drainage for Storm water shall be carried by gravity. Storm water drainage system shall be designed in two parts. a) Main drains b) Auxiliary drains Main drains shall be designed as a network covering total power block area and shall ultimately be led to nearest Plant drain net work. It shall be noted that the drain net work shall also be designed for any discharge from other areas which will have to be carried by the drains in scope of this contract and this data will be furnished separately . Auxiliary / branch drains shall collect discharge from individual areas/Structures /Buildings and shall connect to main drain at suitable locations. 2.4.2 At places where covered drainage system is required, channels with removable cover shall be preferred to piping system, as piped system tend to get blocked. Underground storm water piping shall be restricted strictly to areas where surface drains are not desirable or practicable from functional point of view. 2.4.3 Drainage shall be provided where necessary to prevent ponding and ground erosion and to carry surface water away from building, structures and other works including roads, building or equipment foundations. 2.4.4 The storm water drainage for the contaminated areas shall be designed separately and the discharge shall be led separately for treatment and disposal. 2.4.5 Diversion drains shall be provided to arrest the entry of storm water from outside catchment area to plant if any and suitably diverted towards existing nallahs. Drains shall be lined brick/stone masonry or PCC slabs		
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2.5 Sewage / Waste water drainage 2.5.1 For sanitary sewage disposal, Effluent, waste water from each of the building complex shall be collected through a sewage network and led to a sewage treatment plant. 2.5.2 The type of pipes shall be as described under sewage /Effluent drainage system under section D 4.6 outlining outdoor civil works. They shall be encased in concrete at road crossings. Manholes shall be at junctions and change of direction. In straight stretches manhole shall be provided at a maximum spacing of 30 metres. 3.0 CONSTRUCTION ENABLING WORKS 3.1 Construction water: Construction water supply will be provided from the Raw water reservoir located in the existing plant. However CONTRACTOR shall provide pumping station at reservoir, Distribution pipe line network for various locations as required, operation and maintenance of water supply etc at his own cost. In case of shortage of water, the Contractor has to make alternative arrangements at his own cost. 3.2 Construction Power For construction Power contractor shall install a substation sufficient to cater all construction power, offices and labour colony requirement including all required civil works. 3.3 Temporary site building The CONTRACTOR shall provide for at his cost the following building facilities for proper execution and quality control of the job, while meeting the provision stipulated by Factory Rules regarding staff welfare facilities. All these building shall have brick cladding, GI/Colour coated metal sheet roofing over steel roof truss with cement concrete flooring and false ceiling with A/c as required. 3.3.1 Stores A covered store shall be provided with brick cladding and GI/Colour coated metal sheeting to store at least one-month requirement of cement. Cement in bags shall be stored on a raised floor well away from outer walls and insulated from the floor to avoid moisture. Not more than 10 bags shall be stacked in any tier. Each consignment of cement shall be stored separately and consumed in its order of receipt. 3.3.2 Covered storage area may also be provided to store other construction material which will be affected on exposure to wind, sun and rain.		
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3.3.3 Reinforcement shall be stacked on top of timber sleepers to avoid contact with ground / water. 3.3.4 Storage yard paved or unpaved shall be provided with in the stores complex for storage of other material. 3.3.5 Proper fencing and security arrangement shall be provided for the stores complex. 3.4 Temporary Workshop and Garage The CONTRACTOR shall provide for a temporary workshop and garage to attend to routine maintenance and repair of the construction equipments as well as his fleet of vehicles used for construction activities. 3.5 Fabrication yard Depending on the extent of fabrication envisaged at site, the CONTRACTOR shall establish a full fledged structural fabrication yard with adequate handling facility during and after the fabrication. A fully equipped testing laboratory providing radiography, ultrasonic, dye penetration, magnetic particle test facilities shall be ensured adjacent to the fabrication yard to enforce strict quality control. Portion of the yard shall have covered shed with H.O.T / E.O.T cranes so that fabrication work can proceed even during inclement weather. 3.6 Quality control laboratory A fully equipped quality control laboratory shall be established at site with qualified personnel to conduct acceptance test on all construction material, weldments, concrete cubes etc. This laboratory shall be housed in a covered building with A/C facility as required by the testing facility. All testing equipment shall be periodically calibrated to the satisfaction of the OWNER. 3.7 Fuel storage area CONTRACTOR shall obtain necessary permission from competent authorities and establish and operate a POL outlet with proper storage, dispensing and adequate fire fighting facility. 3.8 Staff Welfare facility 3.8.1 CONTRACTOR shall provide adequate facility for his staff inside the plant boundary such as Toilets for both gents and ladies, Canteens, drinking water facility, rest places, creches etc.		
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3.8.2 Necessary approach roads to the construction facility complex and internal roads within the complex as well as proper drainage of the area shall be the CONTRACTOR's responsibility. He shall also provide for proper disposal of sewage and other wastewater to meet with the requirement of Pollution Control Board. 3.9 CONTRACTOR shall identify sufficient area outside the plant boundary to locate his staff and labour colony. Construction and maintenance of the staff and labour colony to satisfy all statutory requirements is the sole responsibility of CONTRACTOR. Labour colony shall be provided with sanitation facilities, potable water, electricity and suitable sewage disposal system. 3.10 The contractor shall be preliminary responsible for all statutory deductions and contributions on account of CPF/EPF as per rules/act in force and subsequent amendments during contract period. 3.11 During construction activities, House keeping of the plant area shall be the responsibility of the Contractor. It shall be ensured that the construction waste generated is disposed off suitably and regularly. 3.12 Minimum 4 batching plants of not less than 30 cum /hour for each unit (Total 8 no) shall be installed to ensure production of Ready design mix concrete 3.13 CONTRACTOR shall install sufficient temporary lighting to keep area well lit during night as per directions of OWNER. PRINCIPAL FEATURES OF THE BUILDING /STRUCTURES 4.0 TURBINE BUILDING 4.1 The building will be provided with RCC foundations suitably designed based on the approved Geo technical investigation report. It shall be ensured that the building foundations including TG and BFP foundations rest. only on firm strata 4.2 Turbine building framing shall be of structural steel with moment connection framing in the transverse direction and bracing in the longitudinal direction. 4.3 Service and maintenance bays will not have any intermediate floors. Floors will be provided at EL0.00m, and intermediate floors levels shall be preferably as indicated in the GA drawings The operating floor will have RCC floors over steel framing, where as the mezzanine floor may have chequered plate / gratings supported on structural steel framework or RCC floor as required.		
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4.4 Crane capacity and crane rail level will be fixed based on the equipment to be lifted and the method of lifting generator stator. At crane girder top flange level a crane walkway will be provided in line with Factory rules. Access shall be provided to crane walkway through staircase from operating floor in addition to cage ladder at two ends. Bottom level of roof framing will be decided by the crane clearance required duly taking into account clearance required for mounting light fixtures. Roofing shall consist of in-situ RCC slab of minimum 100 mm thickness (over crest of metal deck), constructed over permanently colour coated galvanised M.S trough metal sheet of approved profile supported on steel purlins and trusses with a slope of 1 in 100. Over the TG bay roof, monitor shall be provided with Exhaust system mounted on the sidewall of the monitor. Sidewall at location of exhaust fan shall be of brickwork supported on the steel beam. Roof of the monitor shall be of RCC over steel beams. Side cladding and end cladding of monitor shall be of translucent sheets except in areas where fans are mounted. The roof opening portion shall be covered with steel grating for access. 4.5 Cladding shall be of brick wall / concrete block supported on concrete encased steel wall beams, up to a height of 3000 mm above the Ground floor level on the transformer side as well as on all sides including gable ends. However, Walls in front of transformers shall be of adequate thickness to satisfy "fire rating" as per LPA regulations. External Stair case blocks shall be provided with brick cladding. Cladding beyond 3m level shall be of permanent colour coated sandwiched insulated metal cladding system. The colour of the cladding system shall be approved by the OWNER/CONSULTANT 4.6 Windows shall be sliding aluminium glazed using 6 mm thick wired glass in the bottom portion provided with brick cladding. However in areas where cladding is of sheeting fixed glazing in anodized aluminium frame work and in accessible areas, sliding windows in anodized aluminium frame work using 6 mm thick wired glass shall be provided. All the doors on external walls shall be of double plate flush steel doors. For equipment entry into the service bay specially designed steel sliding door shall be provided with appropriate operating mechanism. Rolling shutter shall be provided in front of condenser to facilitate tube removal. 4.7 Staircases protected on all sides with fire proof enclosure shall be provided to satisfy TAC regulations. All the doors leading to the inside of the power house from staircase shall be automatically closing fire proof door satisfying TAC regulations. Access cage ladders shall be given to T.G building roof. 4.8 Roof water proofing shall be provided using high solid content liquid applied elastomeric water proofing joint less membrane with separate wearing course as per ASTM C-898 and ASTM C-896. Thickness of the membrane shall be a minimum of 1.5mm. The treatment includes application of		
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polymerized mortar over sloped roof to achieve a smooth surface and a primer coat. Wearing course on the top of membrane shall consist of 25mm thick screed of concrete grade M20, cast in panels of 1.2mx1.2m and reinforced with 0.56mm dia galvanized chicken wire mesh and joints sealed using Polysulphide sealing compound. The roof shall be provided with clay tiles over the entire area with cement sand mortar of 1:4 and grouted. MS rain water pipe conforming to IS: 1239 & IS: 3589 shall be provided to drain off the rain water from roof. 4.9 Thickness of structural RCC floor shall be minimum 150 mm above the steel floor beams for the intermediate floors with an additional 50 mm floor finish which shall be provided later. 25mm concrete cover shall be provided below beam top flange level. 4.10 All the intermediate floors shall be provided with proper drainage. Catch pit with C.I grills shall be provided near the internal column in a regular pattern and the floor shall be sloped towards the catch pit by varying the thickness of the bedding concrete for the floor finish. Catch pits shall be at the same coordinate for all floor levels. 80 NB galvanised M.S pipes conforming to IS:1239 shall be provided to carry the drainage down. The pipes shall be clamped on to the intermediate column. Sumps shall be provided in ground floor to receive the water. Proper drainage arrangement shall be provided in the ground floor by means of RCC gravity channels with M.S grills on top. The drainage shall be led to sumps from where the water shall be pumped to plant drainage arrangement. Around equipment liable to frequent drainage, concrete kerb shall be provided to isolate the area and water shall be led through sump and channels to the floor drainage system. Oil water separator should be provided as required to isolate oil from the drainage water where the water is mixed with oil. 4.11 In operating floor the design live load shall be painted on the floors prominently showing the extent of the area where such loading is permitted. 4.12 Openings shall be provided in floor such that all equipment which needs to be handled by EOT crane are directly above the equipment. All such openings shall be covered with gratings provided over removable steel beams. 4.13 Expansion joint shall be provided in the building to satisfy the requirements of IS: 800 and IS: 3414 unless the location of EJ is not specified in the GA drawings accompanying the Bid document. 4.14 Foundations for major equipment like Turbo generator and Boiler feed pump shall be mounted on properly designed conventional block / frame type RCC foundation. However the foundation shall be isolated from the building frame work.		
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4.15 Building Dimension shall be as indicated in bid drawings attached along with this Bid Document. 5.0 CONTROL ROOM / ELECTRICAL BAYSTRUCTURE 5.1 The building framing shall be structural steel with moment connection in the transverse direction and bracing in longitudinal direction located by the side of turbine building. It shall be ensured that in front of control room no cross bracing is provided. 5.2 Minimum headroom of 2200 mm shall be given in the cable vaults. In control room false ceiling level shall be kept 3500 mm above floor level. 5.3 All floor shall be of in-situ RCC slab provided over structural steel beams with laminated waterproof ply or better finish shuttering. Min thickness of structural concrete shall be 150 mm with an additional 50 mm provided for finish. Roof shall also be of in-situ concrete on shuttering as described above for the slabs or with permanently laid M.S sheet shuttering .The concrete shall be given a slope of min 1 in 100 to effect proper drainage. No openings will be permitted on the roof also, as this will interfere with effective water proofing & also prone to rain water leakage. 5.4 Cladding shall be of brick walls. Windows from switch gear room and control room / electronic cubicle room will not normally be allowed on the Boiler side to avoid coal dust nuisance. Walls shall normally be supported on wall/floor beams. If wall beams cannot be avoided they shall preferably be given at the level of floor beams and shall be encased in concrete. To match the aesthetics of the building single sheet colour coated metal cladding shall be provided over the brick walls. 5.5 Portion of the structural steel column projecting into the room shall be encased with brick masonry to shield it from fire hazards. 5.6 Cable vault in shall be provided with minimum 2 doors per unit. The doors shall be flush steel doors. No windows shall be provided on the turbine bay side. 5.7 Switch gear room shall be provided with minimum two steel doors to satisfy statutory requirement. In addition a two leaf sliding doors of flush welded steel construction shall be provided to move the switch gears into the room making use of equipment lifting hatch provided in turbine building. 5.8 Main entrance to control room shall be provided with air locked lobby with automatic closing sliding double glass doors. Lobby shall be formed of anodized aluminium framing with toughened double sheet glass 6 mm thick. Partition between control room and adjoining rooms shall be of glazed		
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aluminium partition with 300 mm high brick wall at bottom for toe protection. All the doors shall be single leaf glazed aluminium doors for all cabins. For movements of panels suitably sized double leaf aluminium glazed doors shall be provided. Control room wall up to the false ceiling level shall be of aluminium glazed partition on either side of air lock. In other area cladding shall be of brick wall. UPS room shall be provided with brick cladding around to reduce sound nuisance. 5.9 Battery room shall be provided with Steel doors & shall be as per TAC requirements. For Air washer room steel doors shall be used which shall be air tight. No window shall be provided in Air washer room. 5.10 Staircase properly enclosed to satisfy TAC regulations shall be provided at either ends of each unit. All doors leading to staircase shall be automatic closing fire proof door. Staircase shall not be provided around the passenger lift. Staircase shall extend up to roof. Toilets shall be provided at the switch gear room level and control room level. Toilet floors shall be sunk and shaft shall be provided to route the soil pipe. Sunken floor shall be provided with damp proofing treatment. Pantry shall be provided nearby control room. 5.11 Control room and electronic cubicle room are to be provided with false ceiling. False ceiling shall be designed aesthetically properly arranging, supply air diffuser, return air grill, fire protection sprinklers and light fittings. Aluminium ceiling system shall be provided. A catwalk shall be provided between roof and false ceiling to facilitate maintenance. Under deck insulation shall be provided on the ceiling, on the walls and beams above false ceiling. Under deck insulation shall be provided for Air washer room also. 5.12 Roof shall be given a fall of about 300 mm for proper drainage. Roof water proofing shall be provided using high solid content liquid applied elastomeric water proofing joint less membrane with separate wearing course as per ASTM C-898 and ASTM C-896. Thickness of the membrane shall be a minimum of 1.5mm. The treatment includes application of polymerized mortar over sloped roof to achieve a smooth surface and a primer coat. Wearing course on the top of membrane shall consist of 25mm thick screed of concrete grade M20, cast in panels of 1.2mx1.2m and reinforced with 0.56mm dia galvanized chicken wire mesh and joints sealed using Polysulphide sealing compound. The roof shall be provided with clay tiles over the entire area with cement sand mortar of 1:4 and grouted. 5.13 Any Floor above control room where APRDS and other pipes are located shall be provided with proper drains to prevent any accumulation of water. This is very important to prevent seepage of water into the control room.		
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5.14 All openings in floor for switch gear and other panels shall be sealed with fire proof material after cables are connected. 5.15 Adequately designed RCC storm water drains shall be provided to lead the roof drainage on to the plant drainage system. These drains shall have pre-cast RCC slotted cover. Plinth protection shall be given on the side of the drain up to the brick wall. 5.16 Building Dimension shall be as indicated in drawings attached along with Bid Document 6.0 STEAM GENERATOR / ESP / DUCT SUPPORTING STRUCTURE Type of foundation for the structure is covered under separate section and shall be based on the subsoil condition and recommendations based on detailed geo technical investigations. In addition to foundations for structure other major equipment foundation in the area are those for Primary Air fan, Forced draft fan and Induced draft fan. ID fan foundation shall be designed with vibration isolation system and all others are conventional block/frame type RCC foundation. Contractor shall furnish the design for ID fan inertia block along with spring foundations .Boiler foundations /All fan foundations shall rest only on firm strata. Further in case Turbine driven BFP are adopted as per adopted as per approved mechanical GA drawings and such foundations located on suspended floor VIS system shall be used. 7.0 STEAM GENERATOR ELEVATOR SUPPORTING STRUCTURE 7.1 Capacity and number of the elevator shall be as shown elsewhere. The elevator supporting structure shall be of structural steel braced in both direction. Plan bracings are provided at all the landing locations. Where landing locations are far apart, plan bracings shall considered at least at every 8 m centres. 7.2 Elevator shaft shall be provided with colour coated insulated metal cladding system supported on structural steel work. Lift pit shall be of RCC construction. Ground floor entry shall be kept about 500 mm above general graded / paved level with a ramp for approach. A sump for drainage and Aluminium ladder shall be provided in the lift pit. 7.3 Machine room floor shall be of RCC with 300 mm kerb wall all round. Roof also shall be of RCC construction with permanently colour coated galvanised MS trough metal sheet decking. Roof shall be sloped to one side for drainage purpose. Side cladding shall be of insulated cladding as specified for lift cage. Adequate window shall be provided for admitting natural light. Adequately designed monorail with equipment hatch in the machine room floor shall be provided to lift heavy machinery. Steel		
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staircase shall be given to the M/C room from last landing. Landing levels are generally governed by the floor levels in the Boiler structure. In addition landing shall be provided at feeder floor and tripper floor levels. Structural steel gallery shall be provided from the elevator landing platform to these floors. 7.4 Windows in the M/C room shall be of steel glazed type using 6 mm thick wired glass. Door shall be of flush welded hollow steel type. All structural steel work shall be provided with 2 coats of primer and a minimum of 2 coats of synthetic enamel paint. 8.0 MILL AND BUNKER BUILDING 8.1 The framing shall be of structural steel. This shall be designed as a moment connected framing in the transverse direction and braced in the longitudinal direction. These structures primarily support coal bunkers, coal feeders and tripper arrangement to feed the coal into coal bunker. Building Foundations including mill foundations shall rest only on firm strata. 8.2 The bunker shall be circular in plan and each bunker shall have a holding capacity as per the requirements of the steam generator. For number of bunker refer mechanical part of this document. A comprehensive flowability study shall be conducted by the CONTRACTOR for the coal bunker hopper to ensure smooth flow of coal in all seasons with different moisture contents and different percentage of fines. Geometric parameter of hopper and lining material shall be decided considering the findings of flowability study. Complete hopper (including vertical and sloped portions) shall be provided with Stainless steel lining of at least 5 mm thk SS 409 material. 8.3 Mills are to be located on the ground floor. Mill foundations are to be designed with conventional block/frame type RCC foundation. In addition to Mill foundations provision has to be made in the Mill bay ground floor for trenches accommodating Mill reject system conveyors as well as all the equipment foundations and air duct supports etc. 8.4 A Mill maintenance platform shall be provided at appropriate elevation to attend to routine maintenance. This shall be a platform with chequered plate or gratings over steel framing with hand rails all round. Above this floor a framing shall be provided to support under slung crane used for handling mill maintenance work. The crane runway girders shall extend to the full length of Mill bay to enable approach to the service bay also. 8.5 Above this framing, feeder floor is provided. The extent of the feeder floor shall be for the complete width and length of bunker bay and shall take care of all maintenance requirements. Feeder floor shall be of RCC supported on structural steel framework. Handrails shall be provided on all the sides.		
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In case of front mill arrangement the feeder floors of the units shall be interconnected by a walkway. 8.6 Frame work for supporting the circular bunker are provided above the feeder floor based on geometry of the hopper. 8.7 Bunker shall be provided with a top steel cover with slit openings for entry of coal. On sides of the bunker necessary openings shall have to be provided for bunker ventilation / dust extraction. 8.8 Tripper floor is immediately above the bunker. This floor is of RCC supported on structural steel frame work. 8.9 Tripper roof shall be of RCC supported on structural steel frame work. Feeder floor, Tripper floor, and its roof RCC should be laid on permanently fixed MS deck sheets of 1mm thick. A fall of about 300 mm to one side is to be given for the roof framing to effect proper drainage. Tripper roof supports bunker ventilation / dust supporting structure. Roof water proofing shall be provided using high solid content liquid applied elastomeric water proofing joint less membrane with separate wearing course as per ASTM C-898 and ASTM C-896. Thickness of the membrane shall be a minimum of 1.5mm. The treatment includes application of polymerized mortar over sloped roof to achieve a smooth surface and a primer coat. Wearing course on the top of membrane shall consist of 25mm thick screed of concrete grade M20, cast in panels of 1.2mx1.2m and reinforced with 0.56mm dia galvanized chicken wire mesh and joints sealed using Polysulphide sealing compound. The roof shall be provided with clay tiles over the entire area with cement sand mortar of 1:4 and grouted. An RCC parapet or steel handrail shall be provided for the tripper roof. A access stair / ladder shall be provided from tripper floor to roof in each unit. In case of front mill arrangement the tripper floors of both the units shall be connected with RCC floor supported on steel structure frame work matching the complete width of the tripper floor 8.10 In addition to the above, framing arrangement for structural steel platform at various levels around the bunker shall be provided with proper access ladder, for poking, striking and attending to air cannons. 8.11 Bunker building shall be provided with a regular staircase at one end of the building up to tripper floor level with landing at feeder floor level for each unit. Tripper roof shall be given access through a ladder from tripper floor to roof and also Boiler platform. An elevator shall be provided up to tripper floor level for each of the units 8.12 Bunker supporting structure is normally left uncladded up to the bottom of tripper floor. For tripper floor up to 3000 mm above finished tripper floor level, brick wall shall be provided. Above this level permanent colour coated galvanised sheet cladding shall be provided. Fixed steel windows		
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with 6 mm thick wired glass shall be provided in the tripper house as per requirements for conveyor gallery. 8.13 Rain water down take pipes shall be of MS pipe conforming to IS: 1239 & IS: 3589. 8.14 All structural steel work shall be given two coats of primer and minimum 2 coats of synthetic enamel paint of approved brand and shade. All exposed gratings and handrails shall be galvanised. Expansion joint shall be provided in the structure as required by IS:800. 8.15 A suitable cage ladder shall be provided from feeder floor level to bunker support structure level for inspection 9.0 ESP CONTROL ROOM 9.1 This shall be RCC framed structure. Separate building is envisaged for each unit. The ground floor shall accommodate cable vault, toilet, staircase. First floor shall accommodate switch gear rooms, control rooms and AHU room. An auxiliary transformer yard with fencing and gate shall be provided adjoining to the building. Side cladding shall be of brick wall with wall in front of transformer yard made sufficiently thick to satisfy fire rating as per TAC regulations, package air conditioners for EC control room and VFD room. 9.2 Staircase area shall be protected from fire safety angle as per TAC regulations. Main door to switch gear room shall be steel sliding door having adequate area to admit switch gear. There shall be minimum two doors to the switch gear room, of flush welded steel type. Control room should have one swing type aluminium glazed double panel door and one single panel door. Windows shall be steel glazed for switch gear room with wired glass. For control room if window is provided the same shall be of fixed glass type with 6 mm thick sheet glass. Main entrance of the building shall be a rolling shutter with appropriate ramp approach. Aluminium false ceiling shall be provided in the Control room. Under deck insulation shall be provided above false ceiling. A catwalk shall be provided between roof and false ceiling to facilitate maintenance 9.3 Roof shall be given access by means of regular RCC/ structural steel stairs. An equipment hatch shall be given in the first floor with lifting beam to lift the switch gear / control panel to the first floor. 9.4 Roof shall be given a slope of minimum 1 in 100 towards the side opposite to transformer yard. Roof shall be given with proper water proofing, for description mentioned elsewhere in this specification. Adequate number of rain water down take pipe shall be provided using MS pipe conforming to		
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IS: 1239 & IS: 3589. Garland drain as well as plinth protection shall be given around the building 9.5 Transformer shall be founded on RCC foundations with rails on the top. Transformer yard shall be provided with 3 m high chain link fencing with gates. In case more than one transformer is being provided, fire wall shall be given to separate the transformers. Oil soak pit shall be provided below the transformer. Burnt oil pit shall be provided connecting the soak pits with RCC pipes. The transformer area floor shall be provided with RCC grade slab over 230 mm thick rubble soling finished with 50 mm thick ironite flooring and shall be sloped towards peripheral drains and lead to oil water drainage system 10.0 STEAM GENERATOR AREA PAVING 10.1 Entire steam generator area up to the road at end of Chimney shall be provided with RCC paving on 75mm thick PCC over rubble soling with 50 mm thick floor finish. 10.2 Paving shall be carefully planned such that maintenance access roads of minimum 4 m wide to all major equipment are available. This area shall be designed for heavy loads similar to design of roads. Such approach road shall be provided to the S.G elevator also to enable handling of equipment at higher level during maintenance. Such road ways shall be clearly identified with kerbs / painting. All drain / trench covers in these areas shall be designed to withstand truck loading. 10.3 The drainage of the entire SG area shall be properly planned. Network of RCC drains with MS grills shall be provided covering except for heavy loaded area shall be designed separately, the entire area which lead the storm as well as process leakage water to the peripheral drains, which in turn will lead to plant drainage system. Where open drains are not permitted underground pipes may be provided in which case at all junctions and ends proper manholes shall be provided to permit periodic cleaning of the pipes. All structural steel column in the area shall be provided with RCC encasing to a height of minimum 200 mm from the top of finished paving. The maximum paved level in SG area shall be kept a minimum 150 mm below the finished ground floor level in Turbine building area. 11.0 RCC CHIMNEY 11.1 Parameters of the Chimney shall be designed based on the exit flue dia, the fuel burnt, quantity of gas generated and probable composition of the flue gas. Minimum height of the Chimney shall be 275 m. The chimney will be twin flue chimney with brick flues. Chimney shall be provided with internal		
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staircase for maintenance. Proper aviation warning signals shall also be provided for the Chimney. Chimney shall also be provided with Rack and Pinion type Lift for access and maintenance. Specifications for chimney have been described in more detail elsewhere in the specifications. 12.0 TRANSFORMER YARD 12.1 Generator transformer, station transformer, unit auxiliary transformer and service transformer are located in front of the turbine building. Transformers shall be founded on RCC foundations with rails on the top and oil soak pits filled with hard stone aggregate. Burnt oil pits are provided to collect leaked oil from the soak pit through concrete, pipes laid to slope. RCC blast wall / RCC frame with brick wall of adequate thickness and height to satisfy TAC regulations shall be provided in between transformers as Fire barrier wall. 12.2 RCC foundations shall be provided with rail to transport transformers out of transformer yard during maintenance. Entire area shall be surrounded with 3 m high GI chain link fencing with gates. Where rails cross the fencing, fencing shall be made of removable type to facilitate transport of transformer. Floors shall be paved with Reinforced cement concrete and shall be sloped towards peripheral drains, which shall lead to a sump from which the drainage is led through an oil water separator. The clear water shall be led to plant drainage. 13.0 SWITCH YARD Extent of the Switch yard will depend on the layout of the switch yard which has been outlined in the Electrical section of this document. 13.1 Galvanised steel structure All steel structure for the Switch yard shall be hot dip galvanised structure with welded / bolted connections at shop and bolted connection at site. All bolts and nuts shall also be galvanised. Minimum zinc consumption shall be 610 gms per square meters of exposed surface. Design criteria of Switch yard structure are furnished elsewhere in this document. ISSUE R1		

