

	TITLE: 2X800 MW LARA STPP STAGE-II EPC SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-508-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

LARA SUPER THERMAL POWER PROJECT EPC
STAGE-II (2X800 MW)

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION-C
SPECIFIC TECHNICAL REQUIREMENTS
(RCC CHIMNEY)

SPECIFICATION NO. PE-TS-508-620-C002
REV-00



Bharat Heavy Electricals Limited
 Project Engineering Management
 Power Sector, PPEI BUILDING, Plot No-25
 SECTOR 16A, NOIDA-201301, UP

	TITLE: 2X800 MW LARA STPP STAGE-II EPC SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-508-620-C002
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PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.

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SECTION	DESCRIPTION

Section-C	SPECIFIC TECHNICAL REQUIREMENTS

Section-D	SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

- Sub-section D1: Earthwork in excavation and backfilling
- Sub-section D2: Cement concrete (Plain and reinforced) and formwork
- Sub-section D3: Carpentry and joinery
- Sub-section D4: Roof and underground structures water proofing, insulation and allied works
- Sub-section D5: Metal doors, windows, ventilators, louvers etc.
- Sub-section D6: Glass and glazing.
- Sub-section D7: Rolling Steel Shutter and Grills
- Sub-section D8: Miscellaneous Metal
- Sub-section D9: Masonry and allied works
- Sub-section D10: Finish to masonry and concrete
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- Sub-section D14: Suspended ceiling
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- Sub-section D16: Road and drainage
- Sub-section D17: Fabrication of structural steelwork
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- Sub-section D19: Roof decking
- Sub-section D20: False flooring
- Sub-section D21: Bored cast in situ RCC pile
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Sub-section D23: Anti termite

Sub-section D24: Quality Assurance & Inspection

Sub-section D25: RCC stack

Sub-section D26: Borosilicate glass block lining system

CHIMNEY TENDER GA

CHIMNEY ELECTRICAL SPECIFICATION

CHIMNEY ELEVATOR SPECIFICATION

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SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS (RCC CHIMNEY)

NTPC Limited

(A Government of India Enterprise)



LARA SUPER THERMAL POWER PROJECT STAGE-II (2 X 800 MW)

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – A

SECTION - VI

BIDDING DOCUMENT NO.: CS-9587-001R-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

III	TERMINAL POINTS & EXCLUSIONS
IV	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
V	ESSENTIAL DATA
VI	MANDATORY SPARES

PART-A

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

SUB-SECTION – I

INTENT OF SPECIFICATION

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	INTENT OF SPECIFICATION			
1.00.00	INTENT OF SPECIFICATION			
1.01.00	Scope of the proposal The complete scope of the proposal for the Design, Engineering, Manufacture, Supply, Construction, Erection, Testing & Commissioning works for the EPC Package for Lara STPP Stage-II (2X800 MW), shall be on the basis of single point responsibility, completely covering the following activities and services in respect of all the equipment & works specified and covered under the specifications : a) Basic Engineering of the plant including preparation of Plant Definition Manuals; b) Detailed design of all the equipment and equipment system(s) including civil, structure steel works included in bidder's scope. c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information; d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required; e) Complete manufacturing including shop testing/type testing; f) Complete Civil, Structural and Architectural works, including survey, providing construction offices, field laboratory and construction equipments, construction water supply, construction power distribution from the supply point of Employer, infrastructure works, construction / permanent roads, drainage arrangements, fencing / boundary wall. g) Packing and transportation from the manufacturer's works to the site including logistic studies, customs clearance & port clearance, port charges, if any. h) Receipt, storage, preservation, handling and conservation of equipment at the site; i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation; j) Performance and guarantee tests will be carried out along with the initial operation; k) Furnishing of spares on FOR site basis; l) Reconciliation with customs authorities, as required. m) Conclusion of the contract. n) Insurance and other requirements for the complete EPC package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document. The requirements, conditions, appendices etc. given in Technical Specifications (Section-VI, Parts A, B, C, D and E) shall apply to and shall be considered as a part of this volume as completely as if bound herewith. The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification (Section VI) as completely as if bound herewith. The Contractor shall be responsible for providing all material, equipment and service, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. It is not the intent to specify herein all aspects of design and construction; nevertheless, the equipments and civil works shall conform in all aspects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Employer, who will interpret the meaning of the specification and drawings and shall have a right to reject or accept any work or material which in his assess-			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 1 OF 9

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
1.02.00	ment is not complete to meet the requirements of this specification and/or applicable to Indian/ International standards mentioned elsewhere in this specification. Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarifications should be sought within the time period as stipulated in section ITB. Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. However, if the bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately. Bidder may also make alternate offers provided such offers are superior, in his opinion, to the requirements of these specifications in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption, etc. shall be clearly brought out. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the equipment/systems as specified herein shall be brought out as an alternative offer i.e. the system/equipment specified shall be made as a base offer. In case the above requirements are not complied with, the offers may be considered as incomplete and would become liable for rejection.			
	This enquiry concerns two (2) power generating units each having a rated output of 800 MW, including but not limited to: ➤ Steam Generators and Auxiliaries including, - Complete pressure parts, structures, platforms, stairs, piping, valves, supports etc. - Soot blowing system with piping, valves, controls etc. - Coal feeder and complete milling system - Coal combustion system including coal / oil burners & scanners. - Selective Catalytic Reduction (SCR) System / Hybrid (SNCR+SCR) Ready System as per the scope defined in scope chapter. - Air and flue gas ductwork. - Primary air fans. - Forced draft fans. - Induced draft fans. - Aux PRDS and piping - Start up & circulation system, - Air heaters & SCAPH. - Fuel oil pressurizing system (Common system) - Elevators for Steam generators - Chemical LP Dosing system and Oxygenated Treatment system - Electrostatic Precipitators. - Wet Limestone based Flue Gas Desulphurization System - Other systems like tools & tackles etc. as specified.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 2 OF 9

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
	➤ Turbo Generators including, - Steam turbines. - Condensing plant. - Complete Regenerative Feed system. - HP-LP Bypass system. - Low Pressure Chemical Dosing system. - Condensate Extraction Pumps. - Boiler Feed Pumps - Condensate transfer pumps - Turbine hall E.O.T. crane. - Power cycle piping - Low pressure piping. - Equipment cooling water system - Boiler fill system ➤ Water Treatment Plant Including, - DM plant and CW chemical treatment. - Pre treatment and liquid effluent treatment plant - Chlorine di-oxide plant - Condensate polishing unit including regeneration facility - Reverse osmosis plant for waste water ➤ Cooling Water System including, - Equipment Cooling water system including ACW pumps. - Circulating water system including CW pumps - Cooling towers for circulating water system - Aux water system including Raw water pumps ➤ Plant Utilities including, - Compressed air system - Air conditioning and ventilation system - Fire detection and protection system ➤ Material Handling System including, - Mill Reject Handling system. - Coal & Biomass Handling Plant - Ash Handling system - Fuel Oil Handling Plant - Lime Stone & Gypsum Handling Plant			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 3 OF 9

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
2.00.00	➤ Elevators, Cranes and Hoisting equipments ➤ Electrical Equipments including, - Main generator and associated equipment. - All Transformers. - Bus ducts. - Medium and low-voltage switchgear, motor control centres. - Motors & Cables etc. - Illumination, Earthing, Lightning protection, DG sets, Batteries, Battery Chargers, Overhead lines etc. - Electrical systems as required. - Switchyard ➤ Control and Instrumentation system along with accessories and Instrument Cables. ➤ Civil works for the complete plant covered under bidder's scope shall be as mentioned in Sub-Section II-D, Section VI, Part-A of the specification. ➤ Complete Mechanical, Civil, Electrical & C&I works related to raw water System. ➤ Solar PV Plants on Roof Tops			
	ADDITIONAL REQUIREMENTS (a) Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer. (b) Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the contractor at his own cost to the satisfaction of the Employer. The contractor shall also take all necessary safety measures with specific reference to excavation in rock, at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power plant. (c) For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Porta cabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look. (d) In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill.			
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	(e) Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements/tie up with equipment manufacturers / suppliers for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.			
3.00.00	TENDER DRAWINGS The tender drawings are enclosed along with the specification as Part-E, Section-VI and shall supplement the requirements specified in these technical specifications. The scope and terminal points of the equipment to be furnished under this EPC package shall be as identified in these drawings read in conjunction with text of the specification.			
4.00.00	OTHER GENERAL REQUIREMENTS Items though not specifically mentioned in the specification but needed to complete the equipment/systems to meet the intent of specification, shall also be deemed to be included unless otherwise specifically mentioned in exclusions. In addition to the scope of supply and services indicated in other Sub-Sections of the scope of supply and services, the other general requirements are covered in this sub-section as part of the scope of the Contractor.			
4.01.00	Paints The Contractor's scope of work includes supply of paints and painting of all equipments and structures as per stipulated requirements and the Employer's standard color coding scheme.			
4.02.00	Pre-commissioning and commissioning activities The contractor's scope shall include all pre-commissioning and commissioning activities, materials and services as detailed in other portion of technical specifications including supply of all consumables (except coal, oil and limestone for which subsequent para may be referred), temporary equipment and pipings, instruments, labour / skilled manpower's etc. The scope includes complete requirement of flushing oils including fresh oil refilling during the pre-commissioning and commissioning activities and subsequent initial operation. Regarding, coal & fuel oil, the Contractor shall quote the total maximum quantity of the coal and fuel oil as required upto the successful completion of "Initial Operation" (as defined in General Technical Requirements, Part-C, Section-VI of Technical Specification) for both the units which shall be issued to it free of charge by the employer for such operation during execution. Such quoted quantity shall include all pre-commissioning & commissioning activities (including running of units for tuning or any other purpose as required before commencement of initial operation) and considering consumption during initial operation considering average load of 60% of rated value for both the units. These quantities for both coal and fuel oil shall be compared with the respective quantities as quoted by various bidders. The quantities over & above the base value (minimum among the quoted figures for coal & fuel oil) shall be used as a loading factor and corresponding computed price (total for coal & fuel oil) shall be added to the quoted bid price for deriving the total bid price. The cost of coal & fuel oil shall be used as Rs. 1790/Ton (Rupees one Thousand seven Hundred and ninety only per ton of coal) Rs. 40,000/KL (Rupees Forty Thousand per KL of fuel oil) for such purpose. Further, during execution any requirements (of coal & fuel oil) beyond the quoted quantities by the successful bidder would be issued by NTPC but charged back to the contractor as per			
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4.07.00	purposes and shall be in an unused and new condition, when they are handed over to the Employer. A list of all such special tools and tackles shall be submitted along with the offer. The scope of the Contractor includes complete design and engineering, technical co-ordination (including participation and arranging technical co-ordination meetings), finalization of drawings/documents, submission of engineering drawing/documents and processing of their approvals by the Employer as per requirement indicated in Part-C of section -VI and other relevant clauses given elsewhere in the Technical Specifications. Further, the scope shall also include submission, in proper shape and format, of all types of manuals, handbooks and documents in requisite numbers to the Employer at different phases of the project as per the requirement of Employer.			
4.08.00	All the plant layouts shall be made in computerized 3D modelling system as detailed in Part C of the Technical Specification. Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include, Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary. Contractor shall prepare 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.) and structural arrangement drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. The contractor shall prepare the 3D model indicating the control & instrumentation equipments, devices such as location of LIE,LIR, flow elements, instrument tappings, thermowell stubs, JBs , cable trays, Flame scanners, Flame viewing cameras, ASLD, Control valves & actuators, Coal bunker level instruments along with approach / maintenance platform, provided for all these equipment's/devices. The LIE & LIR shall be placed in such a way that the doors can be opened freely from front & back side for ease of maintenance. The cable tray layout shall be implemented in such a way that the fouling to the pipes, ducts and other structures can be avoided. These above drawings are to be extracted from the said 3D model and submitted for employers review and approval along with the 3D model. After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.			
4.09.00	The Contractor shall be responsible to undertake some activities related to its Corporate Social Responsibility (CSR) in the immediate vicinity of the project. The Contractor shall undertake such activities after prior consultations with the Employer to ensure that the efforts of the Employer and Contractor are complemented. The vendor / contractor is expected to carry out the CSR activities as per the provision (Rules) under section 135 of the companies Act 2013 relating to CSR and other circulars / instructions of various government departments viz MoEF etc. The share of CSR expenditure to be incurred by the vendor / contractor for this project in the total CSR expenditure incurred by the vendor/contractor as a company will be in the same			
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	proportion as the turnover of the project concerned to the total company turnover. This will be certified by the chartered accountant once every fiscal year. Such activities will be undertaken by the contractor / vendor in consultation with the Employer.			
4.10.00	The vendor / contractor shall visit the site to ascertain the position of land acquisition etc. and it is presumed that the contractor submitted his bid after considering the facts on the ground and that once vendor / contractor is successful in his bid, he will work in cooperation with the client for smooth execution of the project.			
4.11.00	The scope of the contractor shall also include supply and installation of e-learning packages for the equipment / system for the Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system as indicated in Part-C of Section-VI.			
5.00.00	GENERAL ENVIRONMENTAL REQUIREMENTS			
	The contractor shall execute all work at site as per the general environmental requirement and following the applicable codal provisions and local regulations in this respect. The contractor shall provide and install suitable safeguards and facilities as approved by the Engineer for meeting general environment requirements given herein under.			
5.01.00	Protect from damage and disturbance of the existing trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipe lines, drains, sewers, or other surface or sub-surface systems / facilities within or adjacent to the works being carried out given herein below.			
5.02.00	Take all necessary precautions against soil erosion, water and environmental pollution and safe disposal of waste material.			
5.03.00	Control the ground in the vicinity of all excavations, so that the surface of the ground is properly sloped or dyked to prevent surface water from running into the excavated areas, during construction.			
5.04.00	All natural materials arising out of site clearance and excavation shall be the property of owner. All salvaged materials of archaeological importance or of value (in the opinion of the Engineer) shall be segregated from the other materials and stacked separately at locations as indicated by the Engineer.			
5.05.00	The method and arrangement of blast cleaning shall conform to factory act, local laws, stipulations of pollution control board, if any.			
5.06.00	a) Excavated earth should be stockpiled properly at designated areas so as not to spread and cause air pollution (fugitive dust emission) and water pollution (suspended solids in run-off). Top soil (top 150mm layer of the fertile soil) may be stored separately for future use in landscaping / revegetation / horticulture. b) Solid wastes generated during construction such as construction debris, excess cement / concrete, wrapping materials (e.g. plastic packets and wrappers), timber, tins, cans and drums, wire, nails, glass etc., chemical wastes and hazardous wastes, food and domestic wastes etc., should be properly disposed off so as not to cause any air / water pollution. c) Potential pollutants (such as oils, chemicals) shall be kept, stored, and used in such a manner that any escape can be contained and the surface and ground water resources are not contaminated. d) Water containing pollutants such as cements, concrete, lime, chemicals and oils shall be discharged through a temporary sedimentation and equalization tank.			
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	e)The necessary precautions shall be taken to control emission of fugitive dust and suspended solids in effluents leading to sedimentation of receiving water bodies. f)Provide necessary sanitation facilities to the labour camps. g)All vehicles and equipment shall be kept in good working order and serviced regularly to maintain the exhaust emissions and noise levels within reasonable limits. h)Control the movement of all vehicles so as to minimize disruption to regular users of the routes. i)The speed of the vehicles on gravel or earth roads in and around site may be restricted to minimize the emission of fugitive dust. Further, the road surface of gravel or earth roads may be provided with suitable cover to reduce the emission of fugitive dust.			
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SUB-SECTION-I-A

PROVENNESS

CLAUSE NO.	PROVENNESS			एनटीपीसी NTPC				
PROVENNESS The bidder/its sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for the items/ services listed below as per the stipulated criteria indicated in the respective clauses. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on the techno-commercial bid opening date of EPC package unless otherwise specified in the respective clauses. The Bidder/its Sub vendor(s) shall be a company incorporated in India under the Companies Act of India for Collaborator(s) / Associate / Licensor / Technology provider route as specified in various clauses of the provenness requirement for equipment/systems. 1.0 Provenness of Turbine Set (a) The turbine set offered shall be built up using proven design modules of HP, IP (or Combined HP-IP ,if applicable) and LP turbines of the Qualified Steam Turbine Generator Manufacturer. The offered HP turbine module should have been in successful operation with Super critical pressure and Main steam temperature of 593 deg C or higher for a period of not less than one (1) year prior to the date of techno commercial bid opening. The offered IP turbine module should have been in successful operation with Reheat steam temperature of 593 deg C or higher for a period of not less than one (1) year prior to the date of techno commercial bid opening. In case Combined HP-IP turbine module is offered it shall meet the respective requirements of HP turbine and IP turbine modules as above. The offered LP turbine module should have been in successful operation for a period of not less than one (1) year prior to the date of techno commercial bid opening. The Bidder shall furnish experience list of HP, IP (or Combined HP-IP) and LP turbine modules offered to substantiate their provenness along with the techno commercial bid. (b) The turbine to be supplied under this contract shall be manufactured, assembled and tested in a factory where turbines of at least 500MW rating have been manufactured in the past. Alternatively the same can also be manufactured in the Indian Manufacturing Company under supervision of Qualified Steam Turbine Generator Manufacturer. 2.0 Provenness of Generator a) The generator offered shall be of proven design of the Qualified Generator Manufacturer, of 800 MW or above rating, which is in successful operation for a minimum period of one (1) year prior to the date of techno-commercial bid opening. b) The offered generator shall be similar in design and construction to the above proven generator in respect of: i. Cooling medium (e.g. water, Hydrogen etc.) and number of shaft mounted fans. ii. Thermal Class of Insulation for stator and rotor windings. iii. Core support system (e.g. spring type, rigid type etc.) iv. Type of Excitation system <tr><td>LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION-VI, PART-A</td><td>SUB-SECTION-I-A PROVENNESS</td><td>PAGE 1 OF 36</td></tr>					LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 1 OF 36
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- c) The generator to be supplied under this contract shall be manufactured, assembled and tested in a factory where generator of at least 500MW rating have been manufactured in the past. Alternatively the same can also be manufactured in the Indian Manufacturing Company under supervision of Qualified Generator Manufacturer.

The Bidder shall furnish experience list for offered Generator to substantiate it's provenness along with the techno commercial bid.

3.0 Provenness criteria for critical equipment(s) and bought out items

- 3.1 The Bidder/ Sub vendor should have previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type and minimum equipment rating as stipulated below such that the respective equipment(s) are in successful operation in at least one (1) plant for a period not less than one (1) year .

Sl. No	Name of equipment	Type of equipment	Equipment rating
a)	PA Fans	Axial type (2 stage) with variable pitch control	Flow 210 M3/Sec (minimum) with Head 1130 mmWC (minimum) & Fan Speed 1500 rpm (maximum)
b)	ID Fans	Axial type (2 stage) with variable pitch control	Flow 525 M3/Sec (minimum) with Head 525 mmWC (minimum) & Fan Speed 900 rpm (maximum)
c)	FD Fans	Axial type with variable pitch control	Flow 365 M3/Sec (minimum) with Head 350 mmWC (minimum) & Fan Speed 1500 rpm (maximum)
d)	Coal Pulveriser	Bowl mill/Roller mill/Ball & Race mill/or approved equivalent	Minimum capacity -78 T/hr with: a) Coal pulverizing fineness not less than 70% through 200 mesh b) Coal input size up to 50 mm c) Total moisture in coal- 12% d) HGI of input coal-55
e)	Raw coal feeders	Gravimetric, belt type with minimum size of 36 inch	Capacity not less than 95 T/hr
f)	Boiler start up drain re-circulation pumps	Glandless pump with submerged type wet motor with external high pressure cooler.	Pump rating not less than that supplied for a 500 MW or higher size super-critical unit.