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Major steel structures are towers, beams, lighting masts etc. They are all of latticed construction using angle sections. In addition supporting structure for equipment, such as isolator, lightning arresters, etc shall also be provided. These structures may be of tubular section or latticed as the case may be. Lighting masts shall be provided with cage ladder. Where platforms are provided on lighting masts for mounting of lighting fixtures, they shall have protection hand rails formed of galvanised section. Platforms shall be of galvanised gratings. 13.2 Foundations for structures and equipment Criteria for design of foundation are given in separate section of the document. 13.2.1 Trenches / Paving / Fencing Trenches shall be of RCC construction. Trench walls shall be designed to withstand a surcharge load of 1500 kg / sq.m. Trench wall shall project 150 mm above the paved / graded level to prevent ingress of storm / rain water. All trenches shall be covered with trench cover after cable laying is complete. All trench, floors shall be given a slope of minimum 1 in 750 and the slope shall lead to a sump, where pump can be installed for drainage. All trenches shall be made water proof by injection grouting. 13.2.2 The complete area within the fencing shall be provided with a mild slope towards peripheral RCC drains which in turn will be connected to the plant drainage system. Minimum 75 mm thick paving shall be provided using hard stone aggregate 20 to 40 mm in size. 13.2.3 Fencing around switch yard area shall comprise of RCC posts with GI chain link fencing of minimum 8G of mesh size 75 mm and of height 2400 mm above toe wall with 600 mm high galvanised anti-climbing device with Razor blade stapled high tensile barbed wire (8 rows) such that total fence height of 3 m above toe wall is achieved. 14.0 Switchyard Control Room 14.1 Switch yard control room will be a two storied RCC framed structure. The ground floor will accommodate cable vault, AHU rooms, Stores, Staircase, panel handling arrangements, battery rooms etc and first floor will have relay panels / PLCC panels, etc.. Floor elevation shall be decided by the CONTRACTOR to suit his requirement of operation and maintenance, package air conditioners for relay room. 14.2 Cladding shall be of brick wall and the same will be supported on RCC wall beams and plinth beam such that unsupported length is not more than		
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about 3 m. Pleasing architecture shall be provided for the building. The external wall surfaces shall be provided with 20 mm thick plaster in two layers, the second layer of 6 mm shall be mixed with W.P compound. Internal plastering shall be of 13 mm thick. Ceiling in areas where false ceiling is not provided shall be given ceiling plaster 6 mm thick. All partition walls in the ground floor shall be of single brick wall. Wall around cable vault shall extend up to the ceiling. Cable vault shall be provided with two flush type sheet steel doors. Wall around stores, air washer rooms and stair case also should extend up to ceiling. Stores and AHU room shall have flush type of sheet steel door. Door in AHU room shall be made air tight. Stair case shall have fire proof, automatically closing glazed aluminium door in the first floor. On the ground floor also similar doors shall be provided. Main entrance shall be aluminium glazed double leaf swing door of adequate size with fixed sheet glass glazing in anodized aluminium frame work on either side. Separate rolling shutter entry shall be planned for panel movement with a hatch and lifting beam on the first floor. In the first floor, stair case shall be given brick enclosure. Entry to the air-conditioned area shall be through air lock lobby with aluminium glazed automatic sliding door of adequate size. At least two doors shall be given from the control room to move out during emergency. All partitions shall be of anodized aluminium framing with 6 mm sheet glass up to false ceiling. The external partition separating A/C area and non A/C area, above the glazed partition shall be provided in brickwork. All internal partitions in the A/C area will extend up to the false ceiling. Doors in Aluminium glazed partition shall be single leaf glazed aluminium swing door. Control room proper on the switch yard side shall have continuous fixed glazing in aluminium frame work above 900 mm high Brick wall. For other rooms aluminium glazed sliding windows may be provided with 6 mm sheet glass. False ceiling with aluminium ceiling system shall be provided in the A/C areas. Under deck insulation shall be provided above the false ceiling on the ceiling as well as for walls. Roof shall be laid to slope of 1 in 100 using screed or by sloping the top of slab. Roof shall be given with proper water proofing, for description mentioned elsewhere in this specification. Rain water down take pipes shall be of MS pipe conforming to IS: 1239 & IS 3589. 15.0 INVENTORY STORE ROOM Inventory store room of size 10m x 20m x 5m height and shall be of composite structure of RCC frame with structural steel truss. Side shall be of brick cladding. Roof shall be provided with permanently colour coated galvanized sheeting. Store shall be provided with record rooms, office rooms of adequate space and with toilets. The floor shall be RCC grade		
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slab designed for heavy duty loading with granolithic finish and non-metallic hardener 16.0 COAL HANDLING SYSTEM This section covers the general requirements for concept, design, construction / fabrication and erection of various structures, buildings and facilities for the Coal handling system, covering complete Civil and Structural works. Some of the important areas of works are described below. 16.1 Crusher house 16.1.1 Crusher house shall be of steel structure of framed / braced design. Floors and roofs shall be RCC over structural steel beam. Side cladding shall be of permanently colour coated galvanised steel 0.6 mm thick above 3000 mm wall on ground floor. Roof shall be given adequate slope for drainage. Roof shall be given with proper water proofing, for description mentioned elsewhere in this specification. Proper arrangement shall be provided to convey the rain water through galvanised gutter of matching colour and MS pipe down comers as per IS:1239 & IS: 3589. Adequate windows shall be provided with steel glazed side hung windows using wired glass. Wherever monorails are projecting outside for lifting of equipment, steel sliding doors shall be provided. Main entrance doors shall be rolling shutter adequately sized to carry equipment inside. Other doors shall be of flush welded steel construction. Ramps shall be provided in front of main door. Grade slab as well as intermediate floors shall be of RCC. Intermediate floor shall be supported on steel beams. Crusher shall be mounted on the floor framing using Vibration Isolator system. Handrail shall be provided around all big openings and kerb plates shall be provided around all small openings. 16.1.2 Two staircases shall be provided one inside and one outside, both of structural steel. Rack and pinion lift shall be provided. Machine room of lift floor and roof shall be of RCC. Side cladding of M/C room shall be of colour coated sandwiched cladding system. An RCC kerb wall of 300 mm shall be given alround the floor. M/C room shall be given adequate slope for drainage purposes. Roof shall be given with proper water proofing, for description mentioned elsewhere in this specification with MS pipe down comers as per IS: 1239 & IS:3589. Main door to M/C room shall be of steel of flush welded construction. Adequate ventilation shall be given using steel glazed window. Toilet shall be provided in the Crusher house. 16.1.3 Foundation of the building columns shall be of RCC. Foundation design criteria are given elsewhere. All the foundations shall be connected together by tie / plinth beams. Top of the pedestals for the columns shall be 150 mm above finished ground floor level.		
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16.2 Junction houses Construction details of Junction houses are similar to the Crusher houses including provision of elevator except that toilet may not be necessary unless otherwise specified in the Mechanical section of the document. 16.3 Conveyor Galleries and Trestles 16.3.1 Over head conveyors shall be housed in a suitably enclosed gallery of structural steel. Maximum span of gallery shall be limited to 24 m unless higher span is necessitated due to site constraints, which shall be subject to approval of OWNER. 16.3.2 For double stream conveyor gallery one central and two side walkways shall be provided. For single conveyor, walkways shall be provided on either side. Width of the walkway and clear height of the gallery shall be as specified in Mechanical section of the document. Both sides of the central and side walkways shall be provided with pipe hand rails with kerb plates using pipe of 'medium' class as per IS:1161 having 32 mm nominal size. Hand rails shall not be connected to conveyor supporting stringer. Walkway shall be of chequered plate construction with anti skid arrangement. Floors of the conveyor gallery shall be provided with seal plates as specified in Mechanical section. 16.3.3 Conveyor gallery shall have permanent colour coated sheets on roof and on both sides. Roof framing shall be given a slope of 1vertical:3 horizontal. A continuous slot opening of 500 mm height shall be provided on both side walls just below the roof sheeting. Adequate provision of windows shall be provided on both sides. Windows shall have grills of wire mesh. Cross over shall be provided at approximately 100 metres interval along the conveyor preferably at 4 legged trestle locations. 16.3.4 In between transfer points four legged trestles shall be given at a spacing of about 100 m. In between 4 legged trestles, two legged trestles may be provided. Trestles shall generally be provided using rolled beams only. 16.3.5 For relieving forces due to temperature variation gallery shall be analysed considering one end of the gallery shall be treated as hinged and the other end on rollers. However for complete system to transfer the force to the four legged trestle, conveyor shall be detailed as both side hinge. 16.3.6 End of conveyor gallery which will be supported over transfer tower shall be so detailed that only vertical reaction is transferred from conveyor gallery. This side of the gallery shall therefore be supported on sliding PTFE support. For design criteria for foundation please refer separate section given in the document. The top of pedestal for the foundations shall project 300 mm above the grade level.		
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16.4 Stacker cum reclaimer 16.4.1 Stacker cum reclaimer rail shall be supported on RCC foundations giving continuous support to the rails. The beams supporting the rails shall be given expansion joint preferably every 30 metres. Stacker / reclaimer conveyor support shall also be provided connecting the above two beams. The entire coal storage area shall be provided with properly sloped RCC paving over rubble soling over properly compacted sub grade. RCC drains with removable pre cast RCC slotted cover shall be provided on either sides of each coal stack. These drains shall be so designed to carry the drainage from coal yard to the decantation tank. Decantation tank shall be of RCC with baffles to induce settlement of the coal dust and shall be sized to store about 30minutes storage. Settled solids shall be removed and dumped to Ash ponds. RCC supports for dust suppression piping system shall also be provided. Beyond the stock pile area till the junction towers on either side, foundations for trestles and short supports will have to be given. The top of pedestal shall project a minimum of 300 mm above the grade level. 16.5 Wagon tippler hoppers/ Reclaim Hopper Pits and Shed 16.5.1 Wagon tippler pit shall be of RCC construction. This structure shall be designed as a water retaining structure with limited crack width of 0.1mm. Proper provision shall be made while constructing to provide structural water proofing after the concreting of the pit is complete. Sump shall be provided to collect and pump out water which enters through coal/tunnels etc. RCC access shaft accommodating staircase as well as monorail for handling of machinery shall be provided. Control and switchgear room shall be of RCC framed construction with brick cladding. Control room shall be provided with fixed glazing in aluminium framework on front side. Steel glazed windows with 6 mm thick wired glass shall be provided for other walls. RCC staircase shall be provided for access to the control room. 16.5.2 ERH is also a RCC construction similar to wagon tippler pit. 16.5.3 Hoppers shall be of RCC construction. The pit shall accommodate the hoppers along with feeder and conveyors below. The hopper pit shall be of RCC construction and designed as water retaining structure. During construction proper provision shall be made to make the pit completely water proof. For Reclaim hopper sloping surfaces 5mm thick stainless steel liner of SS 409M shall be provided. For Wagon tippler sloping surface including grizzly supported RCC beams & all other surfaces where coal is to strike 10mm thick TISCRA / SAILMA plate shall be provided. Suitable sump shall be provided in the pit to effect surface water drainage. RCC access shaft shall be provided with staircase to the bottom of the pit. Monorail for taking machinery into the pit shall be provided in the access shaft projecting through two leaf steel sliding door. Plinth level of the pit		
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shall be kept at least 500 mm above graded level with RCC sloped paving all round to enable bulldozer movement. Shed above hopper pit shall be of structural steel construction. 16.5.4 Wagon tippler shed shall be steel framed structure with rigid framing in the transverse direction and bracing in the longitudinal direction. Roofing shall be of colour coated galvanised sheet of minimum thickness 0.8 mm and side cladding shall be of similar sheet but with 0.6 mm thickness above 3 metres high brick wall. Roof shall be given a minimum slope of 1 vertical : 4 horizontal. G.I. rain water gutters of matching colour shall be provided to convey the rain water through galvanised M.S. pipe type medium conforming to IS:1239. RCC drains shall be given on either side along with plinth protection all round 16.5.5 For ERH the columns shall be raised from the four corners of the pit and shall be designed as free standing, supported only by roof framing, to facilitate dozer movement. Roof shall be provided with permanently colour coated galvanized sheeting of 0.8mm thick. Sides, where dozer movement is not expected, shall also be provided with 0.6mm thick colour coated sheets above 3m high masonry wall. 16.6 Tunnels, Pent houses and Transfer Houses 16.6.1 Tunnels shall be of RCC construction and designed as a water retaining structure. During construction proper provision shall be made to make the tunnel completely water proof. A PCC screed shall be provided to direct the drainage on to one side of the tunnel. A small trench shall be provided on that side of the tunnel to lead the drainage to the nearest sump. The tunnel shall be provided with RCC ventilation duct and shall be provided with grills for supply air. Where the tunnel enters the ground level a pent house is provided of RCC construction. Pent house shall be provided with a lifting beam to lift equipments to the tunnel. Tunnel shall be provided with walkway on either side of the conveyor. Single pipe hand rail shall fixed to the tunnel wall to serve as hand rail. Tunnel floor shall be provided with PCC steps to facilitate movement of operating / maintenance personnel. In the case of double conveyor such steps shall be provided in the centre also. 16.6.2 Where two tunnels meet a Transfer house is to be provided. Transfer house is by and large a junction tower but the meeting of conveyors takes place below ground level. Transfer house shall be of RCC construction with RCC floors and roof, with RCC access shaft with staircase and monorail arrangement for carrying equipments down. Proper drainage arrangement shall be provided in the bottom most floor. Handrails shall be provided around all openings. Around access shaft proper plinth protection shall be provided with ramp towards the door. Access shaft should have one equipment entry which shall be two leaf steel sliding door and a single leaf		
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flush welded steel door for entry of personnel. Transfer house shall be designed as a water retaining structure and provision shall be made during construction to ensure proper water proofing after concreting is over. 16.6.3 Portion of the tunnel or transfer house over which railway line or road passes shall be appropriately designed to support the additional imposed load. Tell tale signs shall be provided above graded ground to identify the extent of the underground structure. 16.7 Switch gear room / Control room 16.7.1 Number of switch gear room shall be decided based on the arrangement of various buildings and their electrical load requirement as discussed in the Electrical portion of this document. Switch gear room shall generally be two storied RCC framed structure with cable vault on the ground floor and switch gears on the first floor. In the case of Switch gear cum control room, an additional floor shall be provided to accommodate the control room and offices above the switch gear room. Other constructional details shall be similar to ESP control room. Roof shall be given proper slope and parapet shall be avoided to prevent the accumulation of coal dust. Similarly above sunshade, fascia shall be avoided to prevent accumulation of dust. 16.7.2 Transformer yard, toilets, equipment hatch, staircase etc. shall be provided similar to ESP control room. 16.8 Dust Suppression, Dust extraction and Ventilation system structures 16.8.1 Civil works on account of the above system will generally consists of Pump houses, RCC reservoirs, slurry sumps, pump foundations, fan foundations etc spread over the complete Coal handling area. Location and details of these structures will depend on requirement based on system design. 16.9 Bull Dozer shed This shall be a steel frame structure with permanently colour coated GI sheathing, with a column free area for bull dozer movement in shed area. The minimum area for this facility shall be 250 Sqm. The auto-repair shop shall have sides with colour coated galvanised sheathing except for bottom three metres of brick work. Ventilation and natural lighting shall be provided with steel glazed side hung windows. Doors shall be of flush welded steel for personnel movement. Rolling shutters of adequate size shall be provided for movement of dozers.		
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The floor shall be RCC grade slab designed for heavy duty loading with granolithic finish and non-metallic hardner. Necessary pit for servicing of vehicles with all necessary steps etc., shall be provided in the repairs area. 16.10 Loco Parking and Repair / Wash Shed This shall be a steel frame structure with permanently colour coated GI sheathing, with a column free area for parking / repairing/washing locos in shed area. The minimum area for this facility shall be 15 m x 40 m to accommodate atleast 4 nos. locos on two tracks. Adjoining the locoshed, rooms for stores, staff office room, storage room to store consumables and other materials, toilets etc. shall be provided. The complete shed along with the facilities shall be as per RDSO norms. The loco shed shall also be provided with sand pit and wash facility. The locoshed shall have sides with colour coated galvanised sheathing except for bottom three metres of brick work. Ventilation and natural lighting shall be provided with steel glazed side hung windows. Doors shall be of flush welded steel for personnel movement. Rolling shutters of adequate size shall be provided for movement of locos. The floor shall be RCC grade slab designed for heavy duty loading with granolithic finish and non-metallic hardner. Necessary pit for servicing of locos with all necessary steps etc., shall be provided in the repairs area. A separate two story building with floor area of 100sqmetre each floor (total 200sqm) having 6rooms with veranda, store, Toilets with PBX, LAN for CMMS and coolers, furniture etc. For Railway staff. 17.0 ASH HANDLING SYSTEM 17.1 The superstructure of pump houses and compressor house shall be of RCC framed structure. The building will support an EOT crane of adequate capacity. Roof shall be of in-situ RCC slab. Side of pump house shall be of brickwork. Building shall be adequately ventilated with steel windows with 6 mm thick wired glass. Roof shall be provided with a minimum of 1 in 100 slope for proper drainage. Main entrance shall be adequately sized rolling shutter. In addition a minimum of two steel doors of flush welded construction shall be provided. RCC foundations / pile cap shall be provided to support the structure based on soil condition. 17.2 Ash water tank shall be formed partly underground and partly over ground. The tanks shall be designed as a water retaining structure as per IS:3370. RCC sumps of Ash Slurry Pump house shall be designed as a water retaining structure as per IS:3370 duly considering water table as well as additional surcharge pressure. Provision shall be made during construction		
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to ensure proper water proofing of the sump after concreting is over RCC staircase shall be provided for access to all the sumps. All basements shall be provided with hand rails around. 17.3 MCC and Switch gear room shall be a two storied RCC framed structure with cable vault on ground floor and switch / control room on the first floor. Control room will be air conditioned hence the same shall be given false ceiling of gypboard and under deck insulation. Air washer room shall also be provided in the ground floor. Under deck insulation shall be provided for Air washer room also. Toilet shall be provided on the ground floor. Walls of the Control / Switch gear room shall be of brick, with wall on the Transformer yard side being designed as per TAC regulations. 17.4 Roofs shall be properly sloped and provided with proper water proofing, for description mentioned elsewhere in this specification. Rain water down take MS pipe conforming to IS: 1239 & IS: 3589 shall be provided. Garland drains shall be provided around the building to carry the storm water to plant drainage system. Plinth protection shall be given all round the building. 17.5 Windows in switch gear / control room shall be of side hung steel glazed type using wired glass. Switch gear room shall have at least two steel flush welded door. Entry to control room shall be with aluminium swing type glazed door. Size of main entrance door to Switch gear room shall be adequate to allow movement of switchgear panels. This shall preferably be steel sliding door with two leaves. Provision shall be made to lift the Switch gear panel to the first floor with equipment hatch and lifting beam. Staircase shall be provided with fire proof enclosure all round to satisfy TAC regulations. Toilet shall be provided with PVC doors. Roof of all buildings shall be given access through cage ladder. Sewage from toilet shall be disposed off through plant sewage disposal system. 17.6 Auxiliary transformer yard may be required near the Switch gear room. The Transformer yard shall provided with chain link fencing and gates along with fire wall, paving, soak pit, burnt oil pit etc similar to ESP control room. 17.7 Work shall also include bottom ash hopper supports, bottom ash extraction equipment supports, pipe line supports and trenches from Bottom ash hopper to Ash slurry sump. Support for fly ash pipe line from ESP etc. to fly ash silo is also included in the scope of civil works. 17.8 Dry fly ash silo along with development of the silo area such as paving, fencing, access roads / drainage of the dry fly ash silo area etc., included in the scope. Fly ash silo shall be of RCC construction. 17.9 Pipe line from Ash slurry pump house to the final disposal area shall be run on pipe racks in the plant area and on pipe racks or RCC pedestals as per topography over the bund up to disposal point (existing ash dyke which		
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shall be raised by 8m in two stages . In first stage ash dyke shall be raised to RL 200.00m from existing RL196.00m. and in second stage raised to RL 204.00m) . All related Civil and structural works shall be included in the scope. At all road / rail crossings pipe bridges are to be provided with bottom of the bridge at least 7 m above the road / rail level. If the OWNER permits at road crossings the pipes may be run inside box culverts also. 17.10 Dry fly ash storage area shall be provided with fencing and gates similar to transformer yard. All other Civil / Structural work to ensure smooth functioning of the Ash handling system are deemed to be included in the scope of work under the sub section. 18.0 Blow down water pump house / Clarified Water Pump House/ Tanks This shall be of single storey RCC frame structure with RCC concrete roof slab. Side of pump house shall be of brickwork. Ventilation and natural lightning shall be provided with steel glazed side hung windows. Roof shall be provided with a minimum of 1 in 100 slope for proper drainage. Screed shall be of under roof tiling. Maintenance bay of pump house shall have RCC grade slab with granolithic finish and non-metallic floor hardener. Adequate Handling facilities for pumps shall be provided, supported from the roof beams. Roof shall be given liquid membrane water proofing treatment. Approach to roof shall be provided with steel cage ladder. The tank shall be above ground/partially above ground partially below ground covered at Top and of RCC construction and shall be provided with compartments and a common sump for facilitating maintenance. Tank roof shall be provided with GI vent pipes. 19.0 FUEL OIL HANDLING SYSTEM 19.1 Unloading pump houses to unload oil from road tankers or rail wagons shall be of single storey RCC frame structure with RCC roof slab and sides shall be of Brickwork construction. A paved platform shall be provided between the pump house and the rail wagon / road tanker parking area with RCC, sloped towards a peripheral drain. The drain will be led to a sump with oil water separator. No cable trenches will be permitted in the pump house. 19.2 Fuel oil pressurisation pump house will house fuel oil pumps, heaters and MCC's. This is also single storeyed RCC framed structure with RCC roof slab. The pumps will be located in an R.C.C basement. Protective hand rail shall be provided all round the basement. MCC shall be located at plinth level. Proper access shall be given to the basement. Basement shall be given proper drainage facility. The oil / water mixture collected in the sump will be led to an oil water separator. The basement shall be designed as a water retaining structure. Electric hoist crane or monorail facilities will have		
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to be provided in all the pump houses as specified in the Mechanical section of the specification. 19.3 Fuel oil tanks shall be of structural steel designed as per IS:803. Foundation of the fuel oil storage tank shall be provided with bitumen sand mixture laid over confined river sand bedding formed with RCC ring beam. The type of foundation to be adopted will depend on the soil condition. Details of subsoil conditions are covered in clause 8.2 of Section D4.1. 19.4 The storage tanks shall be surrounded by RCC wall to prevent the spread of fire or leakage of oil from a leaking tank to other areas. The height of the wall, c/c spacing of tanks as well as area provided within the concrete wall are to be decided based on the statutory requirements for the type of oil stored and the quantity of oil stored. The entire area outside the tank foundation and within the tank farm shall be paved with concrete. The paving shall slope towards RCC peripheral drains which shall lead to an oil water separator. RCC crossovers shall be provided at appropriate locations for entry of personal to the tank farm. Fuel oil storage area shall be protected by chain link fencing as in the case of Transformer yard. Extent of fencing shall be to satisfy statutory requirement. Foundations for trestles and pedestals for supporting the pipes, anchor blocks etc shall provided in RCC at appropriate locations. 20.0 D.M PLANT 20.1 Dimension and height of the building shall be decided based on equipment layout and height of the vessels accommodated inside. The DM plant building shall be of a structural steel framing to result in large column free space. The roof shall be of in-situ RCC, properly sloped, constructed on colour coated permanent metal deck shuttering supported on steel truss / beams. Side cladding shall be of permanently colour coated galvanised steel 0.6 mm thick above 3000 mm wall on ground floor 20.2 Adjoining control room and laboratory shall be provided in an RCC framed building with brick cladding Control room and switch gear room shall have a cable vault below. Control room and laboratory shall be air conditioned. False ceiling with gypboard shall be provided in this area. Underdeck insulation shall be provided in the A/C area as well as in the Air washer room. Staircase in the Control static room Complex shall be extended to the roof also. Flooring on Control room shall be anti-static PVC tiles. Toilet shall be provided in the ground floor. In case a transformer yard is provided the wall in front shall be designed to satisfy fire rating as per TAC. Details / requirements of transformer yard shall be same as those provided for ESP control room. Chemical laboratory shall be sized to hold all the equipments as defined elsewhere in specifications and shall be provided with platforms, sinks, water connection, chemicals and samples storage space etc.		
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20.3	Floor where acid / alkali spillage are expected shall be isolated with RCC kerb and the flooring inside shall be of acid / alkali resistant brick. The drains inside the building carrying acid / alkali mixed discharge shall be provided with epoxy lining. Outside the building upto neutralising pit these drains shall be provided with Plastic polypropylene Glass (PPG) acid /alkali resistant lining. Specification for lining is given elsewhere in this document. Acid / alkali unloading and storage area outside the building shall also be provided with kerb with a sump inside. This area shall also be provided with PPG lining.	
20.4	Neutralising pit shall be designed as a water retaining structure with external damp proofing. Floor and walls of the pit shall be given PPG / PV sheets lining. Ceiling as well as floor, supporting pumps, pumping the clear water from neutralising pit shall be given epoxy lining. D M water storage tank outside the DM plant shall be supported on sand pad with ring wall.	
20.5	Walls inside the DM plant area shall be provided with chlorinated rubber based painting. Main door shall be rolling shutter of adequate size to permit entry of the largest vessel. All doors and windows in the D.M plant area shall be of aluminium glazed type. Windows shall be of sliding type.	
	NOTE: All buildings where movement of operation/maintenance personnel is expected should generally be provided with brick cladding, colour coated sheet cladding will transmit lot of heat inside the building.	
21.0	LABORATORIES All laboratories are of RCC structures with brick cladding. Laboratories shall be provided with platforms , sinks, water connections, chemicals and samples storage space. Acid proof flooring shall be provided and all laboratories shall be air conditioned. Chemical laboratories shall be sized to hold the equipments and all other laboratories shall have minimum area of 50 sqm.	
22.0	CONDENSER COOLING WATER SYSTEM	
22.1	Clarified water shall be used for circulating water system. RCC cooling water channel shall be of covered type rectangular shape and designed as a water retaining structure. Depth of channel and width of channel shall match with the width and depth of the cooling water channel from cooling tower. These branch channel shall join together and form common channel leading to the forebay of the pump house. Dimension of the channel shall be decided on the basis of the quantity of water to be carried by the channel. Floor of the channel shall be given a mild slope to ensure	
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necessary velocity of flow. The top of the channel shall be kept at least 500 mm above ground level with suitable galvanised M.S pipe hand railing on either side. Expansion joint shall be given at a spacing of about 30 m. Pedestrian crossover shall be given across the channel at approximately 300 m centres. The channel shall smoothly diverge and form the forebay in front of the pump house. 22.2 Depth of the forebay shall generally match with the C.W sump level, which shall be decided based on submergence requirement of the C.W pumps at the lowest water level in the sump. Forebay shall be provided with cage ladder at four corners constructed of galvanised steel. Top of the forebay shall be kept 500 mm above grade level and handrail of galvanised M.S.pipes shall be provided for the entire length on either sides. Water level indicator (float type) shall be provided in the forebay close to the pump sump on either side to observe the depth of water. 22.3 Dimension of the pump sumps shall be so selected as to prevent dead water areas, reverse currents, flow separation and eddies. Recommendations of British Hydromechanic Research Association (BHRA) and Hydraulic Institute Standards shall be followed. CONTRACTOR shall conduct Hydraulic Physical Model study to demonstrate trouble free operation of the pump sump and forebay for all possible alternatives / combination of pump operation. 22.4 Pump sump shall be designed as water retaining structure. Each sump shall be provided with stainless steel groove for inserting coarse screen, fine screen and stop logs. Grooves for stop log shall be provided before and after the screens. Whereas number of coarse screen and fine screen shall be the same as the number of pump sumps the number of stop log shall be a minimum of two. Top of the sump floor shall be kept same as of the top of forebay. This floor shall have openings for lowering and lifting of stop logs and screens. These openings shall be covered with galvanised mild steel gratings when the screens are placed in position. Provision for handling of the screens and stop logs shall be made. Sufficient paved space shall be provided to keep the stop log when not in use and also for maintenance of screens. Galvanised MS handrails shall be provided on 3 sides of the pump floor (sump roof). Each individual pump sump shall also be provided with a drain sump to empty the sump for attending to maintenance of pump. 22.5 Pumps generally have common base plate with the motor and hence the pump is supported at motor floor level having separate pump floor and motor floors. A thrust block shall be provided connecting the pump and motor floors to resist the pump thrust. Staircase shall be provided from the pump floor to motor floor. Motor floor shall be given handrail on the two sides. Pump maintenance area shall be provided on one side at the pump floor level.		
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22.6 The pump house structure shall be of structural steel framing with RCC roof laid over permanent colour coated deck sheet supported on structural frames. Side Cladding shall be of brick cladding. Crane girder shall be of steel. Cage ladder shall be provided for access to crane platform. Side of the pump house up to motor floor level on the pump discharge side shall be of RCC . Maintenance bay of the pump house shall have R.C.C grade slab with granolithic finish and non-metallic floor hardener. Motor floor shall also have similar finish. 22.7 An annex to the C.W pump house shall be provided in RCC framed structure to accommodate Switch gear and Control room with cable vault below, Chlorination room, Chlorine cylinder storage room and toilet block. Side cladding shall be of brickwork except in Chlorine cylinder storage area where brick wall is provided only to a height of 1 m. All floors and roofs shall be of RCC. Roof shall be given proper slope. Roof shall be given with proper water proofing, for description mentioned elsewhere in this specification. Rain water down comers shall be of MS pipes conforming to IS: 1239 & IS: 3589. Roofs shall be made accessible by MS cage ladder. 22.8 All doors shall be of flush welded steel construction. For Switch gear room, the main entrance door shall be of adequate size to transport the panels. All windows shall be steel glazed side hung. Wall in front of Transformer yard shall be designed to satisfy fire rating as per TAC regulations. 22.9 An auxiliary transformer yard may be required in front of the Switch gear room. Civil work similar to the transformer yard in front of ESP control room shall be included in the scope of work. 22.10 Outside the pump house support blocks for butterfly valves and pipes along with proper handling facility shall be provided. 22.11 Cooling water conduits of adequate size shall be provided from C.W pumps to Power house Building A row column and hot water conduits from Power house Building A row column to cooling tower. These conduits shall be formed of structural steel conforming to IS: 2062 grade B laid underground with an earth cushion of 1500 mm above the pipes. The pipes shall be given two coats of primer of each 25microns with two coats of epoxy painting of 25 microns each. No coats should be less than 25microns in case total thickness exceeds 100microns thickness over sand blasting on internal surface and wrapping as per IS 10151 for external surfaces. Where pipes are not encased the pipe shall be given sand bedding up to the centre line of the pipe. At location of the bends RCC anchor blocks shall be designed and provided. Thrust block shall be provided for conduits at the outside of CW pump house and at TG building CW pit outside for conduits. Manholes shall be provided along the length of pipe at about 150 m centres and near locations of bend in each pipe. The pipes shall be line tested before commissioning of the system. At road / rail crossing, RCC		
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encasement shall be provided and designed adequately to withstand the additional imposed loads. Following design requirements shall be met: a) The design pressure shall be the highest of the following: i. Pump shut off head + Static head difference between normal water level at CW sump and the lowest invert elevation of the CW conduit. ii. Maximum pressure due to surges. b) The conduit shall also be designed for vacuum pressure inside and overburden pressure outside. The Vacuum pressure shall be based on the surge analysis but in no case less than 0.9 Kg/sq cm for the inlet and outlet pipes from the condenser and the delivery pipes from pump discharge up to the header and 0.5 kg /sq cm for the main inlet and discharge pipes. Suitable protection devices such as air release valves shall be provided to ensure that design vacuum pressures are not exceeded. c) The conduit shall be designed for surcharge of 2 t/m². d) The design shall be checked for other loading combinations of surcharge, transformer load, ground water pressure etc., 23.0 COOLING TOWER Cooling towers shall be of Natural draft type. Detailed specification for civil and structural portion of the towers are covered under section D 4.6 G of this document. 23.1 The cooling tower shall be capable of cooling the rated quantity of water through the specified thermal range at the design wet bulb temperature and it shall conform to the other design parameters as stipulated in mechanical section of this document. 23.2 The scope of work shall include for design, construction, supply of all material, basin, fill with its supporting structure, staircases / walkways / platforms with hand railing, cold water outlet channels including gates, screens with handling arrangement, painting, access doors, water distribution system, aviation warning system, lighting, lightning protection system, with their associated hardware, etc., complete all as required to give satisfactory performance and as stipulated in various clauses in this document.		
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23.3 In the event, CONTRACTOR has quoted in collaboration with another firm (either Indian or foreign), each and every drawing and design calculations submitted shall bear collaborator's seal and signature indicating their approval. CONTRACTOR shall also furnish back-up guarantee for the performance of the cooling tower from the collaborator. 24.0 MISCELLANEOUS PLANT BUILDINGS 24.1 Air Washer Room 24.1.1 This shall be a steel framed building adjoining to the turbo generator bay.. Roof shall be of RCC, supported on colour-coated trough shaped permanent decking supported on steel beams. Side cladding shall be of brick, supported on concrete encased steel beams. Internal wall surfaces shall be given 20 mm cement mortar plastering mixed with water proofing compound as per specifications. Water tank and RCC supporting structures for louvers, filter and foundation for equipment such as fans and pumps are also included in the scope. Proper drainage of the floor shall be provided. Doors shall be of flush welded steel and they shall be made airtight. Rolling shutter of adequate size should be provided for taking the equipment inside. 24.1.2 Compressor House This shall be a steel frame building with RCC roofing on colour coated trough shaped permanent metal decking supported on steel beam. Side cladding shall be of colour coated sheet except for bottom 3 metres of brickwork. The building shall be provided with suitably designed RCC foundations. The roof framing shall support an under slung crane of adequate capacity. Main door shall be adequately sized rolling shutter to permit entry of truck with compressor. Compressor foundation shall be isolated from the grade slab. Air receiver and Air drier can be supported from RCC grade slab. All trenches shall be sloped towards drain sumps. Trenches shall be provided with chequered plate cover. Steel glazed windows shall be provided for ventilation and natural lighting. A minimum of 2 flush type steel doors shall be provided for movement of personnel. Dimension of the building shall be decided to suit the dimension of the equipment supplied, duly taking into account maintenance requirements. 24.1.3 A C Plant This shall be a steel frame building with in-situ RCC roof over colour coated trough shaped permanent metal decking supported on steel beam. AC plant shall be completely enclosed by brick cladding and shall be air tight. The building shall be provided with suitably designed RCC foundations .The roof framing shall support an under slung crane of adequate capacity. The		
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dimension of the building shall be decided to suit the layout and maintenance requirement of the equipment supplied. Main entry shall be through a rolling shutter permitting entry of truck with machinery. A minimum of two numbers single leaf steel flush doors shall be provided for movement of personnel. Steel glazed side hung windows shall be provided for natural lighting and ventilation. The rain water down take pipes shall be of MS. 24.1.4 CLEAN OIL /DIRTY OIL TANK ROOM & GAS CYLINDER STORAGE AREA These facilities if required outside TG building shall consist of a steel frame building with brick cladding with single skin metal cladding above 3 metres to match the general aesthetics provided for TG building. Roof shall be of RCC, supported on colour-coated trough shaped permanent decking supported on steel beams. A minimum of 2 flush type steel doors shall be provided for movement of personnel Dimension of the building shall be decided to suit the dimension of the equipment supplied, duly taking into account maintenance requirements. 24.2 PIPE AND CABLE RACKS 24.2.1 All cable and pipe routing in the main plant island shall be clubbed and shall run over ground on structural steel pipe / cable racks at a height not less than 3000 mm above grade level. Where the pipes cross roads clear headroom shall be 7000 mm. The racks can be multi-tiered. Cable shall normally be laid above the pipes. 24.2.2 The racks are generally designed as a rigid frame in the transverse direction and braced in the longitudinal direction. Expansion provision shall be provided wherever there is a change in direction or where length of the rack exceeds 100 metres. Access ladder shall be provided at suitable location. Where so required checkered plate platforms shall be provided for maintenance purpose. Pipe rack columns shall be supported on RCC foundations with bottom of base plate about 300 mm above ground level 24.2.3 Where pipe / cables have to be run below the ground they shall be provided in suitable RCC pipe trenches / RCC duct banks.		
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24.3 Diesel Generator House 24.3.1 This shall be a single storied composite of both RCC/structural framed structure with electric hoist. The dimension of the building shall be decided by the CONTRACTOR to suit equipment supplied. D.G set foundation shall be isolated from the floor. Side cladding shall be double wall brick cladding with cavity for noise suppression. 24.3.2 All trenches shall be of RCC. There shall be no entry of cables / pipes to these trenches below grade level from outside. All these trenches shall be covered with chequered plate over steel framing. Adequate number of sumps shall be provided to drain these trenches. 24.4 Workshop This building shall be of structural steel frame work. Roofing shall be of permanent colour coated trough shaped steel sheeting supported by steel truss. Side cladding shall be colour coated galvanised sheeting over 3000 mm high brickwork. In the workshop area , electric hoist of adequate capacity shall be provided. The workshop shall accommodate the machinery and facilities listed in the Mechanical section of the document. In addition the workshop shall provide for office space for workshop superintendent and his supervisory staff, locker room and change room for workers, toilet etc. Entry and exit of trucks shall be through adequately sized rolling shutters. In addition a minimum 2 single leaf steel flush door shall be provided for entry of the staff. Adequate steel windows shall be provided for ventilation and lighting. Offices inside shall be of glazed PVC partition above 900 mm high single brick wall. Total height of partition including brick work shall be 2400 mm. Doors to the cabins shall be of ply wood. The dimension and height of the building shall be decided up on by the CONTRACTOR based on his layout requirements. 25.0 NON PLANT BUILDINGS 25.1 Service Building including First Aid Centre 25.1.1 Special attention shall be given to architecture of this building. This building shall be located close to the Turbine building and shall be connected by a covered corridor to the Turbine building at least at two floor levels ie. at mezzanine and operating floors. 25.1.2 This building shall be RCC framed structure having a minimum plan area of about 1200 sq.m in each floor with large column free area. No. of floors		
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shall be decided by the CONTRACTOR depending on the space requirement of various facilities proposed to be housed. A minimum of ground floor plus three (3) floors are recommended. Roof also shall be designed as a floor providing cement / clay tiles over the water proofing treatment such that the area can be utilised for get together. Walls shall be of brickwork 25.1.3 This building has to provide offices for the O & M staff, laboratory for Control & Instrumentation, relay testing & electrical testing, in addition to Conference room, archives, model room, change room with lockers for the O & M workmen, reception, battery room, stores, pantry, Air washer room, Workshop, , First Aid Centre and separate toilets for ladies and gents. The building shall be centrally air conditioned. Hence clear head room below beams shall be designed to run A/C ducts above false ceiling. Level of false ceiling may be kept at 2700 mm in the ground floor and 2400 in upper floor. Cabins for senior officers and conference rooms shall have attached toilet. 25.1.4 False ceiling in the entrance lobby and conference room shall be colour coated aluminium ceiling system. In other areas false ceiling with gypboard shall be provided. 25.1.5 Entrance to building shall have glazed aluminium door swing type with double leaf. Glazed aluminium partition shall be provided on either side of entrance door. Internal partition in the building shall be provided with a combination of pre-laminated particle board and frosted glass in anodized aluminium frame work. All doors to the cabins shall be teak veneered flush plywood door. In other utility areas, aluminium glazed or steel flush doors shall be used. Toilet may be provided with PVC doors. All windows shall be glazed aluminium sliding types with ornamental grills inside for security on ground floor. 25.1.6 One elevator shall be provided at the entrance lobby. Entrance shall be aesthetically decorated with Rose wood architrave and matching granite tile dado. Number of staircases provided shall be decided based on statutory regulations. A minimum of 2 staircases shall be provided. For the staircases in the lobby the treads and dado shall match with the floor finish. Hand rail shall also be of aesthetic appearance. At least one staircase shall lead to the roof. 25.1.7 Specially designed long and spacious RCC porch shall be given in front at the main entrance for receiving cars of VIP's. Length of the porch shall be at least 15 m. For parking facility near Service building please see the section 'parking area'. Special attention shall be given in front of service building in landscaping the area and developing garden with flowering plants and fountains etc.		
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25.1.8	For finishes reference may be made to Part F of Section D4.6 of this document.	
25.1.9	First Aid Centre requirements This shall provide for minimum two beds, a doctor's room, examination room, dispensary, waiting room, toilet block and an ambulance porch. The first aid centre shall be fully equipped to handle emergency. The floors shall be provided with vitrified tiles and walls with dado of white glazed tiles to a height of 2100 mm.	
25.2	Fire Station Fire station shall be a single storey RCC framed building with brick walls in office area. The fire station shall have provision for parking 4 fire tenders, 2 ambulance & 2 mobile environment vehicle including one bay for maintenance with pit, office for the station-in-charge, duty room, stores, recreation cum class room, record cum general room, toilet blocks etc. Parking area for tenders shall ensure fast movement of the fire tender in an emergency. In addition adequate space shall be provided for hose drying and drill ground. The arrangement shall in general satisfy requirement of the local fire brigade. The minimum area for this facility shall be 250 Sqm.	
25.3	Road Weigh Bridge / Control Rooms These shall be RCC framed structure with RCC roof and brick cladding. Adequate windows shall be provided for ventilation & lighting. Roof shall be given liquid membrane water proofing treatment. Flush welded steel doors shall be provided for personnel movement. Toilet facilities shall be provided.	
25.4	Administration Building The Administration building shall be located outside the Power plant boundary but close to main gate, so that the visitors to Administration building need not have to undergo the regular security restriction as required for visitors to power plant. Special attention shall be given to the architecture of this building. The building shall be of RCC framed structure having a plan area of about 1500 sq.m per floor with large column free area. Number of floors shall be to meet the space requirement as conceived by the BIDDER but in no case shall the number of floors less than 2 (two) (Ground floor+2). Roof slab	
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shall also be designed as a floor with clay / cement tiles laid over water proofing course. In addition to Technical, Administrative and Accounts staff the building shall provide accommodation for reception lobby, telephone exchange, air washer room, conference room, model room, archives, bank extension counter, post office, stores, records room, library, printing, Xeroxing, fax facility, pantry, auditorium and toilet facilities for both gents and ladies. Cabins for senior executives, conference room and auditorium shall have attached toilet. The building shall be centrally air conditioned. Hence clear headroom below beams shall be designed to run A/C duct above false ceiling. False ceiling Level shall be minimum 3000 mm from the floor. All air conditioned areas shall be provided with false ceiling. False ceiling at the entrance lobby and conference room shall be colour coated aluminium ceiling system and in other areas false ceiling may be of gypboard. Entrance lobby shall be aesthetically designed. Main entrance door shall be of double leaf swing glazed aluminium doors with glazed aluminium partition on the sides. Internal partition in the building shall be in general provided with a combination of pre-laminated particle board and frosted glass in anodised aluminium frame work. All doors shall be of teak veneer faced ply wood type for all cabins. In other utility areas either glazed aluminium or steel flush doors will be provided. All windows shall be glazed aluminium sliding type with ornamental aluminium grills inside for security. Specially designed RCC porch shall be provided at the main entrance with facility to park at least three big cars. For parking vehicles of staff and visitors separate parking space shall be provided near the Administration building as described in clause 15.7. Special attention shall be given in landscaping around the administration building with a combination of lawns and gardens. 25.5 Canteen 25.5.1 This shall be single storey RCC framed structure with brick cladding. Proper attention shall be paid to the architecture of this building. Spacing of columns shall such that large column free areas are available in the dining area. The dining area shall have the arrangement to seat 100 people at one time. In addition there shall be a separate executive dining area fully air conditioned and with gypboard false ceiling to accommodate about 25 executives. Adequate space shall be provided for stores, preparation, cooking, serving and washing facility. Toilet and hand wash shall be kept sufficiently away from cooking area to satisfy statutory requirements. Walls of the dining hall, cooking and serving area shall be given dado of glazed		
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ceramic tiles to a height of 2100 mm. Floors shall be of ceramic tiles in dining and serving area and terrazo tiles in preparation, cooking and working area. Adequate exhaust fans and ventilation facility shall be given in the cooking area and in dining area. Special arrangement shall be made to lead off the waste water from canteen to the effluent treatment plant. 25.5.2 Main entrance door shall be of aluminium glazed swing type with two leaves opening outside. All windows shall be glazed aluminium sliding type. Fly proof mesh shall be provided isolating cooking area from dining area. 25.6 Gate House / Time Office This shall be aesthetically designed with proper attention to its layout such that entry and exit of personnel are smooth. This shall be a single storied RCC framed building with brick walls. This building shall have adequate area to house the security staff and time office staff in addition to record room, waiting rooms, toilet facilities etc. Dimension of the building shall be approximately 15mx10m. Motor operated barrier for vehicles and electronically operated barriers for personnel shall be provided separately for entry and exit. The systems installed at gate should be capable of identifying personnel by biometric identification, keep record of personnel and vehicle entering and exiting the plant. About 100 meter x50meter area on both inside and outside of gate should be paved with interlocking CC blocks for parking , toilets, drinking water hut etc. A watch tower with bullet proof enclosure shall be provided at gate location to keep eye inside trucks and react in case of terrorist attack. 25.7 Parking Area 25.7.1 Parking area with RCC roof and plain concrete paving with ramps shall be provided near service building and administrative building. 25.7.2 Near service building parking area shall be provided for 50 cars / jeeps and about 50 two wheelers. 25.7.3 Near Admin building also similar parking facilities shall be provided. 25.7.4 In addition, immediately on the outside of the gate house covered parking facilities for about 60 two wheelers & 20 cars/jeeps shall be provided in modular steel construction with provision for expansion as required.		
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25.8	Security Barracks This shall be single storey RCC framed structure with brick cladding. Two Buildings accommodating 100 security personals of approximate size of 42mx15m each shall be provided. The Building shall have Common Bath Room and Toilet facilities, Cupboards for individual security guards Separate storage space for storage of weaponries of security guards, etc. One annexe building for mess and recreation of size 15mx24m shall also be provided.	
25.9	Watch Tower Watch towers having plan area 3m x 3m with a minimum head room 4m. The height of the tower shall be 8m from FGL to the floor level of watch tower. Watch tower shall be of steel structure with permanent colour coated sheet having partly glazed cladding to facilitate the visibility and sight. Roof shall be of permanent colour coated sandwitched insulated metal cladding system. Staircase shall be provided to approach the tower and shall be ensure that the watch tower should not have any leaking due to rain. All accessories required for the security personnel shall be provided. Spacing of watch tower shall be provided each at every 500m distance along the perimeter of the boundary line of expansion project site along with one each at the corners. And lighting facilities shall be provided.	
26.0	Service Water Overhead Tank	
26.1	This shall be of RCC construction with all necessary piping, access stairs, pump room, etc., complete.	
26.2	Potable Water Tanks This shall be standard RCC storage tanks of required capacity conforming to IS 12701 with all necessary piping connection and fittings etc., and fixed over an appropriate base / roof of buildings.	
27.0	EFFLUENT TREATMENT PLANT	
27.1	The CONTRACTOR shall furnish a comprehensive proposal of treating the plant effluent to meet the requirement of the statutory authorities. (like MoEF and RSPCB).	
27.2	All the treated effluent from D.M plant building and other treatment areas shall be discharged to a common monitoring basin. The treated effluent shall conform to the requirement of the Pollution Control Board. All sumps and pits in waste water treatment plant shall be of RCC construction with	
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proper acid / alkali liners. Electrical / control panel shall be located in an RCC building with office space for operating personnel. The ETP shall be necessarily comprised of oil separators , settling ponds, clarifiers, sludge thickeners , R.O.plant of 300cum per hour capacity for each unit etc. Storage reservoir of capacity equivalent to 15days of designed discharge from ETP shall be constructed. The water recovered shall be suitably connected to floor washing , dust suppression, gardening / development of green belt, fire water and ash water sumps etc. 28.0 Raw Water System The work shall include raw water pond, sump, pump foundation, chlorination room, stoplog and coarse screen etc. All other civil / structural work to ensure smooth functioning of the raw water system are deemed to be included in the scope. Water conductor system from Indira Gandhi main canal to raw water reservoir inside plant, de-silting chambers, intake pump house, pipe line from raw water reservoir to various systems like clarifiers, gardening, fire fighting etc. 28.1 Raw water Reservoir 28.1.1 The sizing of the reservoir shall be such so as to store water of atleast 35 lakh cum. The reservoir shall be provided with a free board as per requirements of IS: 10635, but in no case, the same shall be less than 1000 mm. The reservoir shall have two compartments with separate inlet and out let arrangement. The reservoir embankment shall be made in earthwork with side slope 1V: 2H (min) founded on natural ground with proper foundation. However stable slope shall be ensured from other consideration such as type of soil, geo technical recommendations, stability and laying of HDPE lining and precast tiles. The reservoir shall be provided with suitable pressure releasing devices. Detailed soil investigation shall be carried out at the proposed location of RW Reservoir. CONTRACTOR to check and verify the suitability of the excavated soil for the bund construction. In case the excavated material is not suitable for the bund construction the same shall be imported. Proposed Raw water reservoir is formed partly by excavation and partly by earthen Bund. The bund shall have adequate width on the top to form the road for vehicle movement. CONTRACTOR is free to select the shape of the reservoir with proper approval from the owner. Required slush removal sump, provision for deep sump shall be provided in the pumping suction to ensure the pumping head.		
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And, also a suitable spillway arrangement shall be provided to take care of any heavy storm event. Minimum top width of embankment shall be 4.0 m with provision of single lane WBM road including black topping along top of the embankment. WBM road shall be constructed in accordance with IRC: 19 (latest edition). Street light shall be provided along the Road as per standards. On the downstream slope of the embankment, turfing shall be provided with a provision of toe drain (at the bottom) all around. Internal drainage will be taken care by providing sand chimney, sand blanket and rock toe on the downstream side. Toe drain shall be of adequate capacity to be constructed in brick masonry. An approach ramp of minimum 5 M width and min 1:20 slope shall be provided for access to the top of reservoir embankment along with single lane road including black topping. The side slope of ramp embankment shall be minimum 1(V) : 2(H) and shall also be provided with turfing on side slopes. All embankments including reservoir dyke shall be compacted to achieve a max. Dry density of not less than 95% (modified Proctor) by mechanical means at optimum moisture content. The bund shall be of homogeneous type with impervious geomembrane (HDPE 500 micron thick) layer on water contact face including base. 150 mm thick sand blanket is recommended below the geomembrane as a cushion. 150mm thick clay blanket in bottom and side slopes below sand blanket is recommended. The reservoir shall be provided 50 mm thick hydraulically pressed machine made tiles only over 500 micron thick high density polyethylene (HDPE) film. Pre cast concrete tiles shall be of size 300x300x50 mm and shall be laid over 25 Thick, 1:4 cement sand mortar. Any other alternative protective layer system over HDPE film may be permitted with prior approval of the Owner. The protective layer over HDPE shall be provided over the entire bed and side slopes. The concrete tiles shall be jointed by cement sand mortar of 1:4 mix. The design of bund shall ensure that the phreatic line shall not meet downstream face of the embankment. To ensure this adequate internal drainage arrangement shall be provided as described below - Sand chimney a minimum of 500 mm thickness upto 1 m below the top of bund - Sand blanket of a minimum 500 mm thick at ground level connecting chimney to rock toe - Rock toe to a minimum height of 1000 above the outside ground level with a top width of 1 meter and side slope of 1 vertical to 1.5 horizontal. The rock toe shall extend to the full depth of bund below ground level		
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d) 150 mm thick coarse sand filter and 150 thick fine sand filter between sand blanket and rock toe