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Sl. No	Name of equipment	Type of equipment	Equipment rating	
g)	Air pre-heaters	Rotary regenerative (Lungstorm or approved equivalent)-Bisector type or Trisector type with vertical axis of rotation	Air pre-heater rating not less than that supplied for a 500 MW or higher size unit.	
h)	Booster Fans	Axial type with variable pitch control Application - Coal fired power plant	Flow 525 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)	
i)	Condenser	Condenser of the type specified	Condenser of a 500 MW or higher size steam turbine generator unit	
j)	Condensate Extraction Pumps (CEP)	Vertical, cannister with double suction first stage impeller for steam turbine generator sets	Capacity not less than 1025 Ton/ hr and total developed Head not less than 30 Kg/cm2 OR Capacity not less than 880 Ton/ hr (in case drip pumps are used) and total developed Head not less than 30 Kg/cm2	
k)	Condenser Air Evacuation Pump	Liquid ring type for steam turbine generator sets	Free dry air capacity 20 SCFM at 1" of Hg (abs) at 21.1 deg C.	
l)	Feed Water Low Pressure Heaters	Horizontal, U-tube type having condensing and drain cooling zones for steam turbine generator sets	Feed Water Low Pressure Heater of a 500 MW or higher size unit	
m)	Feed water High Pressure Heaters	Horizontal, U-tube type, having integral desuperheating, condensing and drain cooling zones for steam turbine generator sets	Feed Water High Pressure Heater of a 500 MW or higher size unit.	
n)	Deaerator	Horizontal / vertical, direct contact, spray or spray cum tray design for steam turbine generator sets	Deaerator of a 500 MW or higher size unit	
o)	Boiler Feed Pumps (BFP)	Horizontal, centrifugal, multistage, outer casing barrel type with end	Capacity not less than 1250 Ton/ hr and total developed Head not less than 320	
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SI. No	Name of equipment	Type of equipment	Equipment rating
		rotor removal for supercritical steam turbine generator sets	Kg/cm2
p)	HP Bypass system	HP Bypass system for supercritical steam turbine generator sets	Capacity of each valve not less than 750 Ton/hr at 270 Kg/Cm2(abs) & 600 deg.C Main Steam pressure and temperature at Turbine inlet.
q)	LP Bypass system	LP Bypass system for steam turbine generator sets	Capacity of each valve not less than 750 Ton/hr at pressure corresponding to 100% TMCR condition reheat pressure (abs) & 600 deg.C reheat temperature at Turbine inlet.
Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer proposed by the Bidder for the above equipment(s) is qualified.			
The provenness criteria for equipment (PA fans, ID fans, FD fans and Booster Fans) stipulated at SI. No. (a), (b), (c) & (h) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment.			
3.2 In case the Bidder or the proposed Indian sub-vendor(s) is not manufacturer of proven equipment(s) as per clause 3.1 above then it should have manufactured such equipment(s) for units of at least 500 MW rating, and it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment(s), in India with such manufacturer(s) who meet the requirements stipulated at clause 3.1 above for the respective equipment(s).			
3.3 (a) A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 3.1 above in India, should have a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 3.1 above (or the technology provider of the qualified equipment manufacturer). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or up to the end of defect liability period of the contract, whichever is later.			
OR			
Indian Holding Company, of the Qualified Equipment Manufacturer who meets the requirements stipulated at clause 3.1 above for the respective equipment(s), should have a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with the qualified equipment manufacturer.			
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	Further, in such a case, such Indian Holding company shall maintain at least 51 % equity participation in the Qualified Equipment manufacturing company either directly or indirectly, which shall be maintained for a lock-in period of seven (7) years from the date of acquisition of such Qualified Equipment manufacturing company or up to the end of defect liability period of the contract, whichever is later. (b) Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of respective equipment(s) valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor. 3.4 Before taking up the manufacturing of such equipment(s) as per clause 3.2 and 3.3 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments. 3.5 Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified. 3.6 The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. 4.0 Provenness criteria for other equipments/ systems 4.1 Electrostatic Precipitator Bidder / Bidder's sub-vendor should meet the qualifying requirement here under in clauses 4.1.1 or 4.1.2 or 4.1.3 as the case may be. 4.1.1 The Bidder/Bidder's sub-vendor should have designed, supplied, erected/ supervised erection and commissioned/supervised commissioning of rigid discharge framework Electrostatic Precipitators (of the type offered), having a designed efficiency of not less than 99%, operating in conjunction with pulverized coal fired steam generating units, rated for a minimum of 500MW unit size or minimum 1500 T/hr steaming capacity, which should have been in successful operation in at least one installation for a period not less than one (1) year. 4.1.2(a)(i) The Bidder/Bidder's sub-vendor should be an Engineering, Procurement and Construction (EPC) organization executing contracts for setting up of coal fired power plants and shall have experience of supplying at least one (1) no. coal fired power plant of 200 MW capacity or above comprising of Electrostatic Precipitators, which has been in successful operation for a period of not less than one (1) year. Alternatively (a)(ii) The Bidder/Bidder's sub-vendor should be an Engineering, Procurement and Construction (EPC) organization and should have executed, in the last 10 years, large industrial projects on EPC basis (with or without civil works) in		
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the area of power, steel, oil & gas, petro-chemical, fertilizer and / or any other process industry with the total value of such projects being INR 5,000 million or more. At least one of such projects should have a contract value of INR 2,000 million or more. These projects shall be in successful operation for a period of not less than one (1) year. (b) The Bidder/Bidder's sub-vendor who fulfill the requirements as per clause 4.1.2(a) (i) or 4.1.2(a) (ii) above shall Associate/Collaborate with an Electrostatic Precipitator manufacturer who meets the requirements of 4.1.1 above on its own. The Bidder/ Bidder's sub-vendor shall either source the Electrostatic Precipitator from such manufacturer or manufacture the Electrostatic Precipitator as per the design and manufacturing drawings released by such manufacturer under an on-going Collaboration agreement/ Technology Licensing Agreement. Bidder shall be required to furnish a letter of support from Collaborator / Licenser / Technology provider for successful performance of Electrostatic Precipitator valid up to the end of defect liability period of the contracts as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor.				
4.1.3	(a) The Bidder/Bidder's sub-vendor should have designed, supplied, erected/ supervised erection and commissioned/ supervised commissioning rigid discharge framework Electrostatic Precipitators (of the type offered), having a designed efficiency of not less than 99%, operating in conjunction with pulverized coal fired steam generating units, in at least one installation rated for a minimum of 200 MW unit size or minimum 600T/hr steaming capacity, which should have been in successful operation for a period not less than one (1) year. (b) The Bidder/ Bidder's sub-vendor who fulfill the requirements at clause 4.1.3(a) above, shall also have an on-going Collaboration Agreement/Technology Licensing agreement prior to the date of submission of proposal for sub-vendor with such a manufacturer of Electrostatic Precipitators, who meets the requirements of clause 4.1.1 above. Bidder shall be required to furnish a letter of support from Collaborator / Licenser / Technology provider for successful performance of Electrostatic Precipitator valid for a period of 07 (seven) years or up to the end of defect liability period of the contract whichever is later, as per the format enclosed in the bidding document, along with the techno commercial bid.			
Notes to clause 4.1.1, 4.1.2 & 4.1.3 (1) "Qualified Electrostatic Precipitator Manufacturer" means a manufacturer meeting requirements stipulated at 4.1.1. (2) The Bidder/ Bidder's sub-vendor shall also be considered qualified, in case the award for executing the reference works (Electrostatic Precipitator set) has been received by the Bidder/ Bidder's sub-vendor either directly from owner of plant or any other intermediary organization. However, a certificate from such owner of plant or any other intermediary organization shall be required to be furnished by the Bidder/ its sub-vendor in support of Bidder/ Bidder's sub-vendor claim of meeting the qualification requirement as per 4.1.1 or 4.1.2 or 4.1.3 above. Further, certificate from owner of the plant shall also be furnished by the Bidder/ Bidder's sub-vendor for				
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	the successful operation of the Electrostatic Precipitator as specified at clause 4.1.1 or 4.1.2 or 4.1.3 above, whichever is applicable.		
(3)	Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/lignite.		
4.2	CW Pumps		
	The Bidder/its Sub-vendor should meet the qualifying requirements of any one of the qualifying routes stipulated under clause 4.2.1 or 4.2.2 or 4.2.3.		
4.2.1	The Bidder/its sub-vendor should have designed either by itself or through its Collaborator/ Associate, manufactured/got manufactured, supplied, erected/supervised erection, and commissioned / supervised commissioning of at least one (1) no. vertical wet pit pump or one (1) no. concrete volute pump or one (1) no. metallic volute pump with concrete encasement, each of rated capacity 42,000 cum/hr or offered rated capacity whichever is lower, having specific speed in the range of 4000–7000 (*) (US units) which should have been in successful operation for at least one (1) year.		
	The Bidder/its sub-vendor should offer only the type of CW pumps i.e., vertical wet pit type pumps or concrete volute type pumps or metallic volute pumps with concrete encasement for which Bidder/its sub- vendor gets qualified as above.		
4.2.2	Bidder/its sub-vendor who has designed by itself, manufactured/got manufactured, supplied, erected/supervised erection, and commissioned/supervised commissioning of at least one (1) no. vertical wet pit pump or one (1) no. concrete volute pump or one (1) no. metallic volute pump with concrete encasement, each of rated capacity 15,000 cum./hr or more, having a specific speed in the range of 4000–7000 (*) (US units) which should have been in successful operation for at least one (1) year can also participate, provided it associates/ collaborates with a firm who in turn meets the requirements of 4.2.1 above.		
	The Bidder/its sub-vendor should offer only the type of CW pumps i.e., vertical wet pit type pumps or concrete volute type pumps or metallic volute pumps with concrete encasement for which it's Associate/ Collaborator gets qualified as per clause 4.2.1 above.		
	In such a case, the Bidder/its sub-vendor shall be required to furnish a letter of technical support from Collaborator / Associate for successful performance of CW pumps, as per the format enclosed in the bidding document. This letter of technical support should be submitted to Employer prior to the placement of order on approved sub-vendor.		
4.2.3	a) The Bidder/its sub-vendor should be a wholly or partially (with minimum 51% holding) held Indian subsidiary of a firm who in turn meets the requirements of clause 4.2.1. Further, the Bidder/its sub-vendor should have executed/be executing atleast one (1) Contract involving design, manufacture/got manufactured, supply, erection/supervision of erection, and commissioning/ supervision of commissioning of at least one (1) no. vertical wet pit pump or one (1) no. of concrete volute pump or one (1) no. of metallic volute pump with concrete encasement, each of rated capacity 15,000 cum/hr or more. b) The Bidder/its sub-vendor should offer only the type of CW pumps i.e., vertical wet pit type pumps or concrete volute type pumps or metallic volute pumps with concrete encasement for which the Holding Company of the Bidder/its sub-vendor (i.e., the firm meeting requirements of clause 4.2.1 above) is qualified.		
	In such a case, the Bidder/its sub-vendor shall be required to furnish a letter of technical support from Holding company for successful performance of CW pumps, as per the format enclosed in the bidding document. This letter of technical support should be submitted to Employer prior to the placement of order on approved sub-vendor.		
	Notes for clause 4.2.1, 4.2.2 and 4.2.3		
(i)	For qualification under clause 4.2.1, a firm can meet the requirements stipulated under clause 4.2.1 above either singularly or collectively along with its Subsidiaries. In such a case, the Bidder/its sub-vendor shall be required to furnish a letter of technical support from Collaborator / Associate / Holding company along with all its subsidiaries extending support to the holding company / Associate or collaborator for complying requirements of clause 4.2.1 for successful		
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	performance of CW pumps, as per the format enclosed in the bidding document. This letter of technical support should be submitted to Employer prior to the placement of order on approved sub-vendor. (ii) (*) Specific speed as stipulated above is the specific speed calculated at the best efficiency point of the pumps as defined in Hydraulic Institute Standards (HIS).		
4.3	Induced Draft Cooling Towers		
4.3.1	The bidder/ its sub-vendor should have designed by itself, constructed and commissioned at least one (01) number Induced Draught Cooling Tower in RCC or Pultruded Fiberglass Reinforced Plastic(FRP) Construction of capacity not less than 13000m3/hr which should have been in successful operation for atleast one(1) year. The reference Cooling Towers should be of the same type i.e. counter flow or cross flow as is being offered by the Bidder/ its sub-vendor and of the same construction type i.e. RCC construction or FRP construction as being offered by the Bidder/ its sub-vendor.		
OR			
4.3.2	The Bidder/ its sub-vendor should be a wholly or partially (with minimum 51% holding) held Indian subsidiary of a firm who in turn meets the requirements of clause 4.3.1 above. Further, the Bidder/ its sub-vendor on its own or alongwith its holding company should have executed/ be executing atleast one contract involving design, construction and commissioning of atleast one(1) number Induced Draft Cooling Tower in RCC/ Pultruded Fiberglass Reinforced Plastic (FRP) Construction of capacity not less than 6500m3/hr. In such a case, the Bidder/its sub-vendor should furnish a letter of technical support from Holding Company (i.e. the firm meeting requirements of clause 4.3.1 above) for successful performance of the Cooling Towers as per format enclosed in bidding documents. This Letter of Technical Support should be submitted to employer prior to the placement of order on approved sub-vendor.		
	Notes: “design by itself” means that tower(s) of reference plant must have been designed by the bidder’s own engineers. Tower(s) designed by consultant/collaborator/associate of the bidder shall not be considered.		
4.4	Fire Detection and Protection System:		
	The Bidder/its sub-vendor should have designed, supplied, erected and commissioned at least one (1) fire protection system of contract value not less than INR 35.0 Million or equivalent in foreign currency (exchange rate applicable as on date of Techno-Commercial bid opening), in industrial installation. The fire protection system should have comprised of: a) Fire hydrant system. b) High velocity water (HVW) spray or medium velocity water (MVW) spray or sprinkler system. c) Fire water pumping and pressurizing arrangement. The system mentioned above should have been designed to the recommendations of Tariff Advisory Committee of India or Oil Industry Safety Directorate (OISD) or any other International reputed authority (like LPC-U.K. or NFPA, USA) and this system should have been in successful operation for a period of not less than one (1) year. In addition, the analogue addressable type fire alarm system proposed to be supplied shall be sourced from a firm who has supplied at least one (1) similar system which has been approved or listed by UL-USA/ FM-USA/		
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LPC-UK/ similar agency and should have been in operation for at least one (1) year. Further, the Inert gas fire extinguishing system shall be sourced from an agency who has designed and supplied at least one (1) Inert gas total flooding fire extinguishing system having a total risk volume of at-least 1000 Cum. This system must have been designed to the recommendation of Tariff Advisory Committee of India or any other International reputed authority (like LPC-U.K. or NFPA, USA) and should have been in operating condition for a period not less than one (1) year.

4.5 Air Conditioning System

The Bidder/ its sub-vendor should have designed, supplied, erected and commissioned at least one (1) number of Air conditioning system having a total installed capacity of **300TR or more including stand-by chiller unit (if any)**, which should have included at least one chilling unit with a minimum capacity of **60TR**. The system should have been in successful operation for at least one (1) year.

In addition, the chiller unit(s) proposed to be supplied for this package shall be sourced from the manufacturer(s) who have manufactured and supplied at least one (1) number of similar type of chiller unit having a capacity of not less than 150 TR, which should have been in successful operation for at least one (1) year.

4.6 Ventilation System

The Bidder/its sub-vendor should have designed, supplied, erected, and commissioned at least one (1) number ventilation system including similar air washer unit having individual fan capacity of 80,000 Cum./Hr. or more. The system should have been in successful operation for at least one (1) year.

4.7 Compressed Air System

A) The bidder/ its sub-vendor should have designed, manufactured, supplied, erected/supervised erection and commissioned/supervised commissioning of at least one (1) number non-lubricated oil free screw type air compressor of minimum capacity 20 NM³/min or at least one (1) number centrifugal air compressor of minimum capacity 50 NM³/min and at rated discharge pressure of 8 kg/cm² (g) which should have been in successful operation for at least one (1) year. Bidder/its sub-vendor shall offer only the type of compressors for which he is qualified.

B) The Air Drying Plant (A.D.P) shall be supplied from such manufacturers who have manufactured and supplied at least one (1) number Air Drying Plant of capacity 50 NM³/min or more and the type same as offered, which should have been in successful operation for at least one (1) year.

4.8 Water Pre-treatment Plant

The Bidder/its sub-vendor should have designed, supplied, erected and commissioned at least one (1) number water/waste water treatment plant having capacity of not less than 1000 Cu.m/hr, comprising of clarifiers/tube settlers/thickeners or a combination thereof including civil works. The plant should have been in successful operation for at least one (1) year.

4.9 Ion Exchange Demineralization Plant

In case the Bidder/its sub-vendor offers ion exchange based demineralization Plant for DM water, the Bidder /its sub vendor should have designed, supplied, erected and commissioned at least one (1) number of ion exchange based demineralizing plant, consisting of at least two (2) streams each of minimum 60 cum./hr capacity, capable of producing outlet water quality of silica and conductivity not more than 0.02 ppm as SiO₂ and 0.2 micromho/cm respectively, which should have been in successful operation for at least one (1) year.

4.10 Reverse Osmosis Plant

In case the Bidder/its sub-vendor offers reverse osmosis with mixed bed combination plant for DM water, the Bidder/its sub-vendor should have designed, supplied, erected and commissioned / supervised commissioning of one (1) number Reverse Osmosis (RO) Plant of minimum capacity (permeate flow) of 120 Cum/hr OR two (2) numbers RO Plants in separate contracts each of minimum capacity (permeate flow) of 60 Cum/hr OR three (3) numbers RO Plants in separate contracts each of minimum capacity (permeate flow) of 40 Cum/hr. The above RO plant (s) should be having inlet feed Water with TDS $\geq$ 500 ppm and capable of producing permeate water quality with TDS not more than 100 ppm OR having inlet feed as sea water and capable of producing permeate water quality with TDS not more than 500 ppm. The plant (s) should have been in successful operation for at least one (1) year.

4.11 CW Chemical Treatment

The Bidder/its sub-vendor should have executed contracts for cooling water treatment program of at least two (2) different cooling water systems each having a flow rate not less than 10,000 Cu.M/hr operating in alkaline pH range and both the treatment programs should have been in successful operation for at least one (1) year. These contracts should include supply of chemicals, operation and maintenance of the system by main contractor or their agency/sub-supplier. The Chemicals used in these programs should have been organic polymers/ organic phosphorous compounds/ organic phosphates-based chemicals.