The embankment shall be safe against failure due to “piping”. The design shall ensure that the exit gradient is less than 1 in 7. The gradient shall be calculated by drawing flow net.

Material to be used for bund construction shall satisfy the following requirements, which is generally in line with stipulations of IS-1498.

Soil classifications	GC,CL,CI
Liquid limit	30% to 50%
Plasticity index	10 to 20%
Coefficient of permeability	1 x 10 ⁻⁵ cm/sec

Excavated material found suitable for construction of bund shall be stockpiled and the balance material shall be brought from borrow pit identified by Bidder and Owner appropriately.

Construction of bund shall be governed by AASHO modified Proctor Compaction test as outlined in IS: 2720. Laboratory methods shall be used to determine the suitability of construction material and the construction shall be controlled by field test.

Fill material shall be spread in layers not exceeding 225 mm in thickness and compacted to 150 mm with approved compaction equipment. Addition of water shall be by means of sprinklers. All compaction shall be done under controlled condition.

Filling shall be accurately finished to line, slope, cross section and grade as shown on the approved drawings. Finished surface shall be free of irregularities and depressions and shall be within ± 20 mm of the specified level

Frequency of sampling and testing including the methods for conducting the tests are to be submitted. The testing frequencies shall be as mentioned in field quality plan where the desirable is minimum the Engineer shall have the full authority to carry out or call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications

The specification as outlined hereunder shall be treated as bare minimum. However, CONTRACTOR shall offer a system to meet the site specific requirements and shall provide complete details. CONTRACTOR shall

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guarantee the satisfactory performance of the proposed liner system. CONTRACTOR shall also provide a warranty for the proposed liner system. The guarantee/warranty shall be provided in a manner acceptable to the Owner.

28.1.2 Requirement of HDPE material:

All resins for use in geomembrane shall conform to the following requirements. Each lot shall be sampled with following tests conforming to manufacturer's specifications.

- Density : ASTM D 1505
- Melt Index : ASTM D 1238
- Infrared (IR) Spectroscopy Analysis for Additives
- Oxidative Induction Time (OIT) : ASTM D 3895

All additives are to be tested and approved prior to use with the following testing performed and compared to the Manufacturer's requirements:

Carbon Black contents : ASTM D 1603

Oxidative Induction Time : ASTM D 3895

Manufacturer's Quality Assurance Testing shall conform to the provisions as stipulated here. Full width samples shall be taken as token from the end of each roll. The quality control testing shall meet following frequency:

Test Description	Method	Frequency
Thickness	ASTM D 1593	Every roll.
Tensile properties	ASTM D 638	Every 5000 sq.m
Tensile strength at Yield		
Tensile strength at Break		
Elongation at Yield		
Elongation at Break		
Tear Resistance	ASTM D 1004	-DO-
Puncture Resistance	FTMS 101 C 2065	-DO-
Carbon Black Content	ASTM D 1603	-DO-
Puncture Resistance	ASTM D 4833	Everyday once

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Modulus of Elasticity	ASTM D 638	-DO-
Dimensional Stability	ASTM D 1204	-DO-
Carbon Black Dispersion	ASTM D 3015	-DO-
Density	ASTM D 1505	-DO-
Melt Index	ASTM D 1238	-DO-
Oxidative Induction Time	ASTM D 3895	-DO-
Low Temperature	ASTM D 746	Everyday once
	Brittleness	
Environmental Resistance	Stress ASTM D 1693	-DO-

Welding rod samples shall be tested at the frequency of once per 25 rolls of welding rod. Following tests shall be performed on the samples

Thickness as ASTM D 751 : ASTM D 751

Density as per ASTM D 1505 : ASTM D 1505

Melt Index as per ASTM D 1238 : ASTM D 1238

Carbon Black content as per : ASTM D 1603

Results of all tests shall be furnished to the Owner for his review. Owner or his authorized representative reserves the right to inspect the testing facilities and witness the test as and when required.

28.1.3 Installation and Laying of lining system.

The installation and laying of the Geo Membrane shall be as per the Manufacturer's specification and under the supervision of Manufacturer's representative.

Sub grade shall be rolled and compacted and made flat and smooth. The top layer of reservoir basin sub grade shall be compacted to at least 95% of proctor density by vibro compaction equipment and /or by any other suitable equipment. The compaction shall be achieved at least a depth of 300mm from the final sub grade level. Any weak and soft spot, if present shall be removed and replaced with compacted fill. The entire sub grade surface where lining shall be placed shall be smooth, free of all foreign and organic

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matter, sharp objects, standing water or excess moisture shall not be allowed. Sub grade shall be sterilized using effective sterilant/chemicals. CONTRACTOR shall investigate regarding the nature of vegetation growth likely under the inundation conditions and use specifically formulated sterilant to prevent vegetation growth underneath the geomembrane. The sterilant shall not be detriment to the liner system and shall be applied in accordance with the manufacture's recommendations. For the purpose of anchoring the geomembrane, anchor trench shall be excavated to the line, grade and width as shown in the drawings. Rounded corners shall be provided in the trench to avoid sharp bends in the geomembranes. Geomembrane shall not be laid when ambient temperature is above 42deg.C, placement of geomembrane shall not be carried during rains or in presence of excessive moisture such as fog, dew, etc. In presence of high winds also laying of geomembrane shall not be taken up. On embankment slopes and other slopes, in general seams shall be oriented in the general direction of maximum slope. In other words, the seams shall orient down and not across the slope. In corners and other geometric forms. All geomembrane panels shall have a finished overlap of 100 mm (Minimum) in case of hot shoe welding and 75mm (minimum) for extrusion welding unless approved by the engineer, cleaning solvents shall not be used. CONTRACTOR shall provide all equipments as approved by the owner. The equipment shall consist of, but not limited to, hot shoe welder, extrusion welder, high speed side grinder, generator, necessary power grid, vacuum Box test Equipment for non destructive seam testing, air pressure test equipment for non destructive seam testing. Field densitometer for performing shear and peal tests. All field seams are over the full length shall be tested non- destructively. The Non- destructive test shall be conducted either by vacuum Box Testing method and/ or Air pressure testing method. CONTRACTOR shall thoroughly inspect all seams and non- seams areas of the geomembrane for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Surface of the geomembrane shall be cleaned at the time of inspection by CONTRACTOR. Each suspect location in seam and no- seam areas shall be further non-destructively tested in presence of Engineer, if so desired. Each location that fails the non destructive testing shall be marked and repaired by CONTRACTOR		
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28.1.4 Bituminous Road Road construction shall be for Class-A loading of IRC standards. However the minimum requirement for the roads shall be; 150 mm thick (consolidated thickness), sub-base course laid in two layers of 75 mm each & 100 mm thick (consolidated thickness) Water bound macadam base course laid in two layers of 75 mm each and topped with 50 mm thick bituminous macadam and 25 mm thick semi-dense bituminous carpet. The road shall be slopped opposite side of the reservoir to avoid stagnation of water. Guard stone shall be placed along both sides of the road and painted as per IRC to identify the width of road even at night times. 600mm high toe wall and one meter high barbed wire fencing above it shall be provided all along the periphery of reservoirs. The common bund between two compartments shall be provided with 300mm high toe wall and one meter high G.I. pipe railing. The top of common bund shall be paved with concrete precast tiles as used on side slopes laid over 75mm thick PCC. 28.1.5 Turfing With Sods This work shall consist of the furnishing and laying of live sod of perennial turf forming grass on downstream slope. The work shall be taken immediately after bund construction, provided the season is favourable for the growth of sod. Thickness of the sod shall be as uniform as possible, with 5 - 8 cm of soil covering the grass roots depending on the nature of the sod, so that practically all the dense root system of the grasses is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width, not less than about 25cm x 30cm in size but not so large that it is inconvenient to handle and transport these without damage. The finished slope of the bund shall be provided with 150 mm thick layer of surface dressing of good topsoil to ensure proper growth of the turfing proposed The bund downstream side slopes should be protected with turfing. 28.1.6 Drainage Arrangement Proper drainage arrangement shall be provided to ensure that quick and easy drainage system for entire earthen bund. Roadside drains, Catch drains along the slope and toe drains shall be properly planned. 28.2 The sump shall be of RC construction and shall be designed as a water retaining structure. The pump house sump shall be designed in such a way		
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that both compartments of reservoir can be used independently. Each pump sump shall be provided with stainless steel groove for inserting coarse screen and stoplog. The number of coarse screen shall be the same as the number of pump sumps. The number of stoplog shall be minimum of two. The sump roof shall have openings for lowering and lifting of stop logs and screens. These openings shall be covered with galvanised mild steel gratings when the screens are placed in position. Sufficient paved space shall be provided to keep the stoplog when not in use and also for maintenance of screens. Galvanised MS pipe handrails shall be provided for the sump roof. Each individual pump sump shall also be provided with a drain sump to empty the sump for attending to maintenance of pump. Pump House, MCC and Chlorination shall be of similar in nature to that of condenser cooling water system. 29.0 BOUNDARY WALL 29.1 Boundary wall of RCC frame structure with brick cladding having height 2.75m above ground level shall be constructed all around RVUN property of proposed units. RCC post shall be provided at every 3m interval with RCC coping of 150mm thick in 1:2:4 at the top. Expansion joint shall be provided at every 30m interval and at change in direction to account for thermal expansion / contraction. . RCC plinth beam and tie beam at top shall be provided. Below the plinth beam 460mm depth brick masonry shall be provided in CM 1:6 and tie beam if required along the height to be provided from structural stability consideration. The brick cladding shall be constructed in CM 1:6 and the brick cladding shall be plastered in CM 1:4 with 20mm thick with cement wash finish. Weep holes are to be provided wherever required Boundary wall shall provided with anti climbing devices having eight row galvanized Razor blade stapled high tensile barbed wire drawn through slots provided in V-shaped 600mm high upstanding 50x50x6 angle hot dipped galvanized (680gms/ m2) having V shaped goose necks and 4 set diagonal strands weaved through horizontal strands between the angle post in the planes goose neck . Boundary wall shall be designed for DL, WL, SL and suitable foundations shall be provided. 30.0 PT PLANT RC clarifier shall be provided. The number of clarifiers, quantity of water to be treated, conveying the clarified water to the clarified water storage tank, the make up water line and other requirements and structures shall be as		
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indicated in the Mechanical Section of the document. The structure shall be designed as a water retaining structure with a limited crack width 0.1mm. 31.0 HORTICULTURE AND LANDSCAPING WORKS BIDDER shall hire professionally qualified landscaping agencies to develop the landscaping and horticulture in the plant area. Special attention shall be given to development in front of Service building and administrative building. Around the cooling towers and coal stockyard area fast growing tall trees shall be planted to reduce drift and dust, nuisance respectively. BIDDER shall include along with bid his broad proposal for horticulture and landscaping works. 31.1 Plantation Work The scope includes the digging of pits, supply of good earth, manure, pesticides, plants, tree, shrubs, climbers, pots & plantation of trees, plants, shrubs, climbers in pits, pot with manure mix good earth, watering twice a week, maintenance & unkeeping for a minimum period of 12 months from the commissioning of second unit. The area for plantation shall be as approved by the OWNER. Plants such as Neem, Rohida, Pipal, Saresh, Shisham, Pangula, Jal, Bougainvillea or other plants shall be provided with prior approval of OWNER. All plantations shall be in grid and shall be provided with drip irrigation system. 31.2 Plantation of small flower/decorative plant & development of Grass/Hedging & its maintenance. The area shall be as approved by OWNER. The scope includes leveling & grading of area & supply of good earth, manure, pesticides, plants, hedge, lawn pots of approved quality pots of approved type & size, spreading & adding of manure, pesticides, preparation of pits, beds planting small plants, hedge & lawn daily watering & complete maintenance & unkeeping for a minimum period of 12 months from the commissioning of second unit. Area under this shall be as approved by OWNER. Rose, desi crotons, selective varieties of crotons, rubber plants, daffen bachia, Arecca Palm, Song of India, Aglonima, Drassina, Singonium with Moss stick or other plant as approved by owner shall be provided The scope includes complete with cost of watch & ward, all labour, material, consumables, all transportation, hire charges, T&P/ equipment, all taxes, duties, all insurance charges & anything specifically not mentioned here, but required for proper growth of plants as per direction of OWNER. Particulars of items & quantities included in the scope of work as under:		
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31.3 Specification The horticulture work shall be carried out as per standard practice of farming and as laid down in IS codes. The outline specification for various items are given in hereunder: Pits: In general the pit for plants shall be made of size 60cm dia & 60cm deep. The pits shall be filled with good earth mixed with manure in a 2:1 ratio. Beds: The beds shall be of size as required to plant, the small plants/hedging in about 15cm height. The beds shall be excavated upto a depth of 60cm deep and shall be filled with good earth, top 15cm earth shall be mixed with manure in 8:1 ratio & at regular interval manure shall be spread as per requirement for proper growth of plant/hedge and as per approval of OWNER. Manure: In general the manure shall be dry farm yard manure or as approved by OWNER and as per requirement of plant for proper growth. Plants: In general the plants shall be Neem, Rohida, Pipal, Sares, Shisham, Pangula, bougainvillea etc. of Ht. about 90cm and shall be planted in specified area/pits. All the plant shall be watered minimum twice a week or as required for proper growth of plant. All the plant shall well maintained & unkeeping by removal of unwanted shrubs and maintaining the pits upto depth of 15cm for proper watering arrangement. Lawns: In general the lawn/grass shall be of good quality soft initially lawns shall be plough at distance of 7.5cm and proper maintained and unkeeping to spread over in complete area. The lawn shall be daily watered & required to be dressed and cut by lawn mover at regular intervals. In lawn area, unwanted shrubs shall be removal regularly. Hedge: The hedge shall be made out from approved plant. Hedge shall be maintained and unkept to form a uniform line and should be cut to shape as approved by the Officer Incharge. The hedge plant should be well watered and shall be maintained upto a height of 100cm. Flower/decorative Plant: In general the plant shall be rose, desi crotons, selective varieties of crotons, rubber plants, daffodils, areca palm, song of India, aglonima, drassina, singonium with Moss stick or other plant as approved shall be planted in pits/pots as approved by OWNER. All the plant shall be watering minimum twice a week or as required for proper growth of plant. All the plant shall well maintained and unkeeping by removal of unwanted shrubs and		
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maintaining the pits upto depth of 15cm for proper watering arrangement in pits. 32.0 HYDROGEN GENERATION PLANT This shall be a single story RCC frame structure with brick cladding. The facilities housed in this building are rectifiers, electrolysis plant, air compressors, control room, gas bottling manifolds, gas cylinder storage area, toilets, etc. Roof shall be of RCC with no beam projection inside the room to prevent accumulation of gas. All doors and windows shall be of shatterproof glass. All doors in the hazardous areas shall be swing types opening outwards. Hydrogen cylinder storage area shall be well ventilated without any glass windows. Acid/alkali resistant brick flooring shall be provided in areas where acid / alkali spillage is anticipated. Building shall have separate boundary wall with Gate approach road etc. 33.0 SEWAGE TREATMENT PLANT A tertiary sewage treatment plant is to be constructed by EPC contractor and shall be designed in accordance with relevant BIS/CPHEEO standards and state government pollution board norms. The sewage treatment plant shall be sized to cater the total sewage from power plant. The tertiary treated water is proposed to be utilised for gardening and other miscellaneous use. In addition to the sewage treatment, the scope shall also include collection of sewage from power plant area including the supply and construction of sewers. The process for sewage treatment and collection of sewage including sewer design has to be approved by the Owner. 34.0 RAIN WATER HARVESTING 34.1 Need for Rain water Harvesting 34.1.1 Rainwater harvesting at power plant site shall be carried out in view of the following: a) Conserving rainwater and thus reducing the overall water consumption for plant requirements; and b) Possibility of integrating the storm water drainage scheme of the power plant with rain water conservation. 34.1.2 The convenient and economical way of achieving the same is by adopting roof water harvesting methodologies.		
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34.1.3 Rain water harvesting supplements in meeting various non-potable purposes of water usage in the power plant like a) Water for gardening purposes; b) Water for sprinklers that are used on coal; and c) For use in flushing of toilets. 34.1.4 The above components of non-potable use for which water is otherwise to be supplied from raw water reservoir could therefore be saved. 34.2 Components of the Rain Water Harvesting Scheme 34.2.1 Figure-1 presents the schematic of rainwater harvesting scheme to enrich the groundwater resources (before the construction of super structures). Figure-2 presents the schematic of rainwater harvesting scheme intended for roof water harvesting scheme (after the construction of super structures in the power plant). In either case, following will be the components of the rainwater harvesting schemes. 34.2.2 Rainwater harvesting carried out for enriching the groundwater resources essentially consists of a) recharging pits; b) common underground sump; and c) pipeline(s) connecting each of the recharge pits. 34.2.3 Following are the main components proposed for the roof water harvesting system at the thermal power plant including their location in the project area: a) Rainwater pipes from the roofs of all the Station Buildings of Units; b) Storm water drains adjoining the roads of Cooling Towers, ESP / Boiler areas of the plant; c) Rain water collection RCC tank (underground); and d) Pipelines from the rainwater collection tank to the overhead tank and from the tank to various utilities. 34.2.4 The exact location of these components including details of components like pumping main and synthetic tanks could be finalised after identifying the exact location of the storm water out fall that shall be integrated with the rainwater collection tank. 34.3 Integration with Storm Water Drains 34.3.1 The roof water of the Station Building, Staff quarters, etc. shall be collected in the proposed rainwater collection tank. All storm water drains of the main plant area shall be connected to the rainwater collection tank.		
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34.3.2 Storm water from drains and rainwater collected in the rainwater tank is to be utilised for further use. This is achieved by installing a suitable pump at one end of the tank. This shall pump the collected water to the synthetic PVC tank installed on the roof of superstructures like Station Building, etc. The size of the synthetic tank shall be suitably sized based on the rainfall intensity and the runoff there-of. Additional tanks could be installed as and when the underground tanks are added. GI pipe is proposed for pumping water from the rainwater collection tank to the tanks on top of the buildings 34.3.3 Collected water from the synthetic tank is distributed by gravity through GI pipes of 100 mm diameter to desired locations for non-potable use as explained earlier. 34.3.4 Furthermore, most of the junctions (similar to manholes of closed conduit system drains), namely chambers can be made deep enough to allow water to collect and enrich the groundwater source in the storm water drainage network of the main power plant. The dimensions of such chambers including its depth shall be decided at the time of detailed design. NOTE: “As all the required systems, structures and buildings are not elaborated in Section D 4.5; Section D 4.2 Scope of work is to be read together with Section D 4.5 Specific Building/Structure requirement” “If there is a difference in General Technical Specifications, Scope of work and Specific Building/Structure requirement shall prevail”		
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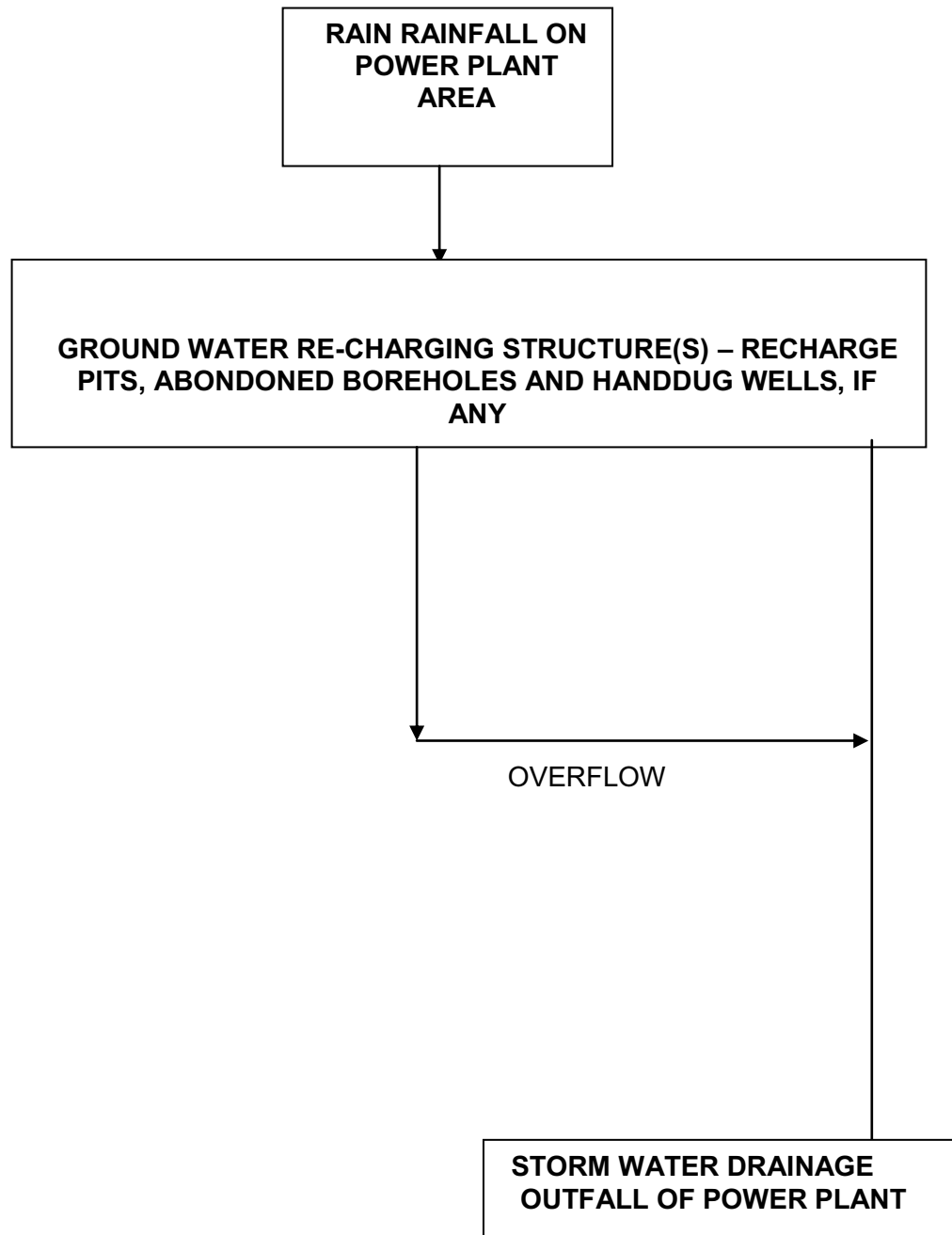


Fig 1 : Flow Diagram for Proposed Rain Water Harvesting Scheme (Before Construction of Power Plant Superstructures)

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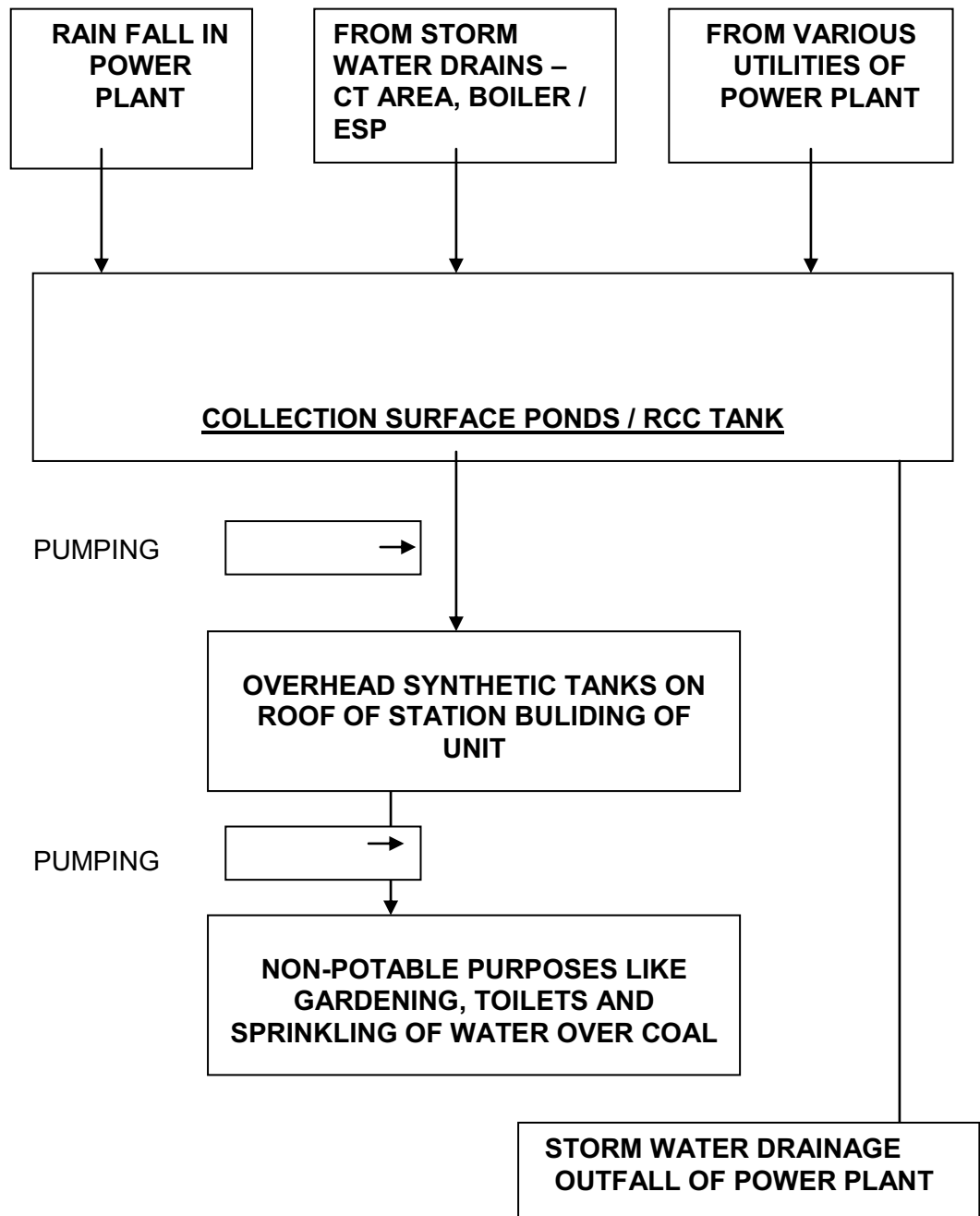


Fig 2 : Flow Diagram for Proposed Roof Water Harvesting scheme (After Construction of Power Plant Superstructures)

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SECTION – D4.6
TECHNICAL SPECIFICATIONS