4.12 NOT USED

4.13 Mill Reject Handling System

Mill reject handling system offered by the Bidder/its Sub-Vendor shall be only from such manufacturer/supplier who has previous experience of manufacturing/got manufactured and supplying metallic belt conveyor type or chain flight conveyor type coal mill rejects handling systems of capacity 1.5 MTPH or higher for a pulverized coal-fired boiler unit which are in successful operation in at least one (1) plant for a period not less than one (1) year.

The reference mill reject handling systems should be of the same type i.e. metallic belt conveyor system or chain flight conveyor system as is being offered by the Bidder/ its Sub- vendor.

4.14 Condensate Polishing Plant

- a) The Bidder/its Sub-vendor should have designed, supplied, erected and commissioned at least one (1) Condensate Polishing Plant of mixed bed, deep bed type consisting of service vessel of minimum capacity of 500 M³/hr. The plant shall have external regeneration system, incorporating the same resin separation and regeneration process as proposed by the Bidder / its Sub-vendor for this package. The above plant should have been in successful operation for a period of at least one (1) year.
- b) The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at (a) above, may also participate provided the Bidder/its Sub-vendor is a Contractor in water treatment plant and has executed at least one (1) number ion exchange based demineralising plant of minimum capacity of 60

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	Cu.m/hr consisting of maximum two (2) streams and associates for this bid with an Associate who in turn fully meets the requirements stipulated at 4.14 (a) above. In such a case, the Bidder/its sub-vendor shall be required to furnish a letter of technical support from Collaborator / Associate for successful performance of Condensate Polishing Plant, as per the format enclosed in the bidding document. This letter of technical support should be submitted to NTPC prior to the placement of order on approved sub-vendor. 4.15 Turbine Hall EOT crane The Bidder/ its sub-vendor should have designed, manufactured, erected and commissioned EOT cranes of capacity 100T or more with minimum crane span of 28 meters, which is in successful operation in at least one (1) station for a minimum period of one (1) year. 4.16 Condenser on-load tube cleaning system (COLTCS) The Bidder/ its sub-vendor should have designed, manufactured, erected and commissioned COLTCS with ball collecting strainer having diameter of not less than 2100 mm, which is in successful operation in at least one (1) station for a minimum period of one (1) year. 4.17 Not Used 4.18 On-line Blade Vibration Monitoring System for Low Pressure (LP) Turbines (in case Free Standing Blades are offered) The Bidder/sub-vendor should have designed, engineered, supplied, installed and commissioned at least one (1) number of Integrated On-line Blade Vibration system for health monitoring/Crack Detection of free standing blades of Low Pressure Turbine of Steam Turbine Generator set of 200 MW or above capacity. This integrated system* should have been in successful operation at each installation for at least 7000 operating hours prior to the date of techno-commercial bid opening. The Bidder should offer and supply the integrated system* of same Make and type for which it/its sub-vendor meets the above requirement. OR The Bidder/sub-vendor should have designed, engineered, supplied, installed and commissioned at least one (1) number of On-line Blade Vibration integrated system* for health monitoring/Crack Detection of free standing blades of Compressor/Turbine of Gas Turbine Generator set** of 200 MW or above capacity. This integrated system* should have been in successful operation for at least 7000 operating hours prior to the date of techno-commercial bid opening. The Bidder should offer and supply the integrated system* of same Make and type for which it/its sub-vendor meets the above requirement. * integrated system means complete system combining both hardware and software and sensors mounted inside turbine casing, directly seeing the blades in non-contact manner. ** In case of combined cycle gas stations, Gas Turbine Generator set capacity means capacity exclusively of Gas Turbine Generator set. 4.19 Ash Handling System		
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	4.19.1 The Bidder/ its Sub- vendor(s) should be supplier of ash handling system(s) and should have executed ash handling system(s) involving design, engineering, manufacturing/got manufactured, supply, erection /supervised erection and commissioning/ supervised commissioning for- (a) Wet Bottom Ash handling system comprising either a jet pump system in conjunction with water impounded Bottom Ash Hopper or a submerged Scraper Chain Conveyor system designed for the following conveying capacities for pulverized coal fired boilers: Jet Pump System : 50 tonnes/hour (dry ash basis) or more per jet pump. Submerged Scraper : 20 tonnes/hour (dry ash basis) Chain Conveyor System or more per Conveyor. The reference Bottom Ash Handling systems should be of the same type i.e. jet pump system or submerged scraper chain conveyor system as is being offered by the Bidder/ its Sub- vendor. (b) Pneumatic fly ash handling system for conveying fly ash from ESPs of a single pulverized coal fired boiler unit by either: (i) Pressure conveying system designed for 30 TPH or more conveying capacity. OR (ii) Vacuum conveying system designed for 30 TPH or more conveying capacity per vacuum extractor. The reference fly ash handling systems should be of the same type i.e. pressure system or vacuum system, as is being offered by the Bidder/ its Sub-vendor. An individual boiler unit having its own independent fly ash handling system up to wetting units/ dry dust collection buffer hoppers/intermediate Silos which includes, among others, independent fly ash handling equipment below ESP hoppers, independent ash conveying piping up to wetting units/ dry dust collection buffer hoppers can be considered as a plant for meeting the requirement above. And (c) Pneumatic Fly Ash Transportation System for transporting fly ash from pulverised coal fired boiler unit having capacity of not less than 20 TPH for a conveying distance of not less than 500 meter including fly ash storage silo. Further, a transportation system provided for an individual boiler unit having dedicated transportation vessels below dry dust collection buffer hoppers and dedicated piping from dry dust collection buffer hoppers/ intermediate Silos to storage silos, including storage silos can be considered as a plant for meeting the requirement above. (d) Complete high concentration ash slurry disposal system for handling not less than 40 tons of ash per hour for pulverised coal fired power stations which includes, among others, positive displacement ash slurry pumps & piping system with associated controls.		
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Notes to Clause no. 4.19.1 (i) An individual boiler unit having its own independent bottom ash handling system of either the jet pump system type or submerged scrapper chain conveyor system type can be considered as a plant for meeting the requirement of 4.19.1 (a) above. (ii) The activity of design and engineering under 4.19.1 (a), (b), (c) & (d) should have been carried out by the Bidder/ its Sub-vendor(s) and not through any external design agency/agencies. (iii) The systems mentioned at 4.19.1 (a), (b),(c) & (d) above, should have been in successful operation in at least one (1) plant for at least two (2) years. For the purpose of qualification, the experience as at 4.19.1 (a), (b), (c) & (d) above in separate plants also is permissible. (iv) For reference fly ash handling systems, the design capacity of conveying from ESPs to wetting units/buffer hoppers/intermediate Silos and of transportation from buffer hoppers/ intermediate Silos to storage silos will be the capacity which the client (of the reference plant against which the Bidder / its Sub- vendor is seeking qualification) must have specified in its contract documents. OR 4.19.2 The Bidder/ its Sub- vendor who has executed ash handling systems but <i>does not meet the</i> requirements under clause 4.19.1 in part or in full can also participate provided it has executed at least the following systems of ash handling plant involving design, engineering, manufacturing/got manufactured, supply, erection/supervised erection and commissioning/ supervised commissioning : a) Bottom ash handling system comprising either a jet pump system in conjunction with water impounded Bottom Ash Hopper or submerged scrapper chain conveyor system. b) Fly Ash Handling System for conveying fly ash from ESPs in dry form involving pneumatic conveying systems of vacuum or pressure type. The systems mentioned at 4.19.2 (a) and 4.19.2 (b) above should have been in successful operation in at least one (1) plant for two (2) years and should have been installed for pulverized coal fired boiler units generating not less than 40 TPH of ash per boiler. And collaborates/ associates with party(ies) who meet(s) either the total requirement or the balance part under 4.19.1 (a) ,(b), (c) & (d) above which the Bidder/ its Sub- vendor itself is not able to meet. In such a case, the Bidder/its sub-vendor shall be required to furnish a 'letter of support' from Collaborator/ Associates for successful performance of the relevant system valid for a period of seven (7) years or up to the end of defect liability period of the contract whichever is later, as per the format enclosed with the bidding documents. The 'letter of support' should be submitted at the time of placement of order on the approved sub-vendor. Note to Clause no. 4.19.2:-			
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For design and engineering activity referred under paras 4.19.2 should have been carried out by either the Bidder/ its Sub- vendor or through design agency/agencies having experience for reference systems. In case of Collaborator(s)/associate(s) (meeting the balance part of total requirement under clause 4.19.1, the activity of design and engineering for the reference systems should have been carried out by them.

4.19.3 (a) Bottom Ash Slurry Disposal Pumps

The ash slurry pumps to be supplied shall be from such manufacturers who have in the past supplied and installed ash slurry pumps for similar duty applications and have at least two (2) nos. pumps of same models that are being offered having capacity not less than 1000 cubic meters per hour at each of the two (2) different stations which are in successful operation for at least two (2) years.

(b) Positive Displacement Pumps for High Concentration Slurry Disposal System

The positive displacement pumps for high concentration slurry disposal System to be supplied shall be from such manufacturers/suppliers who have in the past supplied and installed positive displacement pumps for high concentration slurry disposal System for similar duty applications and have at least two (2) nos. pumps of same models that are being offered having capacity not less than 150 m³/hr which should have been in successful operation for at least two (2) years prior to the date of Techno-Commercial bid opening.

(c) Design and Engineering Agency for High Concentration Slurry Disposal System

Design agency/agencies for high concentration slurry disposal system should be either an high concentration slurry disposal system supplier meeting the qualification of clause 2.3.1 (d), for the offered system or consultancy organization who has designed and engineered similar system(s) for handling not less than 40 tonnes of ash per hour, for pulverized coal fired power station(s) and the system(s) should have been in successful operation in at least one (1) plant for at least two (2) years prior to the date of Techno-Commercial bid opening.

4.20 Coal Handling Plant

4.20.1 The Bidder/ its Sub-vendor should have designed, engineered / got engineered, manufactured/ got manufactured, erected/supervised erection and commissioned/ supervised commissioning at least one (1) number integrated bulk material handling plant (essentially comprising of conveying and crushing) including all associated structural steel works and electrical works of 1000 Metric tonnes per hour rated capacity or above for coal or other minerals of equivalent volumetric capacity which should have been in successful operation for at least one (1) year.

And

4.20.2 The Bidder/ its Sub- vendor should have designed, manufactured/ got manufactured, supplied, erected/supervised erection and commissioned/ supervised commissioning including all associated structural steel works and electrical works at least one (1) number cantilever boom type, slewable and luffable, bucket wheel type traveling Stacker-cum-Reclaimer suitable for stacking and reclaiming at a rated capacity of 1000/1000 Metric tonnes per