PART A

GENERAL REQUIREMENTS

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1.0 GENERAL REQUIREMENTS 1.1 Design and construction of buildings, structure etc., shall take into account requirement for operation and maintenance of all equipment and its users. The buildings will have good architectural features. The surrounding area shall be properly micro levelled and graded. 1.2 Architectural concepts for Building The architectural design concept of buildings structure 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 CONTRACTOR shall employ a qualified architect / architectural firm to carry out all designs and hold all other architectural responsibilities for the project. 1.3 The CONTRACTOR shall obtain and be conversant with an all laws, by-laws, regulations of local and Statutory Bodies as applicable to the project. The architectural concept evolved should also take care of these requirements. The CONTRACTOR shall provide the drawings and documents for such statutory approvals. 2.0 ROOF ACCESS All roofs shall be provided with access thorough a staircase cage ladder. Minimum 1000 mm wide access path shall be provided with cement tiles to approach equipment on roof. 3.0 PLATFORMS AND WALKWAYS 3.1 Platforms shall be provided to all major equipment, not directly accessible from the floors, for maintenance. Platforms and connecting walkways shall have a minimum width of 750 mm. However, in case of space restriction, the minimum allowable clear width shall be 600 mm. Platforms in front of the entry shall be at least 900 mm wide. Platforms located close to each other shall be connected with walkways. 3.2 All steel platforms above grade level shall be constructed with kick plates at edge of the platform to prevent tools or materials from falling off. It shall consist of 8 mm thick steel plate projecting 100 mm above the		
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platform surface. Kick plate shall be painted with the same type of coating as the material to which it is attached. 3.3 Continuous walkway at least 500 mm wide shall be provided along the crane girder level with hand rails, on both side of the building. Approach to EOT crane shall be ensured by Cage ladder or staircase. 4.0 STAIRS & LADDERS 4.1 Steel stairs All steel staircases shall normally have minimum clear width (back to back of stringer) of 1000 mm and minimum inclination with horizontal of 35.75°. However, in case of space restriction, minimum clear width upto 750 mm and slope upto 45° may be provided. The vertical height between successive landings shall not exceed 3 m. Channels (min MC 200) shall be provided as stair stringers. Treads shall be minimum 250 mm wide of grating covers (Chequered plates wherever specifically required), and spaced equally so as to restrict the rise to maximum 180 mm (200 mm in exceptional cases). 4.2 Steel Ladders Ladders shall be provided to platforms, walkways, instruments and equipments which do not require frequent access. Ladders shall preferably be vertical and its angle with vertical shall not exceed 5°. Ladders shall be of minimum 450 mm clear width with 20 mm dia. MS rungs spaced at 300 mm (maximum). Ladders shall be provided with a safety cage of minimum 750 mm dia. clear when the top of ladder is more than 4.5 m above the landing level. However, safety cages shall start at 2.5 m above the lower landing level. 4.3 RCC stairs All stairs shall have maximum riser of 180 mm and a minimum tread of 250 mm. However, for public buildings riser shall be limited to 150 mm and tread width of 300 mm. Minimum width of stairs shall be 1500 mm generally. All stairs normally shall have not more than 15 risers in one flight. MS angle nosing with minimum 50 x 25 x 3 angle shall be provided for edge protection of RCC stairs. 5.0 HANDRAILS 5.1 Handrails shall be provided at appropriate places to ensure safety e.g. around all floors / roof openings, projections / balconies, walkways, platforms, steel stairs etc.		
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5.2 All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per IS: 1161 galvanised using 750 gm/sq. m of zinc. Hand railing shall be a two-rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm centre to centre of posts. Hand railing shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. 5.3 For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminium / Teakwood handrail shall be provided, unless specifically mentioned otherwise. 6.0 EDGE PROTECTION Wherever possible around floor openings an RCC kerb of 150 mm wide 150 mm high shall be provided. All concrete edges, where breakage of concrete corner is expected shall be provided with angles of minimum size L 50x50x6 with lugs for edge protection e.g. allround the cut-outs / openings in floor slab, edges of drains supporting grating covers, edges of RCC cable / pipe trenches supporting covers, edges of manholes supporting covers and supporting edges of precast covers etc. 7.0 ANCHOR BOLTS AND INSERT PLATES 7.1 Anchor bolts shall be designed for working stress, in tension and shear, for embedded length of the anchor bolts and pipe sleeves. Shear and crushing strength of concrete shall also be checked. Increase in allowable stress for loading including seismic and wind loads shall not be permitted in design of anchor bolts. 7.2 Insert plates shall be designed / checked for shear and bending moment. All lugs shall be checked for tension. Bond strength of concrete shall be checked. Lugs using steel bars shall preferably be fillet welded to the plate to transfer full strength of the lug. The bottom 50 mm of all insert plates shall be grouted with free flow grout.		
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8.0 VERTICAL HEADROOM 8.1 All accessible areas shall be provided with minimum clear headroom as follows, unless otherwise specified. Finished floors to ceiling (buildings) : 3000 mm Doors, Walkways, Platforms, Stairs etc : 2100 mm False ceiling of office areas except for - - Service building : 3000 mm Walkway above false ceiling : 1000 mm Safety cage for ladders : 2500 mm Access for fork lift trucks : 3000 mm Main roads / & crane access : 7000 mm Railway crossings : 8000mm Other plant roads and truck access : 6000 mm Cable & Pipe rack : 3000 mm except at road / Rail crossings. 9.0 EXPANSION /CONSTRUCTION JOINTS 9.1 Expansion and construction joints shall be provided wherever required. All expansion and construction joints of water retaining structures in RCC shall be made water tight using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops may be used for the base slabs and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 6 mm and minimum width 225 mm. At other joints these shall be 150 mm wide. 9.2 Two part poly sulphide sealant conforming to IS: 12118 shall be used for sealing of joints in contact with water. For other cases, bitumen sealing compound conforming to IS: 1834 can be used. Preformed bitumen impregnated fibre board conforming to IS: 1838 shall be used as joint filler. 10.0 BRICK MASONRY AND PARAPET WALL 10.1 All masonry works shall be designed in accordance with IS: 1905, IS: 2212, IS: 4326 and other relevant IS codes as applicable. Structural design of load bearing and non-load bearing walls constructed with solid or perforated burnt clay bricks or concrete blocks shall be in accordance		
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with criteria specified by Section 4 of National Building Code of India Part VI. Normally Fly ash bricks only shall be used for all ordinary brick work. In case for any specific work these bricks are not technically suitable then Contractor shall seek written Approval from the owner to use other than fly ash bricks. 10.2 All walls shall be non load bearing in filled panels walls. External walls of all buildings shall be at least one brick thick. All internal wall shall be at least one brick thick except for internal partition walls for office area, canteen, change rooms, first aid rooms and toilets which may be half brick thick. RCC bands shall be provided wherever necessary. 10.3 50 mm thick DPC (1:1.5:3) with water proofing admixture shall be provided at plinth level before starting masonry work. 10.4 Minimum 75 kg/ sqcm compressive strength brick shall be used for non load bearing super structure brick work. Cement sand mortar 1:6 for one brick thick wall and 1:4 for half brick thick wall shall be used. For half brick walls, RCC transomes and mullions shall be provided. 10.5 Type, thickness and height of external walling, facing the transformer yard to take care of fire accidents in transformer yard shall be according to the requirements of Tariff Advisory Committee (TAC) of IRDA India. 10.6 Even where metal cladding is specified, for initial 3 m height from the ground level, minimum one brick thick masonry wall shall be provided. 10.7 All upstands and parapet walls on roof shall be of RCC constructions, minimum height of parapet walls shall be 750 mm and thickness 125 mm. 11.0 DRAINAGE 11.1 Floor drainage 11.1.1 For all buildings and areas, suitable arrangement for draining out water collected from equipment blow downs, leakage, floor washing, fire fighting, etc., shall be provided on each floor. Gully traps, inspection pits, collecting pits etc., shall be located suitably and designed considering flow volume, easy access, maintenance and safety. 11.1.2 All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, pre cast RCC covers shall be provided in place of steel grating. These drains shall lead the water to drain sump. 11.1.3 Garland drains shall be provided around all buildings to receive the drainage water from roof and floor and lead them to the plant storm water drainage system.		
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11.2 Roof drainage & Rain water harvesting 11.2.1 Roof drainage system shall be provided for quick and efficient draining of rain water from roof to avoid seepage and damage to roof. The runoff gradient for the roof shall not be less than 1 in 100 .Any specific requirements are described in the respective building requirements. Roof drainage system shall consist of roof drain heads, rain water down comers and fixtures. System shall be designed to handle design rain fall for the specific site and shall be in accordance to stipulations of IS: 1742 and IS: 2527. Roof drains shall conduct water to storm drains though down comers. All the storm water from the various roofs shall be lead to a rain water collection tank suitably located in the battery limits from where the rain water will be transferred to the main system by others. 11.2.2 Rain water down comers shall be of MS Pipe conforming to IS: 1239 & IS: 3589 of pressure rating PN6 unless MS pipes are specifically called for some locations. 11.3 Sumps In case of underground structures, sumps with pumping arrangement shall be provided at suitable location to collect and pump out any incidental water collection to nearest storm water drain. 12.0 WATER PROOFING OF UNDERGROUND STRUCTURES 12.1 All underground and water retaining RCC structures, storage tanks, etc. shall be made water proof by injection grouting in addition to mixing water proofing admixtures in concrete. The injection grouting be done on walls, roofs, base slabs by providing threaded nozzles at intervals not exceeding 1.5M both ways on inner surface during casting. Injection of cement water together with a suitable water proof expanding grouting admixture of approved quality shall be done through the nozzles after construction in wall & slabs. The injection shall be done under pressure of approximately 2 to 4 Kg/Sq.Cm. The nozzles shall be sealed off with suitable admixture after injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor. 12.2 The external surface of underground & water retaining structure shall be treated with Bituminous or tar coating. The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375 Deg.F) using not less than 2 Kg. per Sq.M or with hot asphalt i.e.,		
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bitumen according to IS:73 (not heated above 400 Deg.F) using not less than 1.5Kg per Sq.M. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25Kg. per Sq.M in case of coal tar and 1 Kg. per Sq.M in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. In place of hot application by coal tar /asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion/ rubber protective coating of approved manufacturer. 13.0 ANTI TERMITE TREATMENT Pre-constructional anti termite treatment shall be given to all vulnerable areas susceptible to termite attack and shall include column pits, wall trenches, foundations filling bellow the floors etc., as per IS:6313 and other relevant Indian Standards. 14.0 PLINTH LEVEL 14.1 Finished ground floor level (plinth level) of all buildings and pump houses shall be minimum 500 mm above the formation level / grade level. 14.2 All cable vaults shall be located above ground level i.e., vaults shall not be provided as basements in the buildings. 14.3 Finished floor levels of Boiler area / transformer area yard paving shall be kept 150 mm lower than the finished floor level of turbine building. 15.0 STATUTORY REQUIREMENTS 15.1 All the applicable statutory rules pertaining to Indian Factories act, Factory rules of State Government, Fire safety rules of Tariff Advisory committee, Water act of Pollution Control boards, Explosives act etc., and stipulations of other relevant statutory authorities shall be taken into consideration at the time of design and construction. 15.2 Provisions of safety, health and welfare according to Factories act shall be complied with at design stage. These shall include provision of continuous walkway (minimum 500 mm wide) along crane-girder at crane girder level on both sides of the building, comfortable approach to EOT		
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crane cabin, railings, fire escape locker room for workmen, pantry, toilets, rest rooms etc. 15.3 Adequate no. of fire escapes shall be provided in a building. Fire proof doors, no. of staircase, fire separation walls, lath plastering on structural steel member (in fire prone areas) shall be made according to the recommendation of TAC. For fire safety requirements of buildings IS: 1641 and IS: 1642 shall be followed in addition to TAC requirements. All masonry fire walls shall be minimum 345 thick and RCC fire wall shall be minimum 200 mm thick. Each building shall be provided with two regular stair cases. 15.4 Short term permit from mining department and compliance to PF rules shall be the responsibility of the Contractor.		
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PART B

LOAD & LOAD COMBINATIONS

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SPECIFIC TECHNICAL REQUIREMENTS PART B – LOADS AND LOAD COMBINATIONS 1.0 GENERAL All structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, steam piping (static & dynamic) and other piping loads, wind loads, seismic loads, temperature loads, loads and forces developed due to differential settlement and any other loading conditions which can occur during the design life of the facility. 2.0 DEAD LOADS 2.1 Dead loads consist of the weights of the structure complete with finishes, fixtures, partitions, wall panels and all equipment of semi-permanent nature including tanks, silos, bins, partitions, roofing, piping, cable trays, bus ducts etc. The content of tanks, silo, bins and hoppers etc., shall be measured at full capacity for this purpose. 2.2 The piping loads, cable tray loads and the contents of the tank, silos, bins and hoppers shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilising load for uplift. 2.3 The following unit weight of material shall be considered for computation of loads. Loads given in IS: 875 (part-I) shall be made use of for material not listed below. <table border="0"> <thead> <tr> <th>Materials</th> <th>:</th> <th>Unit weight</th> </tr> </thead> <tbody> <tr> <td>Plan cement concrete</td> <td>:</td> <td>2.40 t/cum</td> </tr> <tr> <td>Reinforced cement concrete</td> <td>:</td> <td>2.50 t/cum</td> </tr> <tr> <td>Structural steel</td> <td>:</td> <td>7.85 t/cum</td> </tr> <tr> <td>Brick work</td> <td>:</td> <td>1.9 t/cum</td> </tr> <tr> <td>Cement plaster</td> <td>:</td> <td>2.1 t/cum</td> </tr> <tr> <td>Floor Finish</td> <td>:</td> <td>2.4 t/cum</td> </tr> <tr> <td>Coal</td> <td>:</td> <td>1.20 t/cum</td> </tr> <tr> <td>Fly Ash</td> <td>:</td> <td>1.60 t/cum</td> </tr> <tr> <td>Bottom Ash</td> <td>:</td> <td>1.60 t/cum</td> </tr> </tbody> </table>			Materials	:	Unit weight	Plan cement concrete	:	2.40 t/cum	Reinforced cement concrete	:	2.50 t/cum	Structural steel	:	7.85 t/cum	Brick work	:	1.9 t/cum	Cement plaster	:	2.1 t/cum	Floor Finish	:	2.4 t/cum	Coal	:	1.20 t/cum	Fly Ash	:	1.60 t/cum	Bottom Ash	:	1.60 t/cum
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3.0 IMPOSED LOADS 3.1 Imposed loads in different areas shall include live loads, dust loads, minor equipment loads, cable trays, small pipe racks / hanger, erection loads, operation / maintenance loads, etc. The loads considered shall not be less than that specified in IS:875 (part II). The loads listed here under are the minimum loads for the areas involved. Special use areas shall be investigated and loads revised upward as necessary. Floors and supporting members which may be subjected to heavy equipment live loads shall be designed on the basis of the weight of equipment or specifically defined live loads, whichever is greater. 3.2 The specific minimum floor live loads are listed below: 3.2.1 Roofs: (a) Flat Roof : 1.5 kN/sqm for roofs : 5.0 kN/sqm for accessible roofs with HVAC Equipment etc. (b) Sloped Roof : As per IS: 875 3.2.2 Turbine Building (a) Ground floor : General area 25 kN/sqm : Heavy eqpt. Storage area 50 kN/sqm (b) Operating Floor : Rotor removal Area 50 kN/sqm : Eqpt. Laydown Area 50 kN/sqm : Other areas (Corridors etc.) 15 kN/sqm : Rotor removal area beams shall also be checked for $\frac{1}{2}$ the rotor load at the center of the beam (c) Heater bay floor : 10 kN/sqm (d) Deaerator floor : 10 kN/sqm		
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(e) Precast concrete : 12 kN/sqm covers (f) Mezzanine floors : 10 kN/sqm (g) Platform around : 10 kN/sq, deaerator (h) Floor around feed : 20 kN/sqm water tank 3.2.3 Boiler / Bunker area (a) Floor at (+/-) 0.00 : 15 kN/sqm (under operation) or actual loads specified by Boiler manufacturer (b) Feeder / Tripper : 20kN/sqm. Beams however shall be checked for feeder / tripper load. 3.2.4 Main control room/electrical building: (a) Control Room Floor : 10 kN/sqm (b) MCC Room : 15 kN/sqm (c) Cable vault floor : 5 kN/sqm (d) Battery Rooms : 10 kN/sqm (e) AHU,AC & ventilation plant : 10 kN/sqm floors (f) Switchgear room : 15 kN/sqm (g) PLCC, relay room : 15 kN/sqm 3.2.5 Pump house (a) Operating floor slab : 15 kN/sqm or as required by equipment supplier whichever higher. 3.2.6 Workshop : 10 kN/sqm		
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3.2.7 Other Areas: (a) RCC floors : 5 kN/sqm for offices, laboratories, conference rooms and general floors. (b) Stairs and balconies : 5 kN/sqm (c) Chequered plate/ gratings : 5 kN/sqm (d) Walkways : 3 kN/sqm (e) Toilet rooms : 1 kN/sqm 3.3 Railway supporting bridges such as bridges, culverts etc., shall be designed as per Railway bridge rules. 3.4 Culverts and allied structures including RCC pipes shall be designed for Class “AA” loading and checked for Class“A” loading as per IRC standards for two lane road and above. 3.5 Covers for trenches & channels which are not exposed to vehicular traffic shall be designed for Live load of adjoining area or 2 t/sqm whichever is higher. Where channels are likely to be exposed to vehicular traffic, the requirements of Code of practice for road bridges shall be adhered to. 3.6 Piping anchor and restraint forces of major piping shall be obtained from piping analysis results and be considered as live load in the structure design. 3.7 Ponding effects due to framing deflections for roofs, if any shall be considered. 3.8 In addition to the live loads, a minimum of 0.50 kN/sq. m shall be considered as Hung loads for electrical, ventilation & air conditioning. A load of 1.0 kN/sq. m shall be considered as Hung loads for piping unless otherwise mentioned. 3.9 Live loads reduction shall be in accordance with the provisions of IS: 875 & IS: 1893 in case of seismic analysis. 3.10 All structures which is situated in the vicinity of Railway lines, the design has to conform to the Indian Railway standard Specification.		
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4.0 EARTH PRESSURE LOADS 4.1 Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable). However, for design of substructure of pump house, cold water basin of cooling water and underground liquid storage tanks earth pressure at rest shall be considered. 4.2 In addition to earth pressure and ground water pressure, etc., a minimum surcharge load of 2.0 t/sqm shall also be considered for the design of all underground structures including channels, sumps, cable & pipe trenches, etc., to take into account the vehicular traffic in the vicinity of the structure. Ground water pressure shall be arrived at considering water table at finished grade level. 5.0 WIND LOAD 5.1 Wind load on structures shall be calculated as per provisions of IS: 875 (part 3). The wind shall be assumed to blow in any direction and most unfavourable condition shall be considered for design. 5.2 Basic Wind speed 47 m/sec & Category of terrain- Category 2 all other parameters as per IS: 875 (Part 3) 5.3 In design of structures, wind force on equipments supported on frame including all fixtures, piping, staircase, ladders, etc., shall also be considered. 6.0 SEISMIC LOADS 6.1 Seismic analysis shall be carried out as per the latest edition of IS: 1893 (Part 1 & 4). Zone –II shall be considered for design 6.2 The Structures shall be classified into four categories as per Table 5 of IS: 1893 (Part 4) 6.3 Importance factor for each structure shall be as per Table 2 of IS: 1893 (Part 4). 6.4 Method of analysis for each structure shall be decided as per clause 10.3 IS: 1893 (Part 4), which depends on the seismic zone & category of the structure. 6.5 Response Reduction factor shall be as per Table 3 of IS: 1893 (Part 4).		
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7.0 TEMPERATURE LOAD 7.1 Expansion and contraction due to changes of temperatures of materials of a structure shall be considered and adequate provisions shall be made for the effects produced (as per provision in relevant IS codes). Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively. 7.2 Analysis shall be carried out for ambient temperature variation. The temperature variation shall be considered as 2/3 of average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stresses due to 50% of the temperature variation. 7.3 Coefficient of thermal expansion of steel shall be taken as per IS: 800. Coefficient for thermal expansion for concrete shall be taken as per IS: 456. 8.0 EQUIPMENT LOADS 8.1 Static and dynamic loads of major equipments such as deaerator, heaters, etc., shall be based on the manufacturer's data of the specified equipments and shall be considered in design in addition to the live load. However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load shall not be considered. Eg: switchgear and control room floors are usually designed for a live load that includes the equipment weight. 8.2 All equipment, tanks and piping design loading shall include hydraulic testing loading. Weight of equipments, ducts, tanks, pipes, conduits, etc., supported by structure shall include maximum possible loading conditions i.e. flooded conditions and associated impacts, test loading, anchorages and constraint effects. 8.3 Air and gas duct loads shall include weight of insulation, duct attachments, dust accumulation loads, seismic, wind and other loads applicable.		
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9.0	CRANE, MONORAIL & ELEVATOR LOADS	
9.1	Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as per crane vender’s data. All lifting beams and monorails shall have their design loads increased for impact factor as mentioned hereinafter.	
9.2	Impact Factor Loads for cranes, hoists and elevators shall be taken as per IS: 875. The minimum impact factor to be used in design shall be as follows:	
9.2.1	Crane loads: a) For vertical force, an impact factor of 25% of the maximum crane wheel load b) A lateral crane surge of 10% of the weight of the trolley plus lifted load applied at the top of each rail divided in proportion to the relative lateral stiffness of the rail support system c) A horizontal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail in longitudinal direction.	
9.2.2	Monorail loads a) Impact factor of 10% of lifted load of hoist for monorail and support design b) Impact factor of 25% of the lifted load for electrical pulley and support design	
9.2.3	Elevator A 100% of the lifted load including elevator live load plus the cab weight for the elevator support beams. Pedestals supporting gravity take ups for conveyors and pedestals in elevator pits shall be designed assuming 100% impact factor.	
10.0	OTHER LOADS	
10.1	Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance loads, creep and shrinkage shall also be considered in design of all structures.	
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10.2	Roof girders / trusses in the service / maintenance bay of Turbine building shall be designed for crane erection loads.	
10.3	Columns in turbine building near transformer yard shall also be designed to support tension due to strung conductors and shield wire if the conductors are connected to the Turbine building columns.	
10.4	The C row columns of Power House Building (Column adjoining first Row of Boiler columns) shall be designed for an additional load of 500 KN to account for piping/Cable rack Loads.	
10.5	Cable rack between boiler & TG building if any load of the same shall be considered in the analysis of TG building even though pipe rack is isolated from TG building.	
11.0	BASIC LOAD CASES The following basic load cases shall be considered for the analysis: a) Dead load : D b) Self weight of permanent equipment : EL c) Live load on floor / walkway : L d) Live load on roof : LR e) Crane load with lift : CR1 f) Crane load without lift : CR2 g) Wind load : WL h) Seismic load : SL i) Load due to soil pressure : SP j) Load due to surcharge : SCL k) Load due to hydrostatic pressure : HP l) Load due to temperature : TL m) Special loads : SPL	
12.0	LOAD COMBINATIONS	
12.1	The individual members of the frame shall be designed for worst combination of forces such as bending moment, axial force, shear force and torsion. Permissible stresses for different load combinations shall be taken as per IS: 875 (Part-V) and other relevant IS codes. Wind and seismic forces shall not be considered to act simultaneously.	
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12.2 Criticality of erection / maintenance loads shall also be checked separately in combination with other simultaneously occurring loads for possible design loading. 12.3 For design of main plant structures during seismic conditions, the deaerator feed water tank shall be considered fill up to operating level. However for other load combinations flooded condition shall be assumed. 12.4 “Lifted load” of crane shall not be considered during seismic condition. 12.5 In case more than one crane is provided and Tandem operation is not envisaged, the load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane. 13.0 LOAD COMBINATIONS FOR UNDERGROUND STRUCTURES Following loading conditions shall be considered in addition to the loading from super structure for the design of sub-structure of pump house, channels, sumps, tanks, reservoirs, trenches and other underground structures. 13.1 Only liquid pressure from inside and no earth pressure and ground water pressure, and surcharge pressure from outside (applicable only to the structures which are liable to be filled with water or any other liquid). 13.2 Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. 13.3 Base slab of the pump house shall be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water table. Intermediate dividing piers of pump sumps and partition walls in channel shall be designed considering water on one side only and the other side being empty for maintenance. 13.4 Design shall also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS: 3370 against buoyancy shall be ensured considering empty condition ignoring superimposed loads.		
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14.3	Switchyard structures	
14.3.1	The loading for the design of switchyard structures shall be as per IS: 802 Part 1/Sec 1:1995 (latest edition). Following loads shall be considered: a) Dead load due to equipment and dead load due to structure b) Wind load on towers, conductors, ground wires and insulator strings calculated as per clause 8 and 9 of IS: 802 c) Temperature effects consisting of effect of temperature variation and sag tension as per clause 10 of IS: 802 d) Climatic loads as per clause 11.2 of IS: 802 e) Anti cascading loads as per clause 11.3.1 of IS: 802 f) Torsional and longitudinal loads caused by breakage of conductor as per clause 11.3.2 and 16 of IS: 802 g) Construction and maintenance loads h) Seismic loads as per IS: 1893 i) Short circuit forces including “snap effect” in the case of bundled conductors	
14.3.2	Switchyard structure shall be designed for the worst combination of above loads. The factor of safety for design of members shall be considered as 2 for normal and broken wire conditions and 1.5 for combined short circuit and broken wire conditions. Short circuit forces and wind forces shall not be considered simultaneously.	
14.3.3	Foundation shall be designed for a factor of safety 2.2 for normal and broken wire condition and 1.65 for combined short circuit and broken wire conditions.	
14.4	Coal Handling System In addition to the loads specified in section 3 above, following additional loads shall be considered for design of various structures: a) Flat roof – accessible : 0.50KN/sqm dust load 	

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(Where equipment is located) d) Load due to material on belt : 1.6 times design weight of the Material on belt e) Spillage load i. Gallery walk way : 1KN/sqm ii. Seal plate : 1KN/sqm f) Belt tension for twin conveyors condition : One belt at starting and one in running condition. g) Impact factor for drive machines : 1.50 h) Grizzly over the Wagon tippler hopper and reclaim hopper shall be designed for JCB/Hydraulic excavator loads. Also reclaim hopper and grizzly shall be designed for loads transmitted by coal heap equivalent to 5m. i) Coal density shall be considered as 1200 kg /cum for design of wagon tippler/Reclaim hoppers. j) Wagon tippler structure shall be analysed for the worst load combination. However it shall be analysed for the following load combination also. 1. Combination-1 i. Hopper full ii. Equipment load iii. Maximum load from railway track iv. Earth pressure without surcharge and sub soil water pressure v. Maximum load from steel column for shed vi. Maximum load from paddle feeder support vii. Maximum load from coal tray 2. Combination-2 i. Hopper full ii. Equipment load iii. Maximum load from railway track iv. Earth pressure with surcharge and subsoil water pressure v. Maximum load from steel column for shed vi. Maximum load from paddle feeder support vii. Maximum load from coal tray		
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k) ERH structure shall be analysed for the worst load combination. However it shall be analysed for the following load combination also. 1. Combination-1 i. Hopper full ii. Coal Heap load of height 5m and dozer load iii. Earth pressure without surcharge and sub soil water pressure iv. Maximum load from steel column for shed v. Maximum load from paddle feeder support vi. Maximum load from coal tray if any 2. Combination-2 i. Hopper full ii. Coal Heap load of height 5m and dozer load iii. Earth pressure with surcharge and subsoil water pressure iv. Maximum load from steel column for shed v. Maximum load from paddle feeder support vi. Maximum load from coal tray if any 14.5 Ash handling system In addition to the loads specified in section 3 above, the additional loads shall be considered for design of various structures of bottom ash handling system structures as per above clause 14.4. 14.6 R.C.C chimney Reference shall be made to IS: 4998 Part I (1992) – “criteria for design of Reinforced concrete chimneys – part I, assessment of loads” for loading details. For wind loading IS: 875 and for seismic loading IS: 1893 shall be referred to. Wind load magnification on the Chimney induced by adjacent tall structures such as cooling towers/Boiler structures shall be included in model study conducted in wind tunnel, and necessary modification shall be made in the wind loading for design. Detailed requirements in respect of the chimney have been described elsewhere in the specifications.		
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PART C