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	hour (or above) for coal or other mineral of equivalent volumetric capacity which should have been in successful operation for at least one (1) year.			
4.20.3	The Bidder/ its Sub- vendor who meets the requirements of only clause 4.20.1 above can also participate provided it collaborates / associates with a firm which fully meets the requirements specified at clause 4.20.2 above. In such a case, the Bidder/ its sub-vendor shall be required to furnish a 'letter of support' from Collaborator/ Associates for successful performance of the relevant system valid for a period of seven (7) years or up to the end of defect liability period of the contract whichever is later, as per the format enclosed with the bidding documents. The 'letter of support' should be submitted at the time of placement of order on the approved sub-vendor.			
4.20.4	Coal Sampling System The Bidder/ its Sub-vendor shall source coal sampling system from a manufacturer/ supplier who has engineered and supplied minimum one (1) number of coal sampling systems for sampling coal /other bulk mineral from conveyor of 1000 MTPH or above and which should have been in successful operation for at least one (1) year.			
4.20.5	Not Used			
4.21	Not Used			
4.22	Not used			
4.23	Selective Catalytic Reduction System The Bidder/Bidder's sub-vendor should meet the qualifying requirements stipulated in any one of the qualifying routes i.e. Route-1 (clause 4.23.1) or Route-2 (clause 4.23.2) or Route-3 (clause 4.23.3) including requirements stipulated in sub clauses of respective Route.			
4.23.1	Route-1 Qualified Selective Catalytic Reduction (SCR) System Manufacturer/ Supplier (QSCRM) The Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/got manufactured/supplied, erected/supervised erection and commissioned/supervised commissioning of at least one (1) no. of ammonia based SCR System, consisting of SCR reactor & Ammonia injection system, with NOx reduction efficiency of not less than 75%, operating in conjunction with pulverised coal fired steam generator for 500MW or higher capacity unit or having minimum 1500T/hr steaming capacity. Further, such SCR System should have been in successful operation for a period not less than one (1) year.			
4.23.2	Route-2 Steam Generator Manufacturer / Indian JV company of Steam Generator manufacturer/ Indian Subsidiary Company of Steam Generator Manufacturer a (i) The Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/got manufactured, erected/ supervised erection and commissioned/supervised commissioning of least one (1) no. of pulverised coal fired steam generator for 200MW or higher capacity unit or having minimum 600T/hr steaming capacity. Further, such Steam Generator should have been in successful operation for a period not less than one (1) year.			
	Alternatively			
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	a (ii) The Bidder/Bidder's sub-vendor shall be a Joint Venture (JV) Company incorporated in India under the Companies Act of India, as on the date of techno-commercial bid opening, promoted by (i) an Indian Company registered in India under the Companies Act of India and (ii) a Steam Generator Manufacturer meeting requirements of clause 4.23.2 a (i), created for the purpose of manufacturing Steam Generator sets in India. The Steam Generator Manufacturer shall maintain a minimum equity participation of 26% in the JV Company for a lock-in period of 7 years from the date of incorporation of JV Company and One of the promoters shall be a majority stakeholder who shall maintain a minimum equity participation of 51% in the JV Company for a lock in period of 7 years from the date of incorporation of JV Company or up to the end of defect liability period of the contract, whichever is later. Further, Bidder/Bidder's sub-vendor should have executed/executing orders related to Steam Generators, in the last 5 years, with the total value of such projects being INR 5,000 million or more. Alternatively a(iii) The Bidder/Bidder's sub-vendor shall be an Indian Subsidiary Company of a Steam Generator Manufacturer meeting requirements of clause 4.23.2 a (i), registered in India under the Companies Act of India, as on the date of techno-commercial bid opening, for manufacturing Steam Generator sets. The Subsidiary Company shall remain a subsidiary company of the Steam Generator Manufacturer for a minimum period of 7 years from the date of incorporation of such Subsidiary Company or up to the end of defect liability period of the contract whichever is later. Further, Bidder should have executed/executing orders related to Steam Generators, in the last 5 years, with the total value of such projects being INR 5,000 million or more. b) Bidder/Bidder's sub-vendor should also have a valid ongoing collaboration and technology transfer agreement with a QSCRM meeting requirements of clause 4.23.1 on its own, valid minimum up to the end of the defect liability period of the contract. c) The Bidder shall be required to furnish an undertaking jointly executed by the Bidder, its sub-vendor (if applicable) and the QSCRM for the successful performance of SCR system, as per the format enclosed with the bidding documents in which the QSCRM and the Bidder and its sub-vendor (if applicable) are jointly and severally liable to the Employer to perform contractual obligations including the technical guarantees for the complete SCR system. The Deed of Joint Undertaking (DJU) shall be submitted at the time of placement of order on the approved sub vendor. In case of award, QSCRM and Bidder's sub-vendor (if Applicable) shall each be required to furnish an on demand bank guarantee for INR 24 million (Twenty Four Million only) in addition to the contract performance security to be furnished by the bidder. 4.23.3 Route-3 EPC Organization a) The Bidder/Bidder's sub-vendor should be an Engineering, Procurement and Construction (EPC) organization and should have executed, in the last 10 years, large industrial projects on EPC basis (with or without civil works) in the area of power, steel, oil & gas, petro-chemical, fertilizer, Flue gas denitrification system and / or any other process industry with the total value of such projects being INR		
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	5,000 million or more. At least one of such projects should have a contract value of INR 2,000 million or more. These projects shall be in successful operation for a period of not less than one (1) year. b) Bidder/Bidder's sub-vendor should also have a valid ongoing collaboration and technology transfer agreement with a QSCRM meeting requirements of clause 4.23.1, valid minimum up to the end of the defect liability period of the contract. In such a case Bidder/Bidder's sub-vendor shall either source the SCR system from such manufacturer or manufacture/get manufactured the SCR System as per the design and manufacturing drawings released by such QSCRM. c) The Bidder shall be required to furnish an undertaking jointly executed by the Bidder, its sub-vendor (if applicable) and the QSCRM for the successful performance of SCR system, as per the format enclosed with the bidding documents in which the QSCRM and the Bidder and its sub-vendor (if applicable) are jointly and severally liable to the Employer to perform contractual obligations including the technical guarantees for the complete SCR system. The Deed of Joint Undertaking (DJU) shall be submitted at the time of placement of order on the approved sub vendor. In case of award, QSCRM and Bidder's sub-vendor (if Applicable) shall each be required to furnish an on demand bank guarantee for INR 24 million (Twenty Four Million only) in addition to the contract performance security to be furnished by the bidder.			
4.24.	Provenness criteria for critical equipment(s) and bought out items for SCR system			
4.24.1	Ammonia handling and storage system for SCR			
	The Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/ got manufactured/ supplied, erected/ supervised erection and commissioned/ supervised commissioning of at least one (1) no. of anhydrous ammonia storage and handling system for SCR system operating in conjunction with coal fired steam generating units, rated for a minimum of 500MW unit size or minimum 1500T/hr steaming capacity. The above System should have been in successful operation for a period not less than one (1) year.			
4.24.2	Catalyst for SCR system			
	Catalyst for SCR system shall be supplied only from such catalyst manufacturer who has designed, engineered, manufactured, supplied plate type catalyst for SCR system which is operating in conjunction with pulverised coal fired steam generator for 500MW or higher capacity unit or with steam generator having minimum 1500T/hr steaming capacity. Further, such plate type catalyst in a SCR System should have been in successful operation for a period of at least 16000 hrs without any replacement during this period.			
4.24.3	SNCR system :- (Applicable in case Bidder proposed hybrid system i.e. SCR with SNCR)			
	The Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/got manufactured/supplied, erected/supervised erection and commissioned/supervised commissioning of at least one (1) no. of urea based SNCR System operating in conjunction with a pulverised coal fired steam generator for 500MW or higher capacity unit or for a pulverized coal fired steam generator having minimum 1500T/hr steaming capacity. Further, such SNCR System should have been in successful operation for a period not less than one (1) year.			
4.24.4	Urea handling and storage system			
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The Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/ got manufactured/ supplied, erected/ supervised erection and commissioned/ supervised commissioning of at least one (1) no. of urea storage and handling system for SNCR system operating in conjunction with a coal fired steam generating units, rated for a minimum of 500MW unit size or for a pulverized coal fired steam generator minimum 1500T/hr steaming capacity. The above System should have been in successful operation for a period not less than one (1) year. NOTES: A) Note to clause 4.23.1, 4.23.2 & 4.23.3 (1) "Qualified Selective Catalytic Reduction system Manufacturer (QSCRM)" means a manufacturer meeting requirements stipulated at 4.23.1. (2) The Bidder/ Bidder's sub-vendor shall also be considered qualified, in case the award for executing the reference works (SCR system) has been received by the Bidder/ Bidder's sub-vendor either directly from owner of plant or any other intermediary organization. However, a certificate from such owner of plant or any other intermediary organization shall be required to be furnished by the Bidder/ its sub-vendor in support of Bidder/ Bidder's sub-vendor claim of meeting the qualification requirement as per 4.23.1 or 4.23.2 or 4.23.3 above. Further, certificate from owner of the plant shall also be furnished by the Bidder/ Bidder's sub-vendor for the successful operation of the SCR System as specified at clause 4.23.1 or 4.23.2 or 4.23.3 above, whichever is applicable. (3) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/lignite. (4) Holding Company as a Qualified Selective Catalytic Reduction system Manufacturer (QSCRM). (i) A Holding Company, singularly or collectively along with its Subsidiaries (held either directly or indirectly), meeting the requirements of clause 4.23.1 above shall also be considered as QSCRM. (ii) In such a case, if the Holding Company is an Associate/Collaborator for Bidder or Bidder's sub-vendor as a QSCRM, the Holding Company and all such subsidiaries lending strength / experience to the Holding Company for meeting the requirements of clause 4.23.1 above should necessarily be part of the DJU being submitted by the Bidder for successful performance of the contract as per format enclosed with the bidding documents. The Deed of Joint Undertaking (DJU) shall be submitted at the time of placement of order on the approved vendor. Further, in such a case the Holding Company and all such entities lending strength / experience to the Holding Company for meeting the requirements of clause 4.23.1 above shall each be required to furnish separate on demand bank guarantees for INR 24 Million (Indian Rupees Twenty Four Million only) divided equally among them, in addition to the contract performance security to be furnished by the Bidder. This bank guarantee requirement shall supersede bank guarantee requirement stipulated at clause 4.23.2 (c) & 4.23.3 (c) for the QSCRM. (iii) In case the Holding Company itself is the Sub-Vendor as a QSCRM as per clause 4.23.1, the Holding Company shall submit its board resolution stating that in case of any likely change of management control of any of these subsidiaries lending strength / experience to the Holding Company for meeting the requirements of clause 4.23.1 above, the Sub-Vendor shall arrange for separate on demand bank			
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	guarantees as per the format enclosed with the bidding documents from all such entities lending strength / experience to the Holding Company for fulfillment of requirement of clause 4.23.1, above for an amount aggregating INR 24 Million (Indian Rupees Twenty Four Million only) before the change in management control actually occurs. B) Technology Transfer Agreement (Applicable for Clause 4.23.2 & 4.23.3) The technology transfer agreement shall necessarily cover transfer of technological know-how for SCR System in the form of complete transfer of design dossier, design software's, drawings and documentation, quality system manuals and imparting relevant personnel training to the Indian Manufacturing Company. C) Note to clause 4.23.2/ 4.23.3 & 4.24.1 In case QSCRM of 4.23.2/ 4.23.3 also meets the requirement of 4.24.1 and the Technology Licensing & Transfer agreement as per clause 4.23.2(b)/ 4.23.3(b) covers Ammonia handling & storage system, in such a case Bidder/Bidder's sub-vendor qualified as per 4.23.2/4.23.3 can also either source the Ammonia handling & storage system from such QSCRM or manufacture/get manufactured the Ammonia handling & storage system as per the design and manufacturing drawings released by such QSCRM. D) Note to clause 4.23, 4.24 i) In case Bidder propose to offer a hybrid of SCR and SNCR De-NOx system then Bidder/ Sub vendor shall meet requirement stipulated at clause no. 4.23 and 4.24.3 ii) In case Bidder/sub vendor(s) propose to procure SCR system/SNCR system/Ammonia handling and storage system/urea handling and storage system from different vendors, in such a case these vendors shall meet the respective provenness criteria stipulated under clause no. 4.23/4.24.3/4.24.1/ 4.24.4. E) Notes for clause 4.23.2,4.23.3 & Notes-A-4 DJU and bank guarantee will not be applicable in case of order of SCR ready/hybrid ready plant system.			
4.25	Wet Limestone based Flue Gas Desulphurisation System			
	Bidder or Bidder's sub-vendor shall be a company incorporated in India under the Companies Act of India and should meet the qualifying requirements stipulated in any one of the qualifying routes i.e Route-1 (clause 4.25.1) or Route-2 (clause 4.25.2) or Route-3 (clause 4.25.3) or Route-4 (clause 4.25.4) including requirements stipulated in sub clauses of respective Route.			
4.25.1	Route-1: Qualified Wet Limestone based Flue Gas Desulphurisation (FGD) System Manufacturer (QFGDM)			
	The Bidder or Bidder's sub-vendor should have designed, engineered, supplied, erected/supervised erection and commissioned/supervised commissioning of at least one (1) no. of wet limestone based Flue Gas Desulphurisation System, having flue gas treatment capacity of not less than 23,00,000 Nm3/hr, with			
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	desulphurisation efficiency of at least 90 %, operating in a pulverised coal fired power plant. The above wet limestone based Flue Gas Desulphurisation System should have been in successful operation for a period not less than one (1) year.			
4.25.2	Route-2: Wet Limestone based Flue Gas Desulphurisation (FGD) System Manufacturer with Collaboration and Technology Transfer Agreement with QFGDM (a) The Bidder or Bidder's sub-vendor should have designed, engineered, supplied, erected/supervised erection and commissioned/supervised commissioning of at least one(1) no. of wet limestone based Flue Gas Desulphurisation system having flue gas treatment capacity of not less than 6,00,000 Nm3/hr, with desulphurisation efficiency of at least 85%, operating in a pulverised coal fired power plant. The above wet limestone based Flue Gas Desulphurisation System should have been in successful operation for a period not less than one (1) year. (b) Bidder/Bidder's sub-vendor should also have a valid ongoing collaboration and technology transfer agreement with a QFGDM meeting requirements of clause 4.25.1 on its own, valid minimum up to the end of the defect liability period of the contract. In such a case Bidder/ Bidder's sub-vendor can either source the FGD System from such manufacturer or manufacture/get manufactured the FGD System as per the design and manufacturing drawings of such QFGDM. (c) Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the FGD system valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor.			
4.25.3	Route-3: Steam Generator Manufacturer / Indian JV Company of Steam Generator manufacturer or QFGDM/ Indian Subsidiary company of Steam Generator manufacturer or QFGDM with Collaboration and Technology Transfer Agreement with QFGDM (a)(i) Bidder/Bidder's sub-vendor should have designed, engineered, manufactured/got manufactured, erected/ supervised erection and commissioned/supervised commissioning of least one (1) no. of pulverised coal fired steam generator for 200MW or higher capacity unit or having minimum 600T/hr steaming capacity. Further, such Steam Generator should have been in successful operation for a period not less than one (1) year. Alternatively (a)(ii) The Bidder/Bidder's sub-vendor shall be a Joint Venture (JV) Company incorporated in India under the Companies Act of India, as on the date of techno-commercial bid opening, promoted by (i) an Indian Company registered in India under the Companies Act of India and (ii) a Steam Generator Manufacturer meeting requirements of clause 4.25.3(a)(i) or a QFGDM meeting requirements of clause 4.25.1, created for the purpose of manufacturing/supply in India of steam generator sets/Flue Gas Desulphurisation System. The Steam Generator Manufacturer/QFGDM shall maintain a minimum equity participation of 26% in the JV Company for a lock-in period of 7 years from the date of incorporation of JV Company and One of the			
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	promoters shall be a majority stakeholder who shall maintain a minimum equity participation of 51% in the JV Company for a lock in period of 7 years from the date of incorporation of JV Company or up to the end of defect liability period of the contract whichever is later. Further, Bidder/Bidder's sub-vendor should have executed order(s), during the last 5 years, with the total value of such projects being INR 5,000 million or more. Alternatively (a)(iii) The Bidder/Bidder's sub-vendor shall be an Indian Subsidiary Company of a Steam Generator Manufacturer meeting requirements of clause 4.25.3(a)(i) or an Indian Subsidiary Company of a QFGDM meeting requirements of clause 4.25.1, registered in India under the Companies Act of India, as on the date of techno-commercial bid opening, for manufacturing/supply of Steam Generator sets/Flue Gas Desulphurisation System. The subsidiary Company shall remain a subsidiary company of the Steam Generator Manufacturer/ QFGDM for a minimum period of 7 years from the date of incorporation of such Subsidiary Company or up to the end of defect liability period of the contract whichever is later. Further, Bidder/Bidder's sub-vendor should have executed order(s), during the last 5 years, with the total value of such projects being INR 5,000 million or more. (b) Bidder/Bidder's sub-vendor should also have a valid ongoing collaboration and technology transfer agreement with a QFGDM meeting requirements of clause 4.25.1 on its own, valid minimum up to the end of the defect liability period of the contract. In such a case Bidder/ Bidder's sub-vendor can either source the FGD System from such manufacturer or manufacture/get manufactured the FGD System as per the design and manufacturing drawings of such QFGDM. (c) Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the FGD system valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor. 4.25.4 Route-4: EPC Organization in Collaboration with QFGDM (a) The Bidder or Bidder's sub-vendor should be an Engineering, Procurement and Construction (EPC) organization and should have executed, in the last 10 years, large industrial projects on EPC basis (with or without civil works) in the area of power, steel, oil & gas, petro-chemical, fertilizer, Flue Gas Desulphurisation and / or any other process industry with the total value of such projects being INR 5,000 million or more. At least one of such projects should have a contract value of INR 2,000 million or more. These projects shall be in successful operation for a period of not less than one (1) year. (b) Bidder/Bidder's sub-vendor should also have a valid ongoing collaboration and technology transfer agreement with a QFGDM meeting requirements of clause 4.25.1 on its own, valid minimum up to the end of the defect liability period of the contract. In such a case Bidder/ Bidder's sub-vendor can either source the FGD System from such manufacturer or manufacture/get manufactured the FGD System as per the design and manufacturing drawings released by such QFGDM.		
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(c) Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the FGD system valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor. Notes for clause 4.25 (1) Definitions (i) "QFGDM" (Qualified Wet Limestone based Flue Gas Desulphurisation System Manufacturer) means a manufacturer meeting requirements stipulated at 4.25.1. (ii) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite. (iii) "Flue Gas Desulphurisation System" or "FGD System" wherever appearing above shall mean consisting of at least Absorber System. (iv) The word "executed" in Clause 4.25.3 (a) (ii) / Clause 4.25.3 (a) (iii) means the Bidder should have commissioned the project(s) specified in the Clause 4.25.3 (a) (ii) / Clause 4.25.3 (a) (iii) even if the contract has been started earlier and / or is not completed / closed. (2) Erection/Commissioning Where erection / supervision of erection and commissioning / supervision of commissioning has not been in the scope of the Bidder/Bidder's sub-vendor as mentioned in clause 4.25.1 & 4.25.2 & & 4.25.3 (a)(i), the Bidder should have acted as an advisor for erection and commissioning. Necessary documents / certificates from the client, in support of above shall be furnished. (3) Direct / Indirect order The Bidder/ QFGDM shall also be considered qualified, in case the award for executing the reference works has been received by the Bidder either directly from owner of plant or any other intermediary organization. However, a certificate from such owner of plant or any other intermediary organisation shall be required to be furnished by the Bidder in support of the Bidder's/ QFGDM claim of meeting the qualification requirement as per clause 4.25.1 or 4.25.2 or 4.25.3(a)(i) or 4.25.4 above. Further, certificate from owner of the plant shall also be furnished by the Bidder for the successful operation as specified at clause 4.25.1, 4.25.2, 4.25.3(a)(i) and 4.25.4 above. (4) Holding Company as a Qualified Wet Limestone based Flue Gas Desulphurisation system Manufacturer A Holding Company, singularly or collectively along with its Subsidiaries (held either directly or indirectly), meeting the requirements of clause 4.25.1 above shall also be considered as Qualified Wet Limestone based Flue Gas Desulphurisation System Manufacturer (QFGDM). (5) Technology Transfer Agreement (Applicable for Clause 4.25.2, 4.25.3 & 4.25.4) The technology transfer agreement between the Bidder/Bidder's sub-vendor & QFGDM shall necessarily cover transfer of technological knowhow for Wet Limestone based Flue Gas Desulphurisation System in the form of				
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complete transfer of design dossier, design software's, drawings and documentation, quality system manuals and imparting relevant personnel training to the Bidder/Bidder's sub-vendor.

(6) **Equity Lock in period**

Wherever equity lock in period requirement or subsidiary status requirement is indicated, the Bidder would be required to furnish a Letter of Undertaking from the promoter(s), supported by Board Resolution as per the format enclosed in the bid documents, for maintaining the required minimum equity for the specified lock in period.

4.26 Provenness criteria for critical equipment, auxiliaries, systems and bought out items for Flue Gas Desulphurisation System:

4.26.1 The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year:

S. N.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(a)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	Flow 10200 m ³ /hr (min.) with Head 16 Meters of Liquid Column (min.)
(b)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant or in any other process application	Flow 7300 Nm ³ /hr Dry Basis (min.) with Head 8500 mmwc (min.) for spray tower process Or Head 3500 mmwc (min.) for bubbling type process Oxidation Blower
(c)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant or any other process application.	20 T/hr (minimum) with pulverizing fineness not less than 90% thru 325 mesh.
(d)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	Flow 50 m ³ /hr (min.) with head 30 Meters of Liquid Column (min.)
(e)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in	Agitator rating not less than that supplied for 500 MW or higher size unit for similar

			Coal fired power plant	application
(f)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant or in any other process application	35 T/hr (minimum)
(g)	Gas Cooling Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	Flow 2800 m ³ /hr (min.) with Head 16 Meters of Liquid Column (min.)

Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified. The provenness criteria for equipment (Slurry Recirculation Pumps) stipulated at Sl. No. 4.26.1 (a) above shall also be considered acceptable provided the rating parameters (i.e., flow and head) is covered within the operating regime of the respective Slurry Recirculation Pump performance curve of the reference plant equipment.

- 4.26.2 A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.26.1 above in India **shall be considered qualified for** such equipments, provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.26.1 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).

Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.

- 4.26.3 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.26.1 (b) above but is a manufacturer of Blowers/compressors for minimum 50 NM³/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.26.1 (b) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.
- 4.26.4 (i) In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.26.1 (c) above but is a manufacturer of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause

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	4.26.1 (c) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the equipment valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor. OR (ii) In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.26.1 (c) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meet the requirements stipulated at clause 4.26.1 (c) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills. In addition, the Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the equipment valid up to the end of defect liability period of the contract as per the format enclosed in the bidding document, at the time of placement of order on the approved sub-vendor. 4.26.5 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.26.1 (e) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.26.1 (e) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. 4.26.6 In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.26.1 (d) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.26.1 (a) above for the Slurry Recirculation Pumps. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. 4.26.7 Before taking up the manufacturing of such equipment(s) as per clause 4.26.2, 4.26.3, 4.26.4(i), 4.26.5 & 4.26.6 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.		
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4.26.8	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.			
4.26.9	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.			
Note to clause 4.26.1				
Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.				
4.27	Agency for Wet Stack Flow Model Study			
Wet Stack Flow Model Study shall be carried out by an agency which has successfully performed at least two (2) flow model studies, in separate coal fired power plants, of wet stack installed after wet limestone based FGD Absorber (without reheating of cleaned flue gas), and based on the studies developed at least two (2) wet stack liquid collection systems which are in successful operation for a period of at least two (2) years.				
5.0	PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS			
5.1.0	Not used			
5.2.0	ISOLATED PHASE BUSDUCT			
Bidder / Sub Vendor should have designed, manufactured, supplied, erected/ supervised erection and commissioned/supervised commissioning of Isolated Phase Busduct for a turbo-generator of at least 500MW, which should have been in successful operation for at least two (2) years.				
5.3.0	HT MOTORS			
BFP MOTOR				
Bidder / Sub Vendor should have manufactured and supplied motor of 10 MW or above rating, which should have been in successful operation in at least one (1) plant for at least two (2) years.				
ID FAN MOTOR				
Bidder / Sub Vendor should have manufactured and supplied motor of 8 MW or above rating, which should have been in successful operation in at least one (1) plant for at least two (2) years .				
CW MOTOR				
Bidder / Sub Vendor should have manufactured and supplied motor of 2 MW or above rating and motor speed not exceeding 500 rpm synchronous, which should have been in successful operation in at least one (1) plant for at least two (2) years .				
BOOSTER FAN MOTOR				
Bidder/Sub Vendor should have manufactured and supplied motor of 4MW or above rating, which should have been in successful operation in at least one (1) plant for at least two (2) years.				
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	5.4.0 BATTERY CHARGER Bidder/ Sub Vendor should have manufactured and supplied at least one (1) number of static automatic voltage regulator type Battery Chargers of highest offered rating or above, in at least one (1) industrial installation, which should have been in successful operation for at least one (1) year. 5.5.1A POWER TRANSFORMERS – Highest Voltage 400kV (As Applicable) (For transformers voltage class from 220 kV to 420 kV) The Bidder/Sub-vendor should meet the qualifying requirements of any one of the qualifying routes stipulated under clause 5.5.1A.1 or 5.5.1A.2: 5.5.1A.1 ROUTE-1 Bidder/Sub-Vendor should have designed, manufactured and supplied at least two (2) nos. (One each at two different installations) of 400 KV or above class Generator transformers of at least 200 MVA capacity (either three phase transformer as a single unit or single phase transformer) which should be in successful operation for at least two (2) years. 5.5.1A.2 ROUTE-2 Bidder/Sub-Vendor who have designed, manufactured and supplied at least two (2) no. 220 KV or above class transformer which are in successful operation for two (2) years and have established manufacturing facilities for 400 KV class transformers in India based on technological support of its associate or collaborator or technology provider or licensor, can also be considered Qualified provided its Associate or Collaborator or Technology provider or Licensor meets the qualifying requirement stipulated at 5.5.1A.1 above, and:- (i) Associate or Collaborator or technology provider or licensor provides a letter of technical support, for successful performance of the transformers, as per format, given in bidding document. This letter of technical support should be submitted prior to the placement of order on approved Sub-Vendor. (ii) Transformer shall be of Collaborator's/Associate's/Technology provider's/Licensor's design. Transformer shall be manufactured in line with manufacturing & assembly drawings of Collaborator/ Associate/ Technology provider/Licensor. (iii) Core coil assembly and final testing of the transformer shall be under the supervision of Collaborator/Associate/Technology provider/Licensor. 5.5.2A SHUNT REACTOR - 400kV (As Applicable) 5.5.2A.1 Bidder/Sub-Vendor should have designed, manufactured and supplied 400 KV or above class shunt reactors of at least 50 MVAR capacity (either three phase as a single unit or bank of three single phase reactors of at least 16.67 MVAR each) which should have been in successful operation at atleast two (2) different installations for at least two (2) years. OR 5.5.2A.2 Bidder/Sub-Vendor who have designed, manufactured and supplied at least two (2) no. 400 KV or above class transformer / 220 KV or above class reactor which are in successful operation for two (2) years and have established manufacturing facilities for 400 KV class shunt reactors in India based on technological support of its		
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Associate or Collaborator or Technology provider or Licensor, can also be considered for manufacturing & supply of reactor specified under present package provided:- (i) Associate or Collaborator or Technology provider or Licensor meets the qualifying requirements stipulated at 5.5.2A.1 above and provides a letter of technical support, for satisfactory performance of the reactors supplied under this contract, as per format, given in the bidding documents. This letter of technical support should be submitted prior to the placement of order on approved Sub-Vendor. (ii) Reactor shall be of Collaborator's/Associate's/Technology provider's/Licensor's design. Reactor shall be manufactured in line with manufacturing & assembly drawings of Collaborator/Associate/Technology provider/Licensor and Collaborator's/Associate's/Technology provider's/Licensor's drawing approved by NTPC. (iii) Core coil assembly and final testing of the reactor shall be under the supervision of Collaborator/Associate/Technology provider/Licensor.			
5.5.3A EHV & HV POWER TRANSFORMERS <u>(Transformer of voltage class above 36 kV to 132 kV and Unit Transformer)</u> a) Bidder/Sub-vendor should have designed, manufactured and supplied at least two (2) numbers (one each at two different installations) of 132 kV or above class transformers of at least 110MVA capacity which should have been in successful operation for at least two years. And b) Bidder/Sub-vendor should have its own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test). And c) 90 MVA, 132 KV or higher rated oil filled transformer manufactured by Bidder/Sub-vendor should have been successfully short circuit tested. <u>Note (applicable for Cl. No. 5.5.1A, 5.5.2A & 5.5.3A):</u> (i) Two different installations means two different project sites or two different contracts. (ii) Equipment designed by the Bidder/Sub-vendor by itself or through its collaborator/associate/technology provider/licensor for reference plant, shall also be considered meeting the requirement of design.			
5.6.0 LT SWITCHGEAR ROUTE 1 1.1 Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years. And 1.2 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) numbers of Air Circuit Breakers having fault rating of at least 45kA rms BREAKING, 105kA peak MAKING and 45kA withstand for one (1) second, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years.			
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ROUTE 2 1.3 Bidder/ Sub Vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years. And 1.4 Bidder/ Sub Vendor should have manufactured and supplied at least seventy five (75) numbers of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years. And 1.5 Bidder/Sub Vendor shall be considered qualified provided its Associate or Collaborator or Technology Provider or Licensor meets the requirement stipulated in Route-1 for sourcing of Air Circuit Breakers. The Associate or Collaborator or Technology Provider or Licensor shall provide a letter of technical support for successful performance of the Air Circuit Breakers, as per the format, given in the bidding document. This letter of technical support should be submitted at the time of placement of order on the Sub Vendor. And 1.6 Bidder/ Sub Vendor should have established manufacturing facility for draw out type Air Circuit Breaker Panels and draw out type Motor Control Centre Panels in India. Further, all the panels for this project shall be manufactured and supplied from the Indian manufacturing facility. NOTE: 1. Each Single Front Panel shall be counted as one (1) Panel, Double Front Panel as one (1) Panel and Air Circuit Breaker Panel as one (1) Panel. 2. The provenness criteria shall be applicable for all draw out type and fixed type switchboards except Lighting DBs and Welding DBs. <tr><td colspan="4"> 5.7.0 11 kV / 6.6 kV / 3.3 kV SWITCHGEARS 1.1 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 6.6kV or above Switchgear panels with fault rating of at least 40kA for one (1) second and 100kA peak, which should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit breakers for 6.6kV or above panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for at least two (2) years. </td></tr> <tr><td colspan="4"> 5.8.0 NUMERICAL RELAYS & NETWORKING 1.1 Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor protections. These relays should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured/ integrated and successfully done Site Acceptance Test (SAT) for a network on IEC 61850 with at least one hundred (100) numbers of Communicable Numerical Relays. </td></tr> <tr><td colspan="4"> 5.9.0 DC BATTERIES Bidder/ Sub Vendor should have manufactured and supplied at least one (1) number of highest offered rating or above of high discharge type plante positive plate type battery (in case bidder offers Lead Acid plante type </td></tr>				5.7.0 11 kV / 6.6 kV / 3.3 kV SWITCHGEARS 1.1 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 6.6kV or above Switchgear panels with fault rating of at least 40kA for one (1) second and 100kA peak, which should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit breakers for 6.6kV or above panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for at least two (2) years.				5.8.0 NUMERICAL RELAYS & NETWORKING 1.1 Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor protections. These relays should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured/ integrated and successfully done Site Acceptance Test (SAT) for a network on IEC 61850 with at least one hundred (100) numbers of Communicable Numerical Relays.				5.9.0 DC BATTERIES Bidder/ Sub Vendor should have manufactured and supplied at least one (1) number of highest offered rating or above of high discharge type plante positive plate type battery (in case bidder offers Lead Acid plante type			
5.7.0 11 kV / 6.6 kV / 3.3 kV SWITCHGEARS 1.1 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 6.6kV or above Switchgear panels with fault rating of at least 40kA for one (1) second and 100kA peak, which should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit breakers for 6.6kV or above panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for at least two (2) years.															
5.8.0 NUMERICAL RELAYS & NETWORKING 1.1 Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor protections. These relays should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured/ integrated and successfully done Site Acceptance Test (SAT) for a network on IEC 61850 with at least one hundred (100) numbers of Communicable Numerical Relays.															
5.9.0 DC BATTERIES Bidder/ Sub Vendor should have manufactured and supplied at least one (1) number of highest offered rating or above of high discharge type plante positive plate type battery (in case bidder offers Lead Acid plante type															