RCC STRUCTURES & FOUNDATIONS

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D 4.6 : PART C
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL WORKS PART C – REINFORCED CONCRETE STRUCTURES AND FOUNDATION	SHEET 1 OF 11
GENERAL All structures, building foundations, machines / equipments foundation, water retaining structure, trenches, pits, etc., shall be designed as per relevant IS codes in general. Construction in general shall follow provisions of IS: 456 and IS: 3370 for normal and water retaining structures respectively. 1.0 DESIGN METHODOLOGY 1.1 General 1.1.1 All designs of RCC structures shall be carried out by limit state method as per IS: 456 unless use of working stress method is specifically mentioned. Design strength of materials and design loads shall be calculated using appropriate partial safety factors over characteristic strength and characteristic loads as per IS:456. 1.1.2 RCC silos shall be designed as per IS: 4995 (part 1 & 2). 1.1.3 For reinforcement detailing IS: 5525 and SP: 34 shall be followed. 1.1.4 The walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration. 1.2 Foundation and Underground structures 1.2.1 General 1.2.1.1 Type of foundation system, i.e., isolated, strip or raft shall be decided based on the loading arrangement, load intensity and soil strata. Design of foundations at various levels shall be dependent upon the soil bearing capacity at that level. 1.2.1.2 Foundation system adopted shall ensure that settlement / relative settlement is as per provision of IS: 1904 and other Indian Standards. However, the settlement shall be restricted to a lower value, if necessary as per the system requirement. 1.2.1.3 All foundation including machine / equipment foundations shall be of RCC construction. All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian standards IS: 2974 and IS: 456. Raft foundations shall be designed as per IS: 2950. 1.2.1.4 For design of underground structures, subsoil water level shall be assumed at the formation level. All underground pits, tunnels, basements, cable and pipe trenches, etc., shall be leak proof RCC		
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structure. Effects of uplift and reduction in bearing capacity due to underground water table shall also be considered. For details of subsoil conditions, foundation system recommendations for various buildings and equipment reference shall be made to preliminary Geotechnical investigations carried out by OWNER as furnished in para 10.0 of section D4.1 No important foundation shall rest on filled up soil. In case some minor foundations are to be placed on filled up soil then underlying soil shall be properly compacted in a masonry /sheet pile enclosure. Excess excavations shall be filled with PCC 1:4:8 up to required level. 1.3 Liquid retaining structures 1.3.1 RCC water retaining structure like storage tanks etc., shall be leak proof and designed as cracked section with limiting crack width of 0.1 mm and limiting steel stresses in accordance with IS:3370 (part I to IV) by working stress method. 1.3.2 Water channels and substructure of pump houses shall be designed as cracked section with limiting crack width of 0.1 mm and limiting steel stresses as per IS:3370 (part I to IV) by working stress method. 1.3.3 All water retaining / storage structures shall be designed assuming liquid upto the height of wall irrespective of provision of any over flow arrangement. No pressure relieving devices shall be permitted in underground structures. 1.3.4 In all liquid retaining structures, PVC water bar shall be provided at each construction / expansion joint. The sequence of construction shall also be specified on drawings showing construction joints. 1.4 Machine Foundations The design of machine / equipment foundation shall be as per IS:456 and IS:2974. The provisions of DIN 4024 shall also be followed for machine foundations. 1.4.1 All machine / equipment foundations and structures subject to vibrations shall be suitably proportioned so that amplitude and frequency of the foundation / structures are within permissible limits. 1.4.2 All block foundations resting on soil shall be designed using the elastic half space theory or Barkens theory. Block foundation resting on piles shall be designed using Novak's theory or Barken's theory .The mass of the RCC block shall not be less than three times mass of the machine		
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and the CG of the combined mass of foundation and equipment should pass through the CG of the base area with tolerance not more than 5%. Dynamic analysis shall be carried out to calculate natural frequencies in all modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant codes or machine manufacturers shall be satisfied. Minimum reinforcement shall be governed by IS: 2974 and IS: 456. 1.4.3 For the foundations supporting minor equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors, etc. suitable vibration isolation shall be provided by means of springs, neoprene pads, etc. and such vibration isolation system (VIS) shall be designed suitably. 1.4.4 Steam turbine generators, Boilers Feed Pumps, PA Fans, FD Fans and Coal mill foundations shall be supported on Conventional framed/Block foundation 1.4.5 Analysis and design of the Steam Turbine-Generator (STG) foundation shall be carried out in accordance with relevant codes IS: 2974 Part-3 and IS: 456 and/or manufacturer's requirements. Static and Dynamic analysis shall be carried out using finite element computer program using 3D beam/shell or 3D solid elements with columns fixed at top of mat level. Natural frequencies and amplitude of vibrations of turbine generator foundations shall be as per relevant applicable code of practices as indicated above and/or as per manufacturer's requirements. For dynamic analysis, masses of stator and rotor shall be lumped at their respective CGs with rigid members. Fundamental natural frequencies in all three directions shall be separated by at least 20% with respect to machine speed. Forced vibration analysis shall be performed at the operating speed and also at frequencies corresponding to certain selected modes (natural frequencies within 0.9 to 1.1 times the operating speed) using normal machine unbalance loads. Amplitudes calculated shall be ensured to be within the permissible limits as specified by the manufacturer. In the absence of specified criteria, amplitude shall be limited to alarm limit specified in ISO 10816-2. The exercise shall be repeated by releasing the rotor mass in the axial direction at each bearing location except at thrust bearing. The loads to be considered for static analysis and design shall consist of dead weight of the machine and foundation, machine power torque, condenser loads under normal operating condition, Equivalent static load due to machine unbalance, thermal elongation forces, forces due to one		
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sided operation of the condenser, forces due to condensate pump failure, vacuum loads, forces due to piping, frictional forces at machine sole plate level for turbine, generator and condenser, temperature distribution under operating condition, failure loads of turbine (blade unbalance/loss of blade/bowed rotor), failure loads of generator (short circuit loads), seismic loads due to generator, turbine and condenser and erection loads. The turbine generator foundations shall also be designed to meet the manufacturer's static deflection criteria. 1.4.6 For framed type foundations which support any major rotary equipment, the criteria specified in paragraph 2.3.5 for STG foundation shall be followed. 1.4.7 In case of variable speed machines such as ID fan, one or more natural frequencies of the foundation may coincide with the operating frequency of the machine. If it is not possible to satisfy the codal frequency or amplitude criteria VIS with springs and viscous dampers shall be provided. It shall be ensured that not more than 5% of the dynamic loads are transmitted to the substructure. Necessary provisions of DIN 4024 shall be adhered to while designing the substructure. Substructure shall be designed for static loads. The vibration isolation system shall consist of helical spring units and viscous dampers supporting the RCC inertia block which support the machine. The spring units shall conform to DIN 2089 and DIN 2096. The static and dynamic analysis shall be carried out as specified in clause 2.3.5 above except that the analysis can be based on a plate model/Three dimensional solid finite element model. The frequency and amplitudes shall be checked as per relevant applicable code of practices or as per manufacturer's requirements. The permissible amplitude of vibration shall be as specified by the manufacturer and shall be in "satisfactory" range as per VDI 2056, whichever is more stringent. Boiler feed pumps to be supported on suspended floor if system demands & as approved by owner/consultant, in such case the same shall be provided with vibration isolation system (VIS) as base isolation to overcome the vibration problems. 1.4.8 The Vibration Isolation system supplied should be of proven make. The Contractor / their associates for the supply of this system should have designed spring supported machine foundations. Manufactured supplied and installed vibration isolation systems consisting of steel helical spring units (Conforming to DIN 2096 & DIN 2089) and viscous dampers (Providing damping resistance in all three planes) for not less than 25 (twenty five) machine foundations of heavy rotating machine systems, such as Turbine generators, Boiler feed pumps, ID/ PA / SA fans etc., All		
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the foundation systems be in successful operation (without replacement) for at least 3 (three) years as on the date of bid opening. 1.4.9 All such foundation shall be separated from adjoining part of building and other foundations. Joints at floor / slab shall be suitably sealed. All appendages to such foundations shall be reinforced suitable to ensure integral action. 2.0 Increase in Stresses 2.1 Where stresses due to wind (or seismic) and temperature are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel shall be increased by 33.33% in case of working stress design. 2.2 Bearing capacity of the soil shall be allowed to increase by 25% under seismic / wind load condition except for chimney where increase in Bearing capacity shall not be considered. 3.0 Stability of structures 3.1 Design shall be checked against buoyancy due to the ground water during construction and maintenance stages for structures like underground tanks, pits trenches, basements, etc. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loading. For purpose of calculating downward load due to any overburden, only the mass located vertically above the projected area shall be taken in to consideration. 3.2 All building sub-structures including pump houses shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS: 456 and other relevant IS codes However, following minimum factor of safety shall be followed. a) Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.5 minimum. b) Factor of safety against sliding shall be 1.5 minimum. c) Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5. 3.3 Stability of the structure shall also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes.		
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3.4	In case where dead load provides the restoring force, only 0.90 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force.	
4.0	MINIMUM THICKNESS OF STRUCTURAL ELEMENTS	
4.1	The following minimum thickness shall be followed:	
	a) Suspended floor / slab / walkways / canopy slabs, etc	150 mm
	b) Ground floor slab (non-suspended)	150mm
	c) Water Retaining slabs / walls	200mm
	d) Cable / pipe trenches / underground pits / Launder walls and base slab	125mm
	e) All footings (including raft foundations)	300mm
	f) Parapets	125mm
	g) Sunshades	75mm at stage
	h) Precast louvers / fins	50mm
	i) Precast trench cover slabs / floor slabs / louvers	75mm
	j) Paving	100mm
	k) Basement walls and base slab	200mm
	l) Silo / bin walls	150mm
	m) Underground reservoir	
	Below ground water table	200mm
	Above ground water table	150mm
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4.2	From fire resistance point of view minimum thickness of reinforced concrete members shall be as per fig 1 or Table 16a of IS 456.	
5.0	MINIMUM HEIGHTS FOR PEDESTALS OF STEEL COLUMNS	
5.1	Pedestals to Steel Columns for building structures: Top or RCC foundations (pedestals) shall normally be kept at a lower level so that the column base plates together with gussets and stiffeners remain below finished floor level (FFL) unless specified otherwise. Foundation levels for some columns shall be changed suitable to accommodate underground services, pits trenches, etc.	
5.2	Stair and ladder pedestal shall be kept 200 mm above the finished floor level.	
5.3	Pedestals to Steel Columns for Equipment structure: a) Equipment in open area : as required (300mm min) b) Equipment in covered area : as required (150 mm min) c) Structures and equipment: : as per vendor's data supplied by vendor subject to minimum as specified above	
6.0	MINIMUM HEIGHTS FOR ENCASEMENT TO STEEL COLUMNS In case the top of pedestal is kept at a lower level so that the column base plate together with gussets and stiffeners remain below finished floor level (FFL) the column bases as well as the column sections shall be encased in concrete above FFL as per following. a) Open area : 200 mm above paved level b) Covered area : 200 mm above FFL	
7.0	CONCRETE MIX	
7.1	The following minimum grades of concrete as per IS: 456 shall generally be used for the type of structures noted against each grade. Ordinary Portland Cement (OPC) shall be used. Grade of cement shall not be less than 43 conforming to IS 8112. For super structure of RCC chimney and Natural draft cooling towers richer mix may be used as per the design requirement.	
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Mix (1:4:8) : Foundation below brick wall, blinding layer below foundations, trenches and underground structures, minimum thickness of the layer shall be 75 mm. Grade M20 : Base plate encasement, pavement around building including plinth protection work, encasement of structural steel work, etc. Grade M25 All RCC members such as Foundation and super structure, grade beams, pedestals, ground floor slabs, roof slabs, cable and pipe trenches, Water retaining structures below and above ground, Precast concrete work, etc. Grade M35 : TG Foundation including Mat, Deck and columns 7.2 Minimum cover to the reinforcement shall be as per IS: 456. 7.3 Minimum cement content shall be governed by the requirement of IS: 456. 8.0 REINFORCEMENT 8.1 Reinforcement bars shall be as per the following codes: High Yield Strength Deformed bars : Grade Fe 415 D of IS: 1786 Mild steel bars : Grade I of IS: 432 Welded wire fabric : IS: 1566 8.2 Intermixing of different grades of rebars or rebars of different material composition in same structure shall not be allowed. 9.0 GROUTING 9.1 Non-shrink flowable grout shall be used for under pinning work below base plate of columns. Non-shrink cum plasticiser admixture approved by OWNER shall be added in the grout. For grouting of base of machine foundation high strength flowable ready mixed non-shrink grout shall be used. 9.2 Type and grade of grouting for structural columns and equipment bases shall be indicated. Crushing strength of the grout shall generally be one grade higher than the base concrete. Minimum grade of grout shall be one grade higher than that used for concreting.		
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9.3	Nominal thickness of grouting shall be at least 50 mm for building columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting shall not be less than 25 mm thick.	
10.0	MINIMUM COVER TO FOUNDATION BOLTS Minimum distance from the center line of foundation / anchor bolt to edge of pedestal shall be the maximum of the following: a) Clear distance from the edge of base plate / base frames to the outer edge of the pedestal shall be minimum 50 mm. b) Clear distance from the face of pocket to the outer edge of pedestal shall be 75 mm. c) Clear distance from the edge of sleeve or anchor plate to the outer edge of pedestal shall be 75 mm.	
11.0	MISCELLANEOUS REQUIREMENT	
11.1	Fillets at the junction of roof and vertical walls shall be provided with cast in situ cement concrete 1:2:4 (nominal mix) followed by 12 mm thick 1:4 cement mortar.	
11.2	A screed layer not less than 100 mm thick of cast in situ concrete of nominal mix 1:3:6 shall be provided below all water retaining structures. A sliding layer of craft paper or bitumen paper shall be provided over the screed layer to destroy the bond between screed and base slab.	
11.3	All underground structures such as conveyor tunnels, wagon tippler pits, reclaim hopper pits, slurry pump house, etc, shall be designed as per IS:456 limiting the crack width to 0.1 mm. Check for crack width shall be in accordance with BS:8007/IS:456. In case of leakage in the above structure injection grouting method shall be applied to repair the structure according to the requirement of IS: 6494.	
11.4	For switchyard foundations anchor bolt with mechanical anchorage shall be provided and cast along with foundation concrete. Bolts in pockets shall not be adopted. Foundation for all switchyard towers shall be designed as per IS: 4091. Contact between foundation and the soil strata shall be ensured for all conditions and combinations of loading	
11.5	Plywood formwork shall be used for all water retaining / conveying structures and for all over ground concrete works, plywood formwork shall be used.	
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11.6	Unless specified 20mm and downgraded aggregates shall be used for all structural concrete works. However 40mm and downgraded aggregates may also be used under special conditions for foundation.	
11.7	Tolerance for formed and concrete dimension shall be as per IS:456	
12.0	MAJOR EQUIPMENT FOUNDATIONS Special requirements for concreting of major equipment foundations shall be as given below:	
12.1	Coarse Aggregates Sound and durable crushed stone aggregates shall be used. All aggregates shall be tested for alkali aggregate reaction. Materials, which contain high percentage of reactive silica, shall not be used. In exceptional cases of high percentage of reactive silica content, aggregate may be allowed where low alkali cement shall be used. Lime stone aggregate shall not generally be used for foundations which are subjected to high temperature and repeated temperature cycles (like in the case of all machine foundations).	
12.2	Temperature Control of Concrete The temperature of fresh concrete shall not exceed 23 deg. C when placed for complete TG foundation including deck/ columns and all fan foundations. . For maintaining the temperature of 23 deg. C for all these machine foundations, crushed ice shall be used in mixing water.	
12.3	Admixture Plasticizer cum retarder type admixture shall generally be added to the concrete for promoting workability in addition to retarding the setting time for mass concreting work. The slumps shall generally be in the range given below:	
	TG Top deck	: 150mm to 200mm
	BFP, ID/PA/FD Fan & Mill deck	: 100mm to 150mm
	Block foundation	: 100mm to 150mm
	Column	: 100mm to 150mm
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12.4 Form work Plywood formwork shall be used for the top decks of all machine foundations and also for columns and raft of TG foundation. 12.5 Scheme for Concreting Weigh batching plants shall be mobilized for all machine foundations. Concrete pump shall be mobilized for TG raft, TG Top deck, BFP Deck, PA/FD/ID Fan deck, Mill Deck. Arrangements for stand-by Plant and Equipments shall also be made. 12.6 Placing of Concrete Base mat and top deck of machine Foundations shall be cast in a single pour 12.7 Ultrasonic Testing Ultrasonic pulse velocity test shall be carried out for the top decks and columns of all machine foundations and TG deck & column & its substructure to ascertain the homogeneity and integrity of concrete. In addition, additional cubes (at the rate of one cube per 150 cum of concrete subject to a minimum of six cubes) shall be taken to carry out Ultrasonic Pulse velocity (UPV) testing on the cubes to serve as reference UPV values Testing shall be done as per IS: 13311 (Part-1). In case of any defects, the CONTRACTOR shall rectify the defects suitably using cement / epoxy grout etc...		
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PART D
STEEL STRUCTURES

SPEC.NO. TCE. 5749A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D 4.6 : PART D
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL WORKS PART-D-STEEL STRUCTURES	SHEET 1 OF 17
1.0 GENERAL 1.1 Design of structural steel work shall include generally but not be limited to the steel constructions listed below: i. Steel building structure and open structures: ii. This shall include beams, columns, bracings, supporting structures for floors, roof slabs, cladding supporting structure etc iii. Crane, gantry girder, monorails etc. iv. Coal conveyor galleries and trestles v. Large diameter oil tanks vi. Large diameter pipe line for cooling water vii. Galvanised latticed structures for switchyard viii. Pipe and cable racks ix. Platforms and walkways x. Ladders, staircases, handrails etc... 2.0 FRAMING 2.1 All steel framed structures shall be either “rigid frame “or“simple space frames “or a combination of two. 2.1.1 Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail. 2.1.2 Simple space frame design utilises single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels. The most of plant steel buildings shall be designed as simple space frame structures. 2.2 The turbine building design shall be a combination of rigid frame in transverse direction and simple frame in longitudinal direction. 2.3 Pipe rack shall consist of rigid main frame in transverse direction spaced longitudinally as required. In longitudinal direction, pipe rack shall be divided into sections of suitable length with an anchor bay. The main transverse frames shall be connected with longitudinal beams which will transmit horizontal forces to braced anchor bays. The pipe and cable rack bridge structure shall be adequately rigid to carry the forces from pipelines at anchor points without undue deflection so that pipelines are really anchored at the anchor points.		
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2.4 Concrete floors shall be considered to provide continuous lateral support to the top (compression) flange of the support beams. However wherever large cut outs are provided in the floor slabs horizontal floor bracing shall be provided. Grating/chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support and horizontal bracing shall be provided as required. Shear connectors 16 mm MS lugs shall be provided over beam tops where floor slab is to be provided 2.5 Floors for vibrating machines of all kind together with supporting framework shall be adequately braced in both horizontal and vertical planes. Floors or structure supporting mechanical equipment shall be designed to minimise vibration, avoid resonance and maintain alignment and level. 2.6 Columns shall be designed to support the load combination which produces the maximum interaction ratio. Exterior columns shall be designed to resist wind moments between braced elevation as appropriate. Columns shall also be designed to resist moments caused by discontinuous vertical bracing or non-concentric bracing work points. 3.0 MATERIALS 3.1 Structural steel shall conform to Grade A of IS: 2062 for rolled steel members or plates up to 20 mm thickness. For plates above 20 mm thickness or welded construction, steel conforming to Grade B (Killed) of IS: 2062 shall be used except for crane girders where Grade C (IS: 2062) steel shall be used. 3.2 Chequered plates shall conform to IS: 3502. All gratings shall be pressure locked type (preferably electro-forged) manufactured in accordance with applicable Indian standard. Pipes for handrail shall be as per medium grade of IS: 1161. Crane rails shall conform to IS: 3443. 3.3 Stainless steel used in Coal bunker shall be of grade designation SS 409M. 4.0 CONNECTIONS 4.1 Welding shall be used for shop fabrication and joints. For site connections, welding or high strength friction grip (HSFG) type bolts shall be used, except in few cases for shear connections of lighter members or removable beam connections where bolted joints using black bolts may be adopted e.g. purlins, side girts etc. A minimum of two bolts per connection shall be used.		
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4.2 IS: 816 and IS: 9595 shall be followed for welding of structures. 4.3 For high strength friction grip bolt connections IS: 4000 shall be followed. High strength friction grip bolts shall be of property class 6.6 or 8.8 and shall conform to IS: 3757 and shall not be less than 20 mm in diameter unless designated otherwise. High strength bolts shall be installed as bearing type joint except where loads are reversible. 4.4 All bolted connections shall have bolts of minimum 16 mm dia. The connections of stairs and hand railing shall be made with 20 mm diameter threaded fasteners conforming to IS: 1363. Erection bolts shall be black bolts of minimum 12 mm dia. 4.5 All bolts and nuts shall have property class compatible to each other. For bolts carrying dynamic or fluctuating loads and those in direct tension shall be provided with an additional double coil helical spring washer conforming to IS: 6755. The threaded portion of the bolt shall project through the nut at least by one thread. 4.6 Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and preferably through shear connection. 4.7 For crane girders, welding between web and flange plates shall be carried out by submerged arc welding process. Full penetration of weld between web plate and top flange shall be ensured. Intermediate stiffeners shall be connected with top flange plate by full penetration butt weld. Welding across tension flange will not be permitted. Bearing edges of crane girders shall be machined. 4.8 The working point of the bracing connection shall be the center of column and girder to which it connects, where practical. The connections of gusset plates to column and girders shall be made to include provisions for eccentricity in connection. The double angle back-to-back with gusset plate in between shall not be used in dust laden areas. Where double angles are not adequate, beam sections with web in the plane of bracing are used. 4.9 Horizontal bracings shall be angle / tee section located at the bottom of framing beams. Field welding of bracing at the underside of beam as required to meet slenderness requirement of bracing member shall be indicated on the drawings. Horizontal bracing shall be arranged to avoid framing into the beams at column locations. 4.10 Minimum size of fillet weld shall be 6 mm. Main structural elements shall be welded continuously. Intermittent weld shall be used only on secondary members, which are not exposed to weather or other corrosive influence.		
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4.11 Efficiency of site welds to be considered shall be as follows: Butt weld above 25 m from ground : 50% Others : 80% 4.12 Welding shall be done only by approved electrodes approved by Engineer In Charge and shall conform to relevant Indian standards or equivalent international standards 5.0 DESIGN METHODOLOGY 5.1 The Design of steel structures shall be done by in accordance with the provisions of IS: 800 -2007 and other relevant IS Codes as applicable to specific structures. 5.2 All buildings/structures shall be framed structure. Basic consideration for structural framing shall be stability, rigidity, building uses, ease of fabrication / erection and overall economy. Additional bracings/moment connections shall be used to assure stability of structures. Structure shall be designed such that the surfaces of all parts shall be accessible for inspection, cleaning, painting and maintenance. 5.3 Crane gantry girders shall be single web plate girder of welded construction with bearing and intermediate stiffeners. Crane girder shall be designed as simply supported and of single span length. Chequered plate shall be used for gantry girder walkway flooring. For lifting / monorails beams ISMB sections shall be preferred and the bottom flange of all beams shall be checked separately for distortion and reinforced suitably if required. 5.4 Permissible stresses for different members shall be allowed to exceed upto 33.33% only under normal loads along with wind and seismic conditions. However, members which are designed primarily to resist wind such as bracing members, no increase in permissible stresses will be permitted. However, permissible stresses in bolts and welds shall be allowed to exceed up to 25 % only under wind and seismic conditions. 5.5 For design which requires the use of the minimum column load (such as, uplift on anchor bolts, column axial tension, etc.) The following criteria shall be used in determining minimum load: Use 90% of the column dead load, No live load is used, Uplift forces from vertical bracing are included where applicable and Wind uplift on the roof is included where applicable. 5.6 Base plates shall be placed on foundation pedestal with grouting. For large base plates necessary grout holes shall be provided. All anchor bolts for fastening steel columns on foundation shall be embedded in		
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6.1.2 For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values: a) For manually operated cranes & monorails : Span / 500 b) For electric overhead cranes i. up to 50 t capacity : Span / 750 ii. over 50 t capacity : Span / 1000 6.2 Horizontal deflections The permissible horizontal deflections shall be as per following unless specified otherwise: a) Single storey building (without crane load) : Height / 325 b) Multi-storeyed building (without crane load) : Height / 500 c) Pipe rack columns : Height / 200 d) Open Structures : Height / 200 e) Crane gantry girder due to surge : Span / 2000 limited to to maximum of 15 mm f) Building main columns at crane rail level due to action of crane surge load only : Height / 2500 limited to maximum of 10 mm g) Open gantry columns at crane rail level due to action of crane surge load only : Height / 4000 limited to maximum of 10 mm h) Coal handling trestles (across the conveyor) : Height/1000 6.3 Provisions of IS: 800 and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.		
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7.0 MINIMUM THICKNESS AND SIZES OF STEEL ELEMENTS 7.1 Minimum Thickness The minimum thickness of various components of a structure and hot rolled sections except for the switch yard structures shall be as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to significantly corrosive environment shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgement in each instance. <table> <tr> <td>a) Trusses, purlins, girts and bracing</td><td>:</td><td>6 mm</td></tr> <tr> <td>b) Columns and beams</td><td>:</td><td>8 mm</td></tr> <tr> <td>c) Gussets</td><td>:</td><td>8 mm</td></tr> <tr> <td>d) Stiffeners</td><td>:</td><td>8 mm</td></tr> <tr> <td>e) Base plates</td><td>:</td><td>10 mm & above</td></tr> <tr> <td>f) Chequered plates</td><td>:</td><td>6 mm o/p & above</td></tr> <tr> <td>g) Grating flats</td><td>:</td><td>5 mm</td></tr> <tr> <td>h) Minimum thickness of structural members other than gratings and chequered plate directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.</td><td></td><td></td></tr> </table> 7.2 Minimum Sizes The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm and for those supporting roof sheeting and wall cladding it shall not be less than 50 mm. Width of steel rolled section connected to other member shall be at least 50 mm. The depth of beams for platform of all structures shall not be less than 125 mm. 8.0 SLENDERNESS AND DEPTH RATIO 8.1 The slenderness ratio of main members in tension, compression or bending shall be in accordance with IS: 800.			a) Trusses, purlins, girts and bracing	:	6 mm	b) Columns and beams	:	8 mm	c) Gussets	:	8 mm	d) Stiffeners	:	8 mm	e) Base plates	:	10 mm & above	f) Chequered plates	:	6 mm o/p & above	g) Grating flats	:	5 mm	h) Minimum thickness of structural members other than gratings and chequered plate directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.		
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8.2	The following limiting ratios of depth to span shall considered as a general guide. <table> <tr> <td>a)</td><td>Truss</td><td>1 / 10</td></tr> <tr> <td>b)</td><td>Rolled beams and girders for Ordinary floors and rafters</td><td>1 / 24</td></tr> <tr> <td>c)</td><td>Supporting floor beams for vibrating Machinery / equipment</td><td>1 / 15</td></tr> <tr> <td>d)</td><td>Roof purlins and girts</td><td>1 / 45</td></tr> <tr> <td>e)</td><td>Gable columns</td><td>1 / 30</td></tr> </table>		a)	Truss	1 / 10	b)	Rolled beams and girders for Ordinary floors and rafters	1 / 24	c)	Supporting floor beams for vibrating Machinery / equipment	1 / 15	d)	Roof purlins and girts	1 / 45	e)	Gable columns	1 / 30
a)	Truss	1 / 10															
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e)	Gable columns	1 / 30															
9.0	FABRICATION AND ERECTION CONTRACTOR shall prepare detailed fabrication drawings and erection scheme based on the design drawings approved by OWNER. Fabrication drawings are not to be submitted to OWNER for approval as the responsibility for correct detailing rests exclusively on the CONTRACTOR. However these drawings will be furnished to OWNER for their reference to effect payment. Fabrication shall commence only on the basis of the fabrication drawings approved by the CONTRACTOR'S Consultant.																
9.1	Fabrication shall in general follow the provisions of IS: 800, and good engineering practice where provisions of IS: 800 are not clear.																
9.2	Tolerance in fabricated steel work shall be as per IS: 7215.																
9.3	Erection of fabricated steel components shall be as per erection drawings prepared by CONTRACTOR and approved by his CONSULTANT																
9.4	Tolerance for erected steel structures shall be as per IS: 12843.																
10.0	INSPECTION OF WELDING The extent of quality control in respect of welds for structural elements shall be as follows.																
10.1	Visual Examination																
10.1.1	All welds shall be 100% visually inspected to check the following: Presence of undercuts																
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ii. Surface cracks in both welds and base metals. iii. Unfilled craters iv. Improper weld profile and size v. Excessive reinforcement in weld vi. Surface porosity 10.1.2 Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter; scales etc... by using wire brush or chisel. 10.2 Dye Penetration Test (DPT) 10.2.1 This shall be carried out for all important fillet welds and groove welds to check the following: i. Surface cracks ii. Surface porosities 10.2.2 Dye Penetration Test shall be carried out in accordance with American National Standard ASTM E165. 10.3 Ultrasonic testing 10.3.1 100% Ultrasonic test shall be conducted for all groove welds and heat affected zone in dynamically loaded structures and for other important load bearing butt welds in statically loaded structures as desired by OWNER to detect the following: i. Cracks ii. Lack of fusion iii. Slag inclusions iv. Gas porosity 10.3.2 Ultrasonic testing shall be carried out in accordance with American National Standard ANSI / AWS D1-92 Chapter 6: Part C. 10.3.3 Before Ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.		
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10.4 Radiographic Testing (X – ray and Gamma – ray Examination) 10.4.1 Total extent of radiography shall be for 10% of weld length for both welds made by manual or semi-automatic welding and automatic welding machines. The location and extent of weld to be tested by this method shall be decided by OWNER to detect the following defects: i. Gas porosity ii. Slag inclusions iii. Lack of penetration iv. Lack of fusion v. Cracks 10.4.2 Radiographic testing shall be conducted in accordance with American National Standard ANSI / AWS D1.1-92. 10.4.3 Any surface irregularity like undercuts, craters, pits etc shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be width of the welded joint plus 20 mm on either side of the weld. 10.5 CONTRACTOR shall provide testing equipment for conducting non-destructive tests for confirming the integrity of welding wherever necessary as directed by the OWNER / consultant. 10.6 Acceptable Limits of defects of weld 10.6.1 Limits of Acceptability of welding defects shall be as follows. i. Visual inspection & Dye Penetration Test The limits of acceptability of defects detected during visual inspection and Dye Penetration Test shall be in accordance with clauses 8.15.1 & clauses 9.25.3 of American National Standard ANSI / AWS D1.1-92 respectively, for statically and dynamically loaded structures. ii. Ultrasonic Testing The limits of acceptability of defects detected during ultrasonic testing shall be in accordance with clause 8.15.4 & clause 9.25.3 of American National Standard ANSI / AWS D1-92 respectively, for statically and dynamically loaded structures.		
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iii. Radiographic Testing The limits of acceptability of defects detected during Radiographic testing shall be in accordance with clause 8.15.3 & 9.25.2 of American National Standard ANSI / AWS D1.1-92 respectively for statically and dynamically loaded structures. 10.7 Rectification of Defects in Welds 10.7.1 In case of detection of defects in welds, the rectification of the same shall be done as follows: - All craters in the weld and breaks in the weld run shall be thoroughly filled with weld - Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal. - Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc. exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld and shall be re-welded. Defective weld shall be removed by chipping hammer gouging torch or grinding wheel. Care shall be taken not to damage the adjacent material. 11.0 PAINTING 11.1 All steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection. 11.2 Steel surface which is to painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be cleaned to grade ST-2 as per SIS05-5900 or as per IS: 1477 (part -I). Primer paint shall be red oxide zinc chromate conforming to IS: 2074. Dry film thickness of each coat shall be 25 microns. 11.3 Finish paint shall be 2 coats synthetic enamel paint conforming to IS: 2932. Dry film thickness of each coat shall be 25 microns. The		
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undercoat and finish coat shall be of different tint to distinguish the same from finish paint. All paints shall be of approved brand and shade as per the OWNER's requirement. 11.4 Joints to be site welded shall have no paint applied within 100 mm of welding zone. Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified. 11.5 Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted. 12.0 REQUIREMENTS FOR SPECIFIC STRUCTURES 12.1 Coal handling system structures 12.1.1 Toe guards shall be provided on sides of conveyor gallery, toe guard shall have a minimum size of 65 x 6 mm. 12.1.2 In case the inclination of the conveyor is more than 10°, walkway shall be given steps. 12.1.3 For the design of conveyor gallery, load due to cables, light fittings and pipes as well as effect of gravity take up loads shall also be considered, in addition to dead load, wind load and imposed load. 12.1.4 Lattice girders supporting the conveyor shall be suitably braced at top and bottom chord levels to transmit the wind load to the end portals connected to trestles. Roof purlins and walkway runners shall also be suitably braced at both ends. 12.1.5 In the case of galleries, temperature expansion joint shall be introduced at intervals less than 180 m to divide the galleries into temperature block. In each block at least one number four legged rigid support guaranteeing stability of structure in the longitudinal direction shall be provided. This shall also take care of all longitudinal forces in the given block. Effect of wind load acting on 2-legged trestle shall also be considered while designing the 4-legged trestle. 12.1.6 Base plates for trestles shall be designed as gusseted bases with shear lugs to transfer horizontal forces. Anchor bolts shall be designed only for uplift forces. 12.1.7 Conveyor galleries and trestles having two conveyors belt shall be designed for both conveyors working together.		
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12.1.8 Chute loads on floors of houses shall be considered plugged with material for the entire height of the chute. 12.1.9 In case chequered plates are used as floor covering the thickness of plate o/p shall be 8 mm. Suitable plan bracings shall be provided 75 mm from top of steel to transfer all the horizontal forces. 12.1.10 Anchor fasteners shall not be used for supporting equipment imparting dynamic forces. 12.1.11 Bracing patterns and locations shall be so planned such that they do not hinder movement of personnel and movement of equipment during maintenance. When floor beam form part of vertical bracing system, additional loads from the floor beams transferred to the bracing shall be taken into account. 12.1.12 Angle section shall not be used as flexural members except for purlins, side girts and walkway runners. Minimum angle size used shall be L50x50x6. 12.1.13 All foundation bolts shall be provided with double nuts. 12.1.14 End connection for rolled beams and channels shall be designed for a minimum of 60% of their shear capacity and built up beams for 80% of their shear capacity in addition to axial load. 12.1.15 Dynamic analysis shall be carried out for beams supporting screens, vibrating feeder, rotating equipments and conveyor supporting beam in conveyor gallery. Deflection of these beams shall not exceed span divided by 500. 12.1.16 To admit proper light into the conveyor gallery perspex sheet shall be provided at the rate of 0.1 square metre per metre length of gallery on the roof and 0.2 square metre per metre length of gallery per side on the sides of conveyor gallery. 12.2 Switchyard Structures 12.2.1 All switchyard structures comprising of towers, gantries, lightning masts, lighting towers, equipment structures etc shall be galvanised steel with bolted site connection. 12.2.2 Three dimensional analysis shall be of carried out for structures like towers and gantries whereas two dimensional approach may be followed for equipment support structures. 12.2.3 All structural steel shall be of tested quality and shall conform to IS: 2062. Steel tubes where used for equipment support structures shall conform to IS: 1161.		
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12.2.4 All bolts and nuts shall be galvanised. In addition to heavy washers conforming to IS: 6610, spring washers conforming to IS: 3063 shall be provided at all bolted connections. Bolts shall conform to IS: 12427. 12.2.5 Fabrication and erection shall in generally be as per IS: 802 and IS: 800; wherever there is a contradiction between two codes the provision in IS: 802 shall govern. 12.2.6 Towers, beams etc shall be trial assembled at shop, keeping in view the actual site condition, prior to dispatch to erection site so that they can be conveniently pre-assembled before erection or conveniently assembled during erection. 12.2.7 Galvanising 12.2.7.1 Galvanising of the towers shall be as per IS: 4759 and 2633 and as given in the following paras. 12.2.7.2 Before galvanising, the steel shall be thoroughly cleaned of any paint, grease, rust, scale, acid or alkali or such other foreign matters as are likely to interfere with the galvanising process. 12.2.7.3 The acceptable values of the coating of zinc on the steel materials shall be in accordance with Table below: <table> <tr> <th>KIND OF MATERIAL</th><th>COATING Average value</th><th>Minimum value</th></tr> <tr> <td>Structural steel members except bolts,nuts and washers</td><td>Over 750 gm/sq.m</td><td>610 gm/sq.m</td></tr> <tr> <td>For bolts, nuts and washers</td><td>Over 550 gm/sq.m</td><td>500 gm/sq.m</td></tr> </table> 12.2.7.4 The galvanised surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth, and shall be free from defects like discoloured patches, bare spots, globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection. 12.2.7.5 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanised steel member shall withstand minimum			KIND OF MATERIAL	COATING Average value	Minimum value	Structural steel members except bolts,nuts and washers	Over 750 gm/sq.m	610 gm/sq.m	For bolts, nuts and washers	Over 550 gm/sq.m	500 gm/sq.m
KIND OF MATERIAL	COATING Average value	Minimum value									
Structural steel members except bolts,nuts and washers	Over 750 gm/sq.m	610 gm/sq.m									
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four no. of one minute successive dips in copper sulphate solution as per IS: 2633 unless specified otherwise. 12.2.7.6 All galvanised members shall be treated with sodium dichromate solution or an approved equivalent after galvanising, so as to prevent white storage stains. 12.2.7.7 Galvanising of each member shall be carried out in one complete immersion. Double dipping shall not be permitted. 12.2.7.8 Wherever galvanised bolts, nuts, washers, accessories etc are specified, these shall be hot-dip galvanised. Spring washers shall be electro-galvanised. Readily available GI nuts, bolts and washers conforming to galvanising requirements may also be used. 12.2.7.9 CONTRACTOR shall ensure that galvanising is not damaged in transit. In the event of occurrence of any damage, CONTRACTOR shall at his own cost adopt scrapping and re-galvanising the member to satisfy the specific requirements. 12.3 Large diameter Oil tanks 12.3.1 Design, fabrication and erection of the cylindrical welded oil storage tank shall follow the provisions of IS: 803. The stresses in the tank shall be computed on the assumption that tank is filled with water. Tension in each course shall be computed at 30 cm above the centreline of lower horizontal joint of the course under consideration. 12.3.2 Wind and internal vacuum loads shall be considered together to check the stability of tank. 12.3.3 Joint efficiency factor shall be taken as 0.85 for butt joints to determine the minimum thickness of shell plates provided all the vertical and horizontal butt welds are spot radiographed. Where welds are not inspected by radiography joint efficiency factor of 0.7 shall be used. However it is recommended that all butt welded joints shall be radiographed. 12.3.4 Minimum thickness of shell plate shall be as given in clause 6.3.3.2 of IS: 803 to which corrosion allowance shall be added. Maximum thickness of shell plate shall not exceed 40 mm. Width of shell plate shall not be less than 1500 mm. 12.3.5 Bottom plate uniformly resting on the substructure shall have a minimum thickness of 6 mm for tanks upto 10 m in diameter and 8 mm for higher diameter. Bottom plate shall project atleast 25 mm all round beyond the outer edge of weld attaching the bottom to the shell plate.		
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12.3.6 For large diameter oil tanks supported cone roof shall be provided. Arrangement of columns and rafter shall in general be as per fig 9 & 10 of IS: 803. Roof plates shall have a minimum thickness of 6 mm and shall not be attached to the supporting member. A curb angle shall be provided at the top of the shell in line with clause 6.3.6.2 of IS: 803. Roof plates shall be attached to the curb angle with a continuous fillet weld on the top side only. Minimum slope of roof shall be 1 in 16. 12.3.7 Rafter clips for the outer row of rafters shall be welded to the shell. Columns shall not be rigidly attached to the bottom plates guide. Clips shall be welded to the tank bottom to prevent lateral movement. 12.3.8 Roof supporting columns shall be made from structural shapes or pipe or built up section. Suitable base frames or reinforcing pads shall be provided at the column base to distribute loads coming on the tank bottom. 12.3.9 Appurtenances and mountings covered under section 7 of IS:803 shall be provided in addition to any other appurtenance which the CONTRACTOR considers essential for the safe and smooth operation of the fuel oil storage and oil handling system. 12.3.10 After erection and inspection of the tank, the tanks shall be tested as per clause 12 of IS: 803. Leakage if any noticed shall be repaired to the satisfaction of the OWNER and the tank retested to satisfy acceptance criteria. 12.4 Large diameter steel pipes Design, installation and testing of the pipe shall in general follow the provision “Steel pipe – A guide for design and installation “– AWWA Manual M11 – published by American Water Works Association. Steel used shall conform to IS: 2062. Minimum earth cover over the pipe shall be 1500 mm. Internal surface of pipe shall be epoxy painted and the external surface shall be provided with two coats of primer. Encasement in RCC with a minimum thickness of 250 mm with reinforcement shall be provided at locations of rail / road crossings and at locations of bends and Anchor Blocks. Bedding shall be of sand. Thrust blocks shall be provided at all bends. Internal design pressure shall be the shut off head as furnished by the pump vendor, 1.5 times the pump working head or maximum surge pressure computed from surge analysis whichever is greater. However for surge pressure the allowable stresses can be increased by 25%. External pressure shall be due to earth pressure, surcharge pressure of 2 T/sq.m and at road crossings pressure due to vehicles. In addition a		
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vacuum pressure of 9 m water column shall be considered while checking against buckling. All site joints shall be inspected by radiography. 12.5 Circular Coal bunkers Design of the bunkers shall be as per IS: 9178. Plates shall be cut to the maximum width to reduce the number of horizontal joints. Vertical joints shall be staggered. All vertical joints above bunker supporting zones and both vertical and horizontal joint below the zone shall be inspected by radiography to ensure quality. Trial assembly of the bunker including hopper shall be made at least for one bunker before commencing regular fabrication of the bunkers. Inside surface of the complete bunker including vertical and sloped portions shall be provided with lining of stainless steel plate of grade designation SS 409 M of atleast 5 mm Following recommendations shall be adopted for bunkers. 12.5.1 100% Testing of welding joints of Bunker and Bunker supporting structure .i.e. butt welds, fillet weld & bevelled weld joints is essential. 12.5.2 All the fabrication drawings should be approved by Consultant. 12.5.3 Connections shall be designed for 100% moment capacity. 12.5.4 Suitable lateral supports to be provided preferably at various levels of bunkers for earthquake and wind loads. 12.5.5 Preferably separate beams and supports for each bunker independently should be provided to avoid cascading failures.		
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PART E
OUTDOOR CIVIL WORKS

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME – VI SECTION : D 4.6 : PART E
Package : EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan PART-E-OUTDOOR CIVIL WORKS	SHEET 1 OF 6
1.0	ROADS, DRAINAGE AND SEWERAGE The drainage lines for storm water collected from rain water down take pipes for the building shall be connected suitably to the nearest storm water net work of the plant; Sewage shall be collected from all the toilets and connected to the nearest sewage manhole of the plant net work. Separate network shall be provided for lines of storm water, sewage, and waste drainage.	
1.1	Surface Drainage	
1.1.1	All the paved and unpaved areas shall be adequately drained. The surface drainage system shall be designed for surface washings and / or rain / fire water as the case may be. Unpaved open areas shall be drained through RCC drains and connected to main storm drains.	
1.1.2	The paved area shall be sloped towards the drains with a minimum slope of 1 in 100. The maximum drainage travel extent shall be limited to 10 metres.	
1.1.3	Run off coefficient for paved and unpaved areas shall be taken as 0.9 and 0.6 respectively.	
1.1.4	The surface drainage from uncontaminated area shall be connected to nearest open storm water drains through rectangular drains. Contaminated area surface drainage shall be collected through separate network.	
1.1.5	The interconnecting pipes and rectangular drains shall be sized for carrying the design discharge when running full.	
1.1.6	The rectangular drains shall be minimum 500 mm wide and of RCC construction. The pipes for water drainage system shall be of RCC class NP2 conforming to IS: 458 with minimum size of 150 mm NB. However for road crossings etc. pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards shall be provided. If sufficient clearance cannot be provided between the top of the pipe and road top, the pipes shall be encased in RCC.	
1.1.7	Surface drains shall normally have a bed slope not milder than 1 in 1000 along longitudinal direction and RCC pipes shall have such slopes so as to have effective discharge. The maximum velocity for pipe drains and open drains shall be limited to 2.4 m/sec and 1.8 m/sec respectively. However, minimum velocity for self cleansing of 0.6 m/sec shall be ensured at peak flow condition (i.e. 3 times average flow) for pipes flowing at half full.	
1.1.8	Minimum earth cover of 450 mm shall be provided over drainage pipes in paved areas.	
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1.1.9	Garland drains minimum 300 mm wide shall be provided all round the building to lead away roof drainage to plant drainage system. Plinth protection in PCC grade M20 shall be provided between brick wall and drain with appropriate slope.	
1.1.10	The plant storm water drainage system shall take into account the topography of the plant area, area drainage patterns and intensity of rainfall etc. The drainage system shall be designed for precipitation intensity equal to hourly rainfall for a return period of 1 in 50 years. However, storm frequency of 100 years return period shall be applied for Coal Storage area. These values shall be based on the recommendations of Indian Meteorological department (IMD).	
1.1.11	All storm water drainage shall preferably be through open storm water drains. These shall be provided on both sides of the roads and shall be designed to drain the appropriate catchment area including road surface, open and covered area etc. The drains shall be minimum 300 mm wide at the base.	
1.1.12	All open drains rectangular in cross section shall be in RCC of minimum M20 grade. The thickness of side and bottom shall be minimum 125 mm or as per design considerations whichever is higher.	
1.1.13	The pipes for water drainage system shall be concrete pipes of class NP2 conforming to IS: 458. However for road crossings etc. higher strength pipe of class NP3 shall be provided. Diameter of pipes used for drainage / culverts shall be between 300 mm to 600 mm. Beyond 600 mm, box drains / culverts shall be provided	
1.1.14	Suitable manholes shall be provided to piped drainage lines at every 30 m intervals, at junctions and at change of gradient, alignment and diameter of pipe and shall be of masonry or RCC construction. Minimum size of manholes shall be 1.0m x 1.0m or circular manhole of 1 m dia. All manholes shall be designed considering maintenance, inspection and cleaning of pipes. Easy accessibility and safety shall also be given due consideration.	
1.1.15	The cushion over the pipes for storm culverts shall be minimum 600 mm. Where less cushion is available, pipe shall be encased in RCC M-15. Suitable RCC or masonry structures shall be provided at drops / falls to prevent scouring or damage to surface.	
1.1.16	Invert of drainage pipe / drain shall be decided in such a way that the water can easily be discharged above the high water level in water course outside the plant boundary to which the storm water is to be led.	
1.1.17	Suitable diversion of Natural Nallah with permanent construction and connection to suitable water course.	
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1.2	Plant Effluent Drainage (Oily Waste / Process Waster Drainage)	
1.2.1	The oily / process waste shall be drained / collected through a separate sewer system consisting of underground (over ground if required) concrete pipes. Catch pits shall be provided at the source location and they shall be interconnected by buried pipes. No bends and branches shall be provided in the pipe line. Manholes shall be provided at all junctions of pipes. Catch pits shall have a minimum internal dimension of 600 mm x 600 mm. They shall be of RCC construction and provided with CI grills. The main and branch connection pipes shall be sized for the expected maximum discharge subject to a minimum of 250 mm NB and 100 mm NB respectively. The pipes shall be adequately sloped for drainage and shall carry flow to neutralisation pit / ETP / Oil water separator as required.	
1.3	Sewage System	
1.3.1	Cement concrete pipes shall be used below ground level for sewage disposal. Pipes connecting toilet facilities to manholes shall be minimum 100 mm NB. Pipes connecting various manholes shall be minimum 150 mm NB. However salt glazed stoneware pipes of diameter not exceeding 150 mm can be used in localised areas not subject to any traffic loads. For main power block below paved area, cast iron spun pipe of Class LA conforming to IS: 1536 shall be used.	
1.3.2	Sewers shall have such slopes so as to have effective discharge. Sewers shall be designed for a minimum self cleansing velocity of 0.75 m/sec for peak flow condition (assumed as 3 times the average flow) and pipes flowing half full. The maximum velocity shall not exceed 2.4 m/sec.	
1.3.3	Suitable manholes shall be provided to piped sewage lines at every 30 m intervals, at junctions and at change of gradient, alignment & diameter of pipe and shall be of masonry or RCC construction. Details of manholes shall be as per IS: 4111 (Part-I). Minimum size of manholes shall be 1.0m x 1.0 m for square section or 1 m dia for circular. All manholes shall be designed considering maintenance, inspection and cleaning of pipes. Easy accessibility and safety shall also be given due consideration.	
1.3.4	Effluent from various buildings shall be connected to a common sewage treatment plant	
2.0	INTER PLANT TRENCHES	
2.1	All cable and pipe trenches shall be of RCC with minimum M25 grade. Trenches located outside the buildings shall project at least 150 mm above finished formation level to avoid entry of storm water into the	
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trenches. The bottom of trench shall be provided with suitable slope for draining out collected water into a sump pit. 2.2 Trenches shall be covered using precast RCC cover of minimum M25 grade, each not weighing more than 75 kg and shall be provided with a lifting hooks. 2.3 As far as possible trenches in the open area shall be avoided for running cables especially in areas where the water table is high. Instead cable racks running above ground shall be provided. 3.0 ROADS All Roads shall be of RCC construction in the main plant area and shall be designed in accordance with the provision of the relevant IRC Codes of Practice. All the other Roads and parking areas shall be of flexible type of construction and shall be designed in accordance with the provision of the relevant IRC Codes of Practice. Top level of parking area shall be flushed with crown of the connecting roads with a cross slope. 3.1 Roads shall be designed for class 'E' of traffic i.e. traffic intensity of 450-1500 vehicles per day (heavy vehicles exceeding 3 tonnes laden weight) as per IRC-37:1984 .Roads/Culverts shall also be checked for heaviest foreseeable load expected in power plant based on equipment transportation planned 3.2 For design of flexible pavements California Bearing Ratio (CBR) method shall be adopted Kerbs of PCC or stone shall be provided to distinguish carriage way. 3.3 Subbase shall be of granular material i.e. laterites, moorum, natural sand, gravel, crushed stone (grading-1) or combination thereof laid over well compacted subgrade. Granular base shall be of water bound macadam course (WBM) construction. The wearing coarse shall be bituminous macadam binder course with open graded premix carpet laid over it. Shoulder provided on either sides shall be in murrum construction of 150 mm compacted thickness. 3.4 The geometric design of roads shall be done in accordance with IRC-73. Road widths, curves and parking areas shall have adequate space for manoeuvring of vehicles. The ruling gradient for roads in longitudinal direction shall be 1 in 30. Normally the roads shall have much flatter gradient. Transverse camber of 1 in 60 shall be provided for the black topping of roads and a slope of 1 in 40 shall be provided on shoulders. Finished top (crest) of roads shall be 250 mm above the surrounding grade level. 3.5 Minimum radius of curvature along the inner side of the carriage way shall be generally 12m. However for minor roads this shall be reduced suitably as per layout requirements and site conditions. Road width and		
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turning radii shall also be checked for to take largest foreseeable vehicles and equipment which can reasonably be expected. 3.6 All service and utility lines crossing under roads shall be taken through concrete pipes / ducts/culverts as required and designed for imposed loadings and heaviest foreseeable load expected in power plant. Number of such crossings shall however be kept to a minimum. 4.0 PAVING 4.1 R.C.C Paving 4.1.1 R.C.C paving of grade M20, minimum 150 mm thick laid to a slope of 1 in 100 towards the nearest drain, 50mm thick granolithic floor finish with metallic hardener topping, Reinforcement shall be minimum 8 mm dia bars placed at 150 mm centres in both ways at top and bottom. a) Entire backside of the main Turbine building up to the further edge of Chimney. The paving shall extend to a minimum of 5 m on either side from the outer most face of equipment structures in the other direction b) 5m wide corridor all along the entire width of TG and Deaerator bay at both gable ends. c) Ash silo area extending at least 10 m on all sides from outer periphery of the silos. d) Fuel oil decantation platforms 4.1.2 The under bed shall consist of well compacted ground supporting dry rubble soling of compacted thickness 250 mm with interstices properly filled with grits, followed by a layer of PCC 1:4:8, 75 mm thick. 4.2 P.C.C. Paving 4.2.1 PCC paving of nominal mix of grade M20, 100 mm laid over 150 mm thick compacted rubble soling shall be provided in the following area. PCC paving should have 50mm thick Cement concrete floor finish with metallic hardener topping. a) Plinth protection around all building to a width of 750 mm or the distance between the brick wall to the garland drain. b) Complete Transformer Yard, covering area between A-row of the turbine building upto the fencing of the Transformer yard. 4.2.2 PCC paving of nominal mix 1:3:6, 100 mm thick shall be provided as paving inside fuel oil tank farm; the paving shall be laid over well compacted ground and laid to slope towards peripheral drain.		
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4.3 Stone Aggregate paving 4.3.1 Entire switch yard shall be provided with 75 mm paving of 40 mm size stone aggregate on top and 75 mm paving of 20 mm stone aggregate below. Before laying the paving, the ground surface shall be treated with anti weed chemicals as per manufacturer recommendations. 4.3.2 For auxiliary transformer yard, paving of stone aggregate of 75 mm thick using 20 mm size aggregate shall be provided after compacting the under bed and treating with anti-weed chemicals.		
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PART F
FINISHES

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SPECIFIC TECHNICAL REQUIREMENTS The minimum quality of finishes used for various building areas are furnished in this section. The bidder is at liberty to use superior finishes provided all specific requirements for the finish specified herein below are satisfied. All fittings, fixtures, brand of paints/colours, tiles, sanitary ware shall be approved by Owner 1.0 FLOORING The nominal total thickness of floor finish shall be 50 mm including under bed and topping. The flooring shall be laid on already matured concrete base. The under bed for floors shall consist of cement concrete 1:2:4 with stone chips 12.5 mm downgraded as coarse aggregates. The under bed shall be provided with appropriate slope towards catch pit for floor drainage. 1.1 FALSE FLOORING SYSTEM If removable type false flooring system is envisaged in any area then RCC floor slab shall be sunk to a depth 600 mm which shall be height of the false floor system. The flooring shall consist of fire resistant phenol formaldehyde bonded particle board panels 600x600x35mm size, mounted on steel pedestals of adjustable height and supporting steel grid system to provide under floor space. 2 mm thick flexible anti-static PVC topping on top and PVC strip edging on sides of each panel shall be provided. 1.2 Epoxy flooring This shall be provided for oil tank rooms and shall be self levelling type over granolithic flooring and shall be as per the manufacturer's requirement. 1.3 Vitrified Tiles This shall be provided in control rooms, general circulation areas such as lift entrance area, office area, laboratory etc. Tiles shall generally be of size 600 x 600 mm and thickness of 9 to 10mm and shall be laid over concrete bedding to result in an overall thickness of 50 mm. 1.4 Kota stone flooring Kota stone flooring shall be provided in the operating floor of the power house building.		
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1.5 Granolithic flooring 1.5.1 Granolithic flooring (cement concrete flooring in 1:1:2) with metallic floor hardener topping 12 mm thick with a total thickness of 50 mm shall be provided in maintenance and unloading area of station building, mill and bunker bay, and other plant building areas where heavy duty flooring is required. 1.5.2 Granolithic flooring without floor hardener shall be provided in all MCC and switch gear rooms which are not air-conditioned. 1.5.3 Granolithic flooring shall also be provided in areas which are not provided with any special finish. Areas which are likely to be subjected to oil spillage shall be provided with two coats of oil resistant painting over granolithic flooring. 1.6 Heavy Duty Ceramic Tiles Heavy duty ceramic tiles with matt finish shall be used in toilets, pantry, dining hall of canteen, locker rooms etc. The tiles shall be 300 x 300 x 7 mm except in dining hall of canteen & in dining of canteen 600 x 600 x 9 mm thick tile shall be used of approved shade brand and colour. 1.7 Acid / Alkali resisting Tiles Battery rooms and other areas coming into contact with acid / alkali vapours or fumes shall be given acid / alkali resistant tiles 25 mm thick, jointed with acid / alkali resistant cement slurry. Bedding shall comprise of potassium silicate mortar conforming to IS:4832 (Part-I) and resin based mortar like epoxy for jointing. Total thickness of flooring shall be 50 mm. Ceramic unglazed vitreous tiles conforming to IS: 4457 with minimum thickness of 20 mm may also be used as acid / alkali resistant tile. 1.8 Integral floor finish For cable vaults floor finish integral to the concrete base shall be provided as per IS: 2571. 1.9 Kota stone Risers and treads of staircases shall be provided with Kota stone. Total thickness of the finish shall be 25 mm.		
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1.10 PLASTIC POLYPROPYLENE GLASS ACID / ALKALI RESISTANT LINING IN D.M PLANT

1.10.1 Scope

PPG lining includes the supply and fixing of 2 mm PPG sheet with 1.5mm approx. thickness of adhesive (Chemical – A and Chemical – B), Hardener and fiber. It includes complete supply of material required for the same along with the tools, tackles and skilled man power for the installation and testing of the same as per the procedure recommended and approved as per instruction of engineers. The jointing of the sheet shall be carried out help of Fusion welding of two sheets by means of PP welding rods.