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battery) or high discharge type Nickel Cadmium battery (in case bidder offers Nickel Cadmium battery), in at least one (1) industrial installation, which should have been in successful operation for at least one (1) year.			
5.10.0 HT POWER CABLES The bidder/Sub-vendor should have manufactured and supplied following cables: (a) Atleast 50kms of XLPE insulated power cables of 6.35/11 KV or higher voltage grade, executed in one or more orders. (b) At least one (1) Km of flame retardant low smoke cables of any voltage level.			
5.11.0 DG SETS The bidder/Sub-vendor should have supplied at least one (1) number of DG sets of rating not less than 1500 kVA, in at least one (1) installation, which should be in successful operation for at least one (1) year. The offered make of the DG set (Alternator and Engine) shall be same as that of reference plant DG sets.			
5.12.1 AUXILIARY OIL FILLED TRANSFORMERS AND HT TRANSFORMERS 5.12.1.1 The Bidder/Sub-Vendor should have manufactured & supplied at least one number (one installation) of 16 MVA, 11KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years. And 5.12.1.2 Bidder/Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test). And 5.12.1.3 16 MVA, 11 KV or higher rated oil filled transformer manufactured by Bidder/Sub-Vendor should have been successfully short circuit tested.			
NOTE: (i) Two different installations means two different project sites or two different contracts. (ii) Equipment designed by the Bidder/Sub-vendor by itself or through its collaborator/associate/technology provider/licensor for reference plant, shall also be considered meeting the requirement of design.			
5.13 Not Used			
5.14 400 kV EQUIPMENTS (AIS): (I) <u>400KV CIRCUIT BREAKERS:</u> 400kV Circuit Breakers being offered should be from Manufacturer who has manufactured and supplied at least five(5) nos. of three phase circuit breakers suitable for Air Insulated Substation/ Switchyard of 400 kV or above class which should have been in successful operation for minimum two(2) years prior to the date of Techno-Commercial bid opening.			
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II.	<u>400 kV INSTRUMENT TRANSFORMERS (Current Transformers / Capacitor Voltage Transformers as Applicable):</u> 400 kV Instrument Transformers being offered should be from Manufacturer who has manufactured and supplied at least fifteen (15) nos. of single phase Instrument Transformers suitable for Air Insulated Substation/ Switchyard of 400 kV or above class which should have been in successful operation for minimum two (2) years prior to the date of Techno-Commercial bid opening.		
III.	<u>400 kV DISCONNECTORS :</u> 400kV Disconnectors being offered should be from Manufacturer who have manufactured and supplied atleast five (5) nos. of three phase Disconnectors suitable for Air Insulated Substation/Switchyard of 400kV or above class which should have been in successful operation for minimum two (2) years prior to the date of Techno-Commercial bid opening.		
(IV)	400kV SURGE ARRESTER (AS APPLICABLE) The Bidder/Sub-vendor should have manufactured and supplied minimum fifteen (15) nos. of single-phase respective equipment of offered voltage class or above, suitable for Air Insulated Substation/ Switchyard and which must have been in successful operation for a minimum period of two (2) years prior to the date of Techno-Commercial bid opening.		
(V)	<u>400KV SWITCHYARD:</u> The bidder/sub vendor should have designed, constructed/erected, tested and commissioned one (1) no. of Air Insulated substation/switchyard of 400KV or above voltage class having at least six(6) bays which should have been in successful operation for minimum (2) years prior to the date of techno-commercial bid opening. Note: For the purpose of qualifying requirement one no of bay shall be considered as a bay comprising of at least one circuit breaker, two disconnectors and three single phase current transformers.		
(VI)	400kV TRANSMISSION LINE: The Bidder/Sub-vendor should have erected and commissioned at least 30KM of Transmission line of 400KV or above voltage class on Towers.		
5.15	SUBSTATION AUTOMATION SYSTEM & PROTECTIVE RELAYS: The Substation Automation System offered with distributed architecture and digital process bus should have been in successful operation in at least one (1) Substation/Switchyard of not less than 220 kV class for minimum one (1) year. The Generator Protection Relays, the Bay Protection Units including the Busbar protection and the energy metering System offered should be from manufacturer(s) who have manufactured and supplied the offered type of		
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 31 OF 36

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devices for respective equipment, which must have been in successful operation in a 100 MW or above unit / 220 kV class or above Substation/Switchyard for a minimum period of one (1) year.				
6.0	Provenness of Control and Instrumentation (C&I) Equipments / Systems			
The Bidder or its proposed sub vendor(s) should meet the provenness requirements of any one of the routes stipulated under clause 6.1 or 6.2 for DDCMIS supplier. In addition, the Bidder or its sub vendor(s) should also meet the requirements stipulated under clause 6.3, 6.4, 6.5 and 6.6 (a to f). For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on date of consideration of approval but not later than six (6) months after award date of EPC package unless otherwise specified in respective clauses.				
6.1	Route 1 (For Distributed Digital Control, Monitoring and Information System (DDCMIS) Supplier):			
a. The DDCMIS supplier should be Indian Company registered in India as per Companies Act. b. The DDCMIS supplier should have engineered, supplied, and commissioned/ got commissioned BOP C&I, SG C&I and TG C&I control systems in at least one (1) unit of rating 200MW or above in a power station(s).				
6.2	Route 2 (For DDCMIS Supplier with Collaborator(s)/Associates(s)):			
The DDCMIS supplier for this package who fully meets the requirement for BOP C&I at clause no. 6.1 but does not meet the requirement for SG C&I and/or TG C&I at clause no. 6.1(b), may also supply DDCMIS for SG C&I and/or TG C&I provided it collaborates /associates with DDCMIS/ DCS supplier(s) who meet(s) the requirement for SG C&I and/or TG C&I respectively stipulated at clause no. 6.1 (b).				
6.3	The Control system(s) offered for BOP C&I , SG C&I and TG C&I application(s) shall be same or of same series as that of the control system(s) for respective applications which has been commissioned in at least one (1) unit of rating 200MW or above in a power station(s).			
6.4	The Control system(s) offered at clause no. 6.3 shall be operating successfully for BOP C&I or SG C&I or TG C&I application(s) for a period of not less than one (1) year in at least one (1) unit of rating 200MW or above in a power station(s).			
6.5	The Control system(s) offered for BOP C&I , SG C&I and TG C&I application(s) shall be of same make.			
6.6	The other C&I systems offered for this package shall meet the following. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on date of consideration of approval but not later than eighteen (18) months after award date of EPC package. a) Isolation valves, Blow down Valves, Coolers & Automatic Pressure reducer valves in Primary Rack, Thermal shut-off valves and Analysers of SWAS system offered for this package shall be same or of same series which should have been in successful operation for a period of not less than one (1) year in at least one (1) supercritical unit of rating 660MW or above in a power station.			
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 32 OF 36

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	b) CEMS, and Vibration Monitoring system offered for this package shall be same or of same series which should have been in successful operation for a period of not less than one(1) year in at least one(1) unit of rating 200MW or above in a power station. c) UPS system offered for this package shall be same or of same series and type as that of 105 KVA or above capacity UPS which should have been in successful operation for a period of not less than one (1) year in a power station. d) 24 V DC modular charger offered for this package shall be same or of same series and type as that of 500A or above capacity 24 V DC modular charger which should have been in successful operation for a period of not less than one(1) year in any industry or telecommunication application. e) The combination of offered make of IP based camera and offered make of video management software, for CCTV system, should have been in successful operation for a period of not less than one (1) year in a large industrial setup viz power plant, cement plant, petroleum refinery, steel plants or coal mine, having installation of minimum forty (40) nos. cameras.						
<table><tr><th colspan="2">Notes:-</th></tr><tr><td>(A)</td><td> Control system for BOP C&I , TG C&I and SG C&I application(s) referred in Para 6.1, 6.2 , 6.3, 6.4 and 6.5 means following :- (i) Control system for BOP C&I shall include Modulating control for Steam Generator (SG), Modulating control for feed water / Condensate Cycle, Binary Control of the auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units. (ii) Control system for SG C&I shall include Burner Management System & Boiler Protections for coal fired units. (iii) Control system for TG C&I shall include Steam Turbine Electro-hydraulic control & Turbine Protection system. </td></tr></table>				Notes:-		(A)	Control system for BOP C&I , TG C&I and SG C&I application(s) referred in Para 6.1, 6.2 , 6.3, 6.4 and 6.5 means following :- (i) Control system for BOP C&I shall include Modulating control for Steam Generator (SG), Modulating control for feed water / Condensate Cycle, Binary Control of the auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units. (ii) Control system for SG C&I shall include Burner Management System & Boiler Protections for coal fired units. (iii) Control system for TG C&I shall include Steam Turbine Electro-hydraulic control & Turbine Protection system.
Notes:-							
(A)	Control system for BOP C&I , TG C&I and SG C&I application(s) referred in Para 6.1, 6.2 , 6.3, 6.4 and 6.5 means following :- (i) Control system for BOP C&I shall include Modulating control for Steam Generator (SG), Modulating control for feed water / Condensate Cycle, Binary Control of the auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units. (ii) Control system for SG C&I shall include Burner Management System & Boiler Protections for coal fired units. (iii) Control system for TG C&I shall include Steam Turbine Electro-hydraulic control & Turbine Protection system.						
7.0	PROVENNESS CRITERIA FOR CIVIL & STRUCTURAL WORKS						
7.1	Bidder or its agency should have executed civil and steel structural works of 500 MW or higher capacity coal based/Lignite based power plant, Earth work in filling involving mechanical compaction and cutting in rock, including Main power house building and Foundation for Turbo-generator.						
7.2	In case Bidder or its agency do not meet the requirements at 7.1 and the Bidder proposes to engage agency (ies) for concrete & steel structural works, the proposed agency (ies) should fulfil the following criteria:						
	a) For concrete works (other than TG Foundation), Bidder or its agency should have executed concrete works of TG building/Bunker building of 500 MW or higher capacity coal based/Lignite based power plant/ TG Building of Nuclear Power Plant. b) For Steel Structural works, Bidder or its agency should have executed steel structural works of TG building/Bunker building of 500 MW or higher capacity (coal based/Lignite based) power plant / TG Building of Nuclear Power Plant / Steel Melting Shop/Proportioning Bin Building of Steel Plant						
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 33 OF 36			

CLAUSE NO.	PROVENNESS	एनटीपीसी NTPC	
	c) For Turbo Generator Foundation, Bidder or its agency should have executed at least one (1) TG Foundation of 500MW or higher capacity (coal based/Lignite based) power plant / Nuclear Power Plant. In case, Bidder proposes to engage more than one agency for the works mentioned at para 7.2 (a) or 7.2 (b) above, Bidder shall do so on work volume basis. The annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, for which it is being engaged. 7.3 For civil & steel structural works of Coal Handling Plant, Ash Handling Plant and DM/PT Plant, Bidder or its agency(ies) should have executed track hopper or wagon tippler of Coal Handling Plant, Ash Handling Plant and DM/PT Plant of 500 MW or higher capacity Coal based/Lignite based power plant. 7.4 For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height with slipform shuttering. 7.5 NOT USED 7.6 Bidder should have executed the reference works within the preceding seven (7) years reckoned as on the date of techno-commercial bid opening. 7.7 a. Bidder or its design agency (ies) should have carried out the design and detailed engineering of Main plant building, Coal Handling Plant, Mill bunker building, transfer points and conveyor gallery, civil & structural works for ash handling plant, CW System Civil Works-of coal based/Lignite based power plant of 500 MW or higher capacity. b. For Foundation for Turbo-generator, Bidder or its design agency should have carried out design & detailed engineering of at least one foundation for Turbo-generator (with or without Vibration Isolation system as offered by the Bidder), for a coal based/lignite based power plant of 500MW or higher capacity or Nuclear Power Plant. c. For Chimney, Bidder or its design agency should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. 7.8 Finalisation of agency(ies) for above works shall be the responsibility of the successful Bidder and owner's approval for the same is not envisaged.		
	8.0 Provenness criteria for Solar PV rooftop on plant buildings:		
	8.1 Solar PV rooftop EPC contractor: The Bidder or its Sub-vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning of SPV based grid connected power plant of at least one plant of 40 kWp or above. The reference plant of 40 kWp or above capacity must have been in successful operation for at least six months.		
	8.2 Solar PV module The bidder/sub-contractor shall meet the requirements as stipulated in para (a) and (b) below for supply of solar PV modules: a) The Bidder / sub-contractor should have manufactured and supplied the solar PV modules of cumulative installed capacity of 1MWp or above using any rating of modules and any source of indigenous or imported PV cells in any one financial year. b) The Bidder / sub-contractor should have manufactured and supplied solar PV modules built up using indigenous and/or imported PV cells of power rating 300Wp or above which must have been in successful operation for at least six months		
	9.0 Bidder shall have the option of awarding the BOP system(s) on EPC basis to qualified sub vendor(s). The qualified sub-vendor(s) for BOP EPC shall meet the following requirements:		
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 34 OF 36

CLAUSE NO.	PROVENNESS	एनटीपीसी NTPC	
The BOP EPC sub vendor should have executed on Engineering, Procurement and Construction (EPC) basis, minimum one (1) no. coal based/Lignite based power plant of at least 500 MW unit capacity comprising of at least a) Coal/Lignite handling plant, b) Cooling Tower, c) Water / waste water treatment plant or DM plant ,including associated civil works, Structural and Electrical systems for the above equipment(s) and systems as a single package, which is in successful operation for a period of not less than one (1) year prior to the date of techno-commercial bid opening. The BOP EPC sub vendor shall source the equipment(s)/ Sub system(s) from such qualified vendors who meet the provenness requirements as stipulated in technical specification for the respective equipment(s)/ Sub system(s).			
10.0	Balance equipment's/ systems		
The Bidder at its option can source the balance of plant equipment/systems not covered in clause 3.0, 4.0, 5.0, 6.0, 7.0 8.0 & 9.0 above. However for such balance of plant equipment/systems, the Employer reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers.			
11.0	Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/its Collaborators/ licensor/ its sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.		
12.0	To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc.		
13.0	Condenser Vacuum pumps are sometimes imported by contractor from manufacturers meeting the Provenness criteria as specified above. However, to promote make in India, vacuum pump is identified for Indigenous manufacturing. In case the bidder wants to purchase it from Indigenous sources who does not meet the specified criteria then the bidder to make sure following requirements are met. However, bidder can offer only one pump from indigenous sources for this package.		
	(i) Bidder has to make himself fully satisfied that the equipments/components shall perform to meet all the contractual requirement.		
	(ii) The bidder will source these equipments from Indian manufacturers who are regular manufacturer of such equipment/components for at least 200 MW or higher size unit.		
	(iii) In such a case additional Testing and Quality requirement shall be tied-up for quality assurance checks before award.		
	(iv) Apart from specific mandatory spares (identified for Vacuum pump), one additional pump of such indigenous source shall be supplied in addition to the requirement as per specification. Same shall be supplied along with the main equipments without any extra cost to the Employer.		
	(v) Additional replacement warranty of 5 year after latent defect period shall be given by the bidder.		
	(vi) In case of any failure of these equipment/components during unit operation/commissioning, then bidder shall replace the equipment from NTPC approved sources.		
14.0	HP Bypass System are generally supplied as per Provenness clause specified above at 3.1/(p). However, to promote make in India, HP Bypass valves is also identified for Indigenous manufacturing. In case the bidder wants to supply it from Indigenous sources who does not meet the specified criteria then the bidder to make sure the requirements specified at clause 14.1 below are met. However, supply of HP Bypass system shall be limited to only		
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS
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CLAUSE NO.	PROVENNESS		
14.1	one unit from such indigenous sources and HP Bypass valves for other unit shall be supplied only from approved sources meeting provenness requirement as specified. (i) Bidder has to make himself fully satisfied that the HP Bypass shall perform to meet all the contractual requirement. (ii) The bidder will source HP Bypass system from Indian manufacturers who are regular manufacturer of HP Bypass system for at least 500 MW or higher size supercritical unit having minimum flow of 650 Ton/Hr for each valve at Main Steam pressure and Temperature of 247 Kg/Cm2(abs) and 565 deg.C respectively at Turbine Inlet. (iii) In such a case additional Testing and Quality requirement shall be tied-up for quality assurance checks before award. (iv) Apart from specific mandatory spares (identified for HP Bypass system), one additional HP Bypass valve set of such indigenous manufacture/source shall be supplied in addition to the requirement as per specification. Same shall be supplied along with the main equipments without any extra cost to the Employer. (v) Additional replacement warranty of 5 year after latent defect period shall be given by the bidder. (vi) In case of any failure of these HP Bypass system during unit operation/commissioning, then bidder shall replace the same from NTPC approved sources. Further, in such a case bidder shall keep provision (till additional warranty period) for insurance to compensate the Employer for consequential losses due to unit outage.		
LARA SUPER THERMAL POWER PROJECT STAGE -II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-I-A PROVENNESS	PAGE 36 OF 36

(XI) In order to satisfy the Qualifying Requirements stipulated at Clause No. 7.4 of Sub-Section-IA, Part-A of section-VI, we declare that
*We/our Sub-Vendors *M/s. have executed civil and structural works related to RCC **Chimney shell using
slipform shuttering** for a thermal power plant of 500MW or higher capacity, as per details given below:

Sl. No.	Name of contracts	Name & Address of Client	Ref. No. and date of Award of Contract	Date of completion of works (Shell / Flue Liner)				Height of RCC Shell (m)	Whether own Slip from equipment	Remarks
				As per Contract		Actual				
				-----		-----				
				start	Finish	Start	Finish			
1	2	3	4	5	6	7	8	9	10	11

Note : i) Certificate from client(s) i.e. M/s regarding civil / structural steel work related to RCC Chimney
executed in the above contracts is enclosed at Annexure

***Strike out whichever is not applicable.**

Signature of authorized signatory.....

(XII) In order to satisfy the Qualifying Requirements stipulated at Clause No. 7.7 of Sub-Section-IA, Part-A of section-VI, we declare that *We/our Sub-Vendors *M/s. have carried out the design and detail engineering of **Main Plant Building, Turbo Generator Foundation** (with or without VIS as offered by bidder), **Condenser, Coal Handling Plant, Ash Handling Plant**, for a coal based/lignite based power plant of 500MW or higher capacity, reinforce concrete **Chimney with steel flues** (minimum 100m height), as per details given below :

Sl. No.	Name of contracts	Name & Address of Client	Ref. No. and date of Award of Contract	Date of completion of Design/Engg	Scope of	works	Remarks
				As per Contract	Actual		
1	2	3	4	5	6	7	8

Note :

- i) Certificate from client(s) i.e. M/s regarding the Completion of design & detailed engineering of civil & structural works of a coal based/lignite based power plant of 500MW or higher capacity is enclosed at Annexure
- ii) Certificate from client(s) i.e. M/s regarding the Completion of design & detailed engineering of reinforced concrete chimney with steel flues (minimum 100m height) is enclosed at Annexure
- iii) Certified from clients(s) ie. M/s regarding the Completion of design & detailed engineering of Civil Works for Condensor is enclosed at Annexure.....
- iv) Certified from client(s) i.e M/s regarding the Completion of design & detailed engineering of Turbo Generator Foundation is enclosed at Annexure.....

* **Strike out whichever is not applicable.**

Signature of authorized signatory.....

(On Company's Letter Head)
LETTER OF SUPPORT FOR SATISFACTORY PERFORMANCE
of..... (Name of Equipment / System*)
for LARA STPP STAGE-II Power Project Package

TO,
[EMPLOYER'S NAME & ADDRESS]

Sub: Letter of Technical Support submitted From (name of the Associate*/ Collaborator*/ Technology provider* / Licensor*)
undertaking the responsibility for successful performance of(name of equipment/system*).

Dear Sirs,

1. In accordance with the Award of the Contract by (Name of the Contractor) to M/s. (Name of the sub-vendor), we, the aforesaid Associate*/Collaborator*/Technology provider*/Licensor*, (M/s) shall be fully responsible for the successful performance of the(name of equipment/system*).
2. Further, the manner of achieving the objective set forth in point 1 above shall be as follows for (name of equipment/system*):
 - (a) We shall provide design, manufacturing and assembly drawings of..... (name of equipment/system*). (name of equipment/system*) which shall be manufactured and supplied as per above design provided by us and the drawings approved by the Employer.
 - (b) We shall depute technical experts to Bidder's/sub-vendor's works for supervision during manufacturing, assembly, erection, commissioning and final testing (as and when necessary) of the..... (name of equipment/system*).
 - (c) We shall promptly carry out all the corrective measures and shall promptly provide corrected design and shall undertake replacements, rectifications or modifications to the equipment/system* as and when required by Employer in case the equipment/system* fails to demonstrate successful performance as per contract at site.
 - (d) We shall participate in Technical Co-ordination meetings (TCMs