1.10.2 Material

3.5mm PPG lining on floor as well as wall shall be polypropylene based material backed with glass fiber cloth. It comes in the form of 2 mm sheet of suitable size and it shall be fixed with suitable adhesive of 1.5mm approx. on the concrete or low carbon steel surfaces. The lining material shall be pasted on concrete / steel surface from glass cloth side whereas, the polypropylene side remains exposed.

These are the following properties of the PPG (BARE sheet)

Properties	Unit	Value of PPG
Physical		
Density	Gm/cm ³	0.9-0.91
Hardness	Shore	66
Heat distortion temp.	°C	80
Softening point	°C	130
Oxygen index		14
Flash ignition Temp	°C	375
Corbon Black	%	2
Mechanical		
Thickness	mm	2.0
Tensile Strength	MPa	27.8
Flexure strength	Kg/cm ²	30
Compressive Strength	Kg/cm ²	525
Izod impact strength	KJ/m ²	6.62
Elongation at break	%	570
Effect of acid		nil
Effect of Alkalies		nil
Thermal		
Thermal conductivity	W/M°k	0.14
Thermal Expansion	m/mokx10 ⁸	112
Specific Heat	J/kg° k	1925

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1.11 Miscellaneous 1.11.1 Angles 75x75x6 mm (minimum) with lugs shall be provided for edge protection of cut outs / openings in floor slabs, edge of drains covering gratings, edge of R.C.C cable / pipe trenches of any other place where breakage of edges / corners is expected. 1.11.2 MS angle nosing with minimum size (50 x 25 x 3) shall be provided for edge protection of R.C.C. stair treads. 1.11.3 Floors of switchgear rooms shall have embedded steel channel suitable for easy movement of breaker panel. 2.0 SKIRTING / DADO 2.1 150 mm skirting matching with floor finish shall be provided in all areas unless specified otherwise elsewhere. 2.2 Toilets & locker rooms shall be provided with dado of 2100 mm high with glazed tiles of minimum 5 mm thickness generally as per IS:777. 2.3 For main Control room and control equipment room minimum 5 mm thick decorative coloured ceramic vitrified tiles shall be provided upto false ceiling level. 2.4 For battery room and other areas coming in contact with acid / alkali spillage / fume, dado of acid / alkali resistant tiling as per IS:4457 shall be provided to a height of 2100 mm set in potassium silicate mortar and joints pointed with resin bonded mortar. 2.5 Staircase wall shall be given dado of matching finish to a height of 1000 mm. 2.6 Entrance lobby and lift area in service building and admin building shall be provided with granite tile dado to a height upto false ceiling level 3.0 METAL CLADDING 3.1 Permanent colour coated sandwiched insulated metal cladding system 3.1.1 Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6 mm minimum thickness (or high tensile steel sheet of 0.5 mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm / sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF2) of Dry Film Thickness (DFT) 20 microns (min) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns. 3.1.2 Galvanised M.S.sheets of minimum 0.6 mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be		
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permanently colour coated with silicon modified polyester paint of DFT 20 microns (min) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanisation shall not be less than 150 gm / sq.m. 3.1.3 The permanent colour coated sheet shall meet the general requirements of IS: 14246 and shall conform to class 3 for the durability. 3.1.4 Inner sheet shall fixed directly to side runners and Z spacers made of atleast 2 mm thick galvanised steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50 m centre to centre to hold the insulation and external sheeting. 3.1.5 The insulation shall be of bonded mineral wool of minimum thickness 50 mm conforming to IS: 8183, having a density of 32 kg / cu.m for glass wool & 48 kg / cu.m for rock wool. 3.2 Permanent colour coated (non-insulated) metal cladding system 3.2.1 Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S.sheets having minimum 0.8mm thickness for roof & 0.6 mm thickness (or high tensile steel sheet of 0.5 mm minimum thickness) for side shall be used for the cladding system. The outside (exposed face) shall be permanently colour coated with PVF2 paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of is: 14246 and shall conform to class 3 for the durability. 3.3 Flashings, caps, trim closures etc All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. 4.0 PLASTERING 4.1 Details furnished below do not include special types of plaster / plaster finishes which may be provided to enhance the architectural appeal. Contractor may propose such superior plaster finish in his bid. 4.2 External face of all walls shall be provided with 20 mm thick cement mortar plastering with an under layer 14 mm thick in CM 1:6 and top 6 mm thick layer in CM 1:4 with approved water proofing compound.		
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4.3	For internal walls 18 mm thick plaster in CM 1:6 shall be provided on the uneven side of the wall and 13 mm thick plaster in CM 1:6 on the even side of the wall.	
4.4	Inside surfaces of walls shall be provided with 2 mm thick approved wall putty over the plastered surfaces in office areas, entrance lobby, corridor, control equipment room and all other air conditioned rooms.	
4.5	Ceiling of all buildings shall be given 6 mm thick cement sand plaster 1:4 except in cable vaults and roof over false ceilings	
4.6	All plastering work shall conform to IS: 1661.	
5.0	PAINTING	
5.1	Details furnished here in below are the minimum acceptable standard for painting. Superior finish if any required by CONTRACTOR to enhance overall appearance will be permitted if such finish meets with the technical requirements.	
5.2	Water proof cement based paint as per IS: 5410 shall be provided on external faces of walls, sunshades, etc.	
5.3	Inside surfaces shall be provided with acrylic emulsion paint as per is:5411 for control room, control equipment rooms, all air conditioned areas and all other areas and above dado in buildings like time office, canteen, first aid centre, toilets residential quarters of type i and type ii etc...	
5.4	Inside surfaces shall be provided with oil bound distemper as per is: 428 for plant buildings like compressor house, pump house, workshop, DG house, ash handling pump house etc...	
5.5	Walls in D.M. Plant shall be provided with chlorinated rubber based paint as per is: 9862 over walls. Walls above dado in battery rooms shall also be provided with similar painting.	
5.6	All plastered ceilings shall provided with water bound distemper.	
5.7	Oil resistant paint as per IS: 161 shall be provided for oil canal and oil equipment room/Clean oil /Dirty oil tank rooms	
5.8	All wood work shall be provided with fire resistant transparent paint as per IS162 over french polish as per IS: 348 or flat oil paint as per IS; 137.	
5.9	Painting for structural steel has been specified elsewhere in this document.	
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5.10 Following general instruction for painting shall be followed. a) For painting on concrete, masonry and plastered surfaces IS: 2395 parts I and II shall be followed. b) For painting on wood work IS: 2338 part I & II shall be followed. c) All paints shall be of brand and make to the approval of OWNER. d) A minimum of two finishing coats of paint over a primer shall be provided to give a smooth uniform finish for the painted surface. e) All painting on masonry or concrete surfaces shall preferably be applied by rollers. f) Thinner shall not be used with textured paint (sandtex matt etc) finish. g) All fire exits shall be painted in Post office red colour shade which shall not be used anywhere except to indicate emergency or safety measure. 6.0 ROOF 6.1 Wherever R.C.C slabs over structural steel framing are provided with troughed metal sheet decking to act as permanent shuttering the sheets shall meet the general requirements of IS:14246 and shall conform to class 3 for durability. The sheeting shall be permanently colour coated galvanized M.S.troughed metal sheet decking of approved profile with minimum base metal thickness of 0.8 mm and minimum trough depth of 38mm. Silicon modified polyester painting shall be used for permanent coating over galvanized surface with minimum rate of galvanizing of 180 gm of zinc per sq.m. Dry film thickness of colour coating shall be at least 20 micron. 6.2 Roof of all buildings having R.C.C. frame work shall have cast in situ R.C.C. slab with conventional shuttering. 6.3 Roof slab of steam generator shall be provided with permanently colour coated galvnaised M.S troughed metal sheet of approved profile. Minimum base metal thickness shall be 0.8 mm. The rate of zinc consumption for galvanising shall be 275 gm/sq.m. The external face shall have permanent colour coating of pvf2 paint of minimum DFT of 20 microns and inner surface shall be coated with silicon modified polyester paint with DFT of 20 microns		
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7.0 ROOF DRAINAGE AND WATER PROOFING 7.1 For efficient drainage of rain water, roof concrete shall be given a gradient of a minimum of 1 in 100. The gradient shall preferably provided by sloping the structural framing system itself. Gradient may also be provided using screed concrete 1:2:4 using 12.5 mm downgraded aggregate. But the average thickness of such screed concrete may be restricted to about 50 mm. 7.2 water proofing shall be provided using high solid content liquid applied elastomeric water proofing joint less membrane with separate wearing course as per ASTM C-898 and ASTM C-896. Thickness of the membrane shall be a minimum of 1.5mm. The treatment includes application of polymerized mortar over sloped roof to achieve a smooth surface and a primer coat. Wearing course on the top of membrane shall consist of 25mm thick screed of concrete grade M20, cast in panels of 1.2mx1.2m and reinforced with 0.56mm dia galvanized chicken wire mesh and joints sealed using Polysulphide sealing compound. The roof shall be provided with clay tiles over the entire area with cement sand mortar of 1:4 and grouted. 7.3 Number and size of rain water down comer pipe shall be decided based on the provisions of IS: 1742 and IS: 2527. The pipes shall be MS pipe conforming to IS: 1239 & IS: 3589. It is recommended that the minimum diameter of the pipe be kept as 150 mm and there shall be a minimum of two pipes provided on each gutter. The down comer pipes shall be suitably concealed with masonry work, cement concrete or sheeting to match with the exterior finish. 2 coats of enamel paint over primer shall be applied for external surface of rain water down comer MS pipes of matching shade to building before installation at place. 8.0 FALSE CEILING AND UNDER DECK INSULATION 8.1 All air conditioned areas, entrance lobbies and corridors shall be provided with the suspended false ceiling system. Under deck insulation system shall be provided on the underside of the roof / floor slab of the air conditioned areas based on the functional requirement. Ceiling of air washer room also shall be provided with under deck insulation. 8.2 Aluminium false ceiling system shall comprise of 84 mm wide 12.5 mm deep closed type plain panels of approved colour, roll formed out of 0.5 mm thick corrosion resistant aluminium alloy AA 5050 fixed on roll formed carriers. Additional hangers and height adjustment clips shall be provided for return air grills, supply air diffusers, light fixtures, AC ducts etc. 8.3 Gyp board false ceiling system shall consist of 600x600x12 mm board with one coat of primer and two or more coats of acrylic emulsion paint.		
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The suspension system shall consist of 6 mm dia galvanised steel rods suspended from ceiling supporting aluminium grid of 38x25x1.5 mm and cross tie of 25x25x1.5 mm and aluminium angle of 25x25x1.5 mm 8.4 Suitable M.S channel (minimum ismc100) grid shall be provided above false ceiling for movement of personnel to facilitate maintenance of lighting fixtures, ac ducts etc. 8.5 CONTRACTOR shall prepare a layout of the false ceiling system incorporating light fixtures, supply air diffuser, return air grills, fire protection sprinklers etc. Such that the ceiling looks aesthetically pleasing. Work shall commence only after the OWNER approves the layout. 8.6 Under deck insulation shall comprise of 50 thick resin bonded mineral wool insulation mat conforming to is: 8183. This mat shall be backed with 0.05 mm thick aluminium foil and 24 Gx25 mm wire mesh netting. They shall be fixed to ceiling or wall as the case may be with 100x50x6 slotted mild steel plate welded to M.S plate inserts embedded at the soffit of the slab at 600 mm c/c and 14 g steel wire drawn through slots and fixed to wire netting. Or expanded polystyrene (EPS) with suitable fixing arrangement. 9.0 DOORS & WINDOWS 9.1 Unless specified all doors, windows and ventilators of air conditioned areas, entrance lobby of all buildings and windows/ventilators provided on the outer face of all buildings shall have, electro colour coated (anodised) aluminium framework with glazing. All doors of office areas shall be of factory made pre-laminated particle board (MDF exterior grade). All other doors (unless otherwise specified) shall be of steel. 9.2 Main entrance of the control room and control equipment room shall be provided with air-locked lobby with provision of double doors of aluminium frame work with glazing. Doors shall be of double swing type generally and sliding type for unit control room. 9.3 For control room, double glazed wall panels with aluminium frame shall be provided between air-conditioned and non air-conditioned areas and on the side of control room and control equipment room(s) facing the operating floor to have a clear view. 9.4 Single glazed panels with aluminium frame work shall be provided as partition between two air-conditioned areas wherever clear view is necessary. 9.5 Coal conveyor galleries shall have steel windows/ventilators. 9.6 All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm		
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centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc. 9.7 Steel windows and ventilators for coal conveyor gallery shall be as per IS: 1361 and for all other areas as per IS: 1038. Windows of coal galleries shall be provided with wire mesh 9.8 Wherever functionally required rolling shutters with suitable operating arrangement Manual / Electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248. 9.9 All windows and ventilators on ground floor of all buildings located in isolated areas shall be provided with suitable anodised aluminium grill. 9.10 Fire proof doors with panic devices shall be provided at all fire exit points as per the recommendations of Tariff Advisory Committee (TAC). These doors shall generally be as per IS: 3614 (Part I and Part II). Fire rating of the doors shall be as per TAC requirements. However minimum rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation. 9.11 Hollow extruded section of minimum 3 mm wall thickness as manufactured by INDAL or equivalent shall be used for all aluminium doors, windows and ventilators. 10.0 GLAZING 10.1 All ventilators and windows on external face of turbine building, conveyor gallery, pump house, compressor house, dg set building, transfer points, workshop building, fire escape staircase and those buildings located in fire prone areas shall be provided with wired glass of minimum 6 mm thickness conforming is:5437. 10.2 Double glazing shall consist of two 6 mm thick clear toughened safety glass conforming to IS: 2553 hermetically sealed and separated by 12 mm thick gap for thermal insulation. 10.3 For single glazed aluminium partitions and doors, Float glass or flat transparent sheet glass of minimum 5.5 mm thickness shall be used. 10.4 Ground glass / frosted glass of minimum 4 mm thickness shall be used for all windows / ventilators in toilets. 10.5 Unless specified otherwise in this specification minimum thickness of plain sheet glass used for windows/ventilators shall be 4 mm. 10.6 Float glass or flat transparent sheet glass shall conform to IS: 2835. 10.7 All glazing work shall conform to IS: 1083 and IS: 3548.		
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11.0 WATER SUPPLY AND SANITATION 11.1 Roof water tank of adequate capacity depending on the number of users and 8 hours requirement shall be provided for each building and pump house. RCC water storage tank shall be used. The tank shall be complete with all fittings including float valve, stop cock etc. The main tank for service and potable water shall be located on the roof of heater/deaerator bay. Pumping arrangements shall be made to pump from this roof to roof of bunker bay where suitable capacity tank is to be provided 11.2 Galvanised M.S. Pipe of medium class conforming to is: 1239 shall be used for internal piping works for potable water supply. 11.3 Sand C.I.Pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level. 11.4 Minimum two toilet blocks with all the facilities shall be provided on each floor of main plant building and service building. One additional toilet block consisting of both ladies and gents toilets shall be provided near control room. Attached toilets shall be provided for conference rooms. One toilet shall be provided in the boiler area. All other buildings where toilet is specified shall have one toilet block each. The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall also be followed. 11.5 Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass fancy type. a) WC (Indian type) Orissa pattern (580x440mm) as per IS: 2556 (Part-3) with all fittings including flushing arrangement of appropriate capacity and type-1 no. b) WC western type 390 mm high as per IS: 2556 (part 2) with toilet paper roll holder and all fittings including flushing system of appropriate capacity and type – 1 no. c) Urinal with all fittings with photo voltaic control flushing system as per IS: 2556 (Part-6, Sec.1) – 2 nos. d) Wash basin (oval shape) with all fittings as per IS:2556 to be fixed on concrete platform finished with 12 mm thick polished granite stone – 2 nos. e) Wall to wall Bathroom mirror (5.5 mm thick float glass) with bevelled edges including all fittings. f) Stainless steel towel rail (600 x 20mm) - 2 nos. g) Stainless steel liquid soap holder cum dispenser – 2 nos.		
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h) Janitor room. i) Provision for installation of water cooler. j) Provision of ventilation shaft. 11.6 Attached toilets provided for senior executive rooms and conference rooms shall have 1 WC, 1 urinal, 1 washbasin, 1 mirror, 1 no. Towel rail, 1 liquid soap holder cum dispenser. WC shall be of western type 390 mm high as per is: 2556(part-2) with toilet paper roll holder and all fittings including flushing valve of appropriate capacity and type. 11.7 Boiler area toilet shall have minimum 2 no. WC (European type), 4 no. Urinals, 4 no. Wash basins, 4 no. Mirrors, 4 no. Towel rails, 4 no. Soap holder cum dispenser, 2 no. Showers, janitor room and a provision for installation of water cooler. 11.8 Unless specified all fittings and fixtures in the toilets shall have same specifications as stipulated in Cl.No.11.5 11.9 .Stainless steel kitchen sink (750 mm size) for pantry shall be provided. Platform in pantry shall be finished with 12 mm thick polished granite stone. 11.10 Laboratory sink shall be of white vitreous china of size 600x400x200 mm conforming to IS: 2556(Part-5) in laboratories and in Battery room. 11.11 For each of the power house building control room and CHP control rooms, one rest room plus one pantry and dining room shall also be provided. 12.0 MISCELLANEOUS REQUIREMENTS 12.1 Doors and windows on external walls of buildings shall be provided with RCC sunshade over the openings with 300 mm projection on either side of the opening. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings. 12.2 Doors and windows on the external walls of buildings with metal cladding shall be fixed by creating recesses in the cladding system. 12.3 No cable trenches shall be provided in TG hall, Boiler/ESP area, 12.4 Duct banks consisting of MS/PVC conduits for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound. 12.5 All floor openings for cables below electrical panel shall be sealed with fire sealing compound after cables are laid.		
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12.6 All openings in external walls provided for pipes, cables, ducts etc. shall be effectively sealed to prevent water seepage, after the routing of the services are completed. 12.7 Natural lighting & Ventilation 12.8 The area of windows shall be a minimum 15 % of the floor area to ensure adequate natural lighting. 12.9 Fans shall be provided in general office area as per standard norms. 12.10 Sewerage system shall be provided with adequate ventilation for the pipe work as well as manhole.		
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SECTION – D4.8
CODES, STANDARDS & REFERENCES

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1.0	CODES, STANDARDS & REFERENCES	
1.1	All the Indian Standards referred to shall be the latest revision (including all amendments issued thereto) at the time of execution.	
1.2	Reference to only some of the codes in this document and various clauses of design criteria shall not limit or restrict the scope or applicability of other relevant codes. It shall be ensured that all other codes relevant to a specific job, in addition to those already mentioned, are followed wherever applicable.	
1.3	Where British / American / DIN or other codes and standards are referred to in this document, equivalent Indian Standards may be substituted if available.	
1.4	In case of any deviation / conflict between provisions of IS codes and the design criteria, the provisions that are more stringent shall followed unless specifically directed otherwise.	
1.5	The Codes and Standards listed below are applicable for the design and construction of structures and buildings in general. Codes and Standards applicable for specific design and construction are listed elsewhere in reference sections.	
1.6	Specifications for materials supplied from India follow the Indian Standard Specifications.	
1.7	Field and laboratory testing procedures for materials follow Indian Standard Specifications.	
1.8	Working stress design can be used as alternative but the approval of OWNER is a prerequisite.	
2.0	LOADS	
	IS:875	Code of Practice for design loads (other than earthquake) for Buildings and structure (All parts)
	IS:1911	Schedule of unit weights of building materials
	IS:1893 (Part I toIV)	Criteria for earthquake resistant design of structure
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3.0	FOUNDATIONS	
	IS:1080	Code of Practice for design and construction of shallow foundations on soils (other than raft, ring and shell)
	IS:1904	Code of Practice for design and construction of foundations in soils general requirement
	IS:2911	Code of Practice for design and construction of pile foundations: (All parts)
	IS:2950	Code of Practice for design and construction of raft foundations
	IS:2974	Code of Practice for design and construction of machine foundations (all parts)
	IS:4091	Code of Practice for design and construction of foundations for transmission line towers and poles
	IS:8009	Code of Practice for calculation of settlement of foundations: (All parts)
	IS:9556	Code of Practice for design and construction of diaphragm walls
	IS:11089	Code of Practice for design and construction of ring foundation
	IS:13301	Guidelines for vibration isolation for machine foundations
4.0	RCC	
	IS:456	Code of Practice for plain and reinforced concrete
	IS:458	Specification for precast concrete pipes
	IS:3370	Code of Practice for concrete structures for the storage of liquids: (All parts)
	IS:3414	Code of Practice for design and installation of joints in buildings
	IS:3935	Code of Practice for composite construction
	IS:4326	Code of Practice for earthquake resistant design and construction of buildings
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	IS:4995 Criteria for design of reinforced concrete bins for storage of granular (all parts) and powdery materials IS:4998 Criteria for design of reinforced concrete chimneys: (All parts) IS:5525 Recommendation for detailing of reinforced concrete works IS:1786 Specification for high strength deformed steel bars and wires for concrete reinforcement IS:10262 Recommended guidelines for concrete mix design IS:11384 Code of Practice for composite construction in structural steel and concrete IS:11682 Criteria for design of RCC staging for overhead water tanks IS:13920 Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces.	
5.0	STRUCTURAL STEEL	
	IS:800 Code of Practice for general construction in steel IS:802 Code of Practice for use of structural steel in overhead transmission line towers: (All parts) IS:806 Code of Practice for use of steel tubes in general building construction IS:808 Dimensions for hot rolled steel beam, column channel and angle section IS:813 Scheme of symbols for welding IS:816 Code of Practice for use of metal arc welding for general construction in mild steel IS:1024 Code of Practice for use of welding in bridges and structures subjected to dynamic loading IS:1161 Steel tubes for structural purposes	
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IS:2062 Structural steel (fusion welding quality) IS:4000 High Strength bolts in steel structures – Code of Practice IS:7215 Tolerances for fabrication of steel structures IS:8640 Recommendations for dimensional parameters for industrial building IS:9178 Criteria for design of steel bins for storage of bulk material (all parts) IS:9595 Recommendation for Metal arc welding of carbon and carbon manganese steel IS:12843 Tolerances for erection of steel structures		
6.0	MISCELLANEOUS	
IS:1038 Specification for steel doors, windows and ventilators IS:1172 Code of basic requirements for water supply, drainage and sanitation IS:1346 Code of Practice for water proofing of roofs with bitumen felts IS:1742 Code of Practice for building drainage IS:1905 Code of Practice for structural use of unreinforced masonry IS:2210 Criteria for design of reinforced concrete shell structures and folded plates IS:2470 Code of Practice for installation of septic tank: (part 1) Design criteria and construction (part 2) Secondary treatment and disposal of septic tank effluent IS:3067 Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings		
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IS:10440 Code of Practice for construction of reinforced brick and reinforced brick concrete floors and roofs SP:6 Handbook for structural engineers (all parts) SP:7 National Building Code of India SP:16 Design Aids for reinforced concrete to IS:456-1978 SP:20 Handbook on masonry design and construction SP:22 Explanatory handbook on codes for earthquake engineering (IS:1982-1975 and IS:4326-1976) SP:24 Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete SP:25 Handbook on causes and prevention of cracks in buildings SP:32 Handbook on functional requirements of industrial buildings SP:34 Handbook of concrete reinforcement and detailing IRC:37 Guidelines for design of flexible pavements IRC:73 Geometric design of roads Bridge rules of Government of India, Ministry of Railways (Railway Board) BS:4485 (part 4) Structural design of Cooling Towers		
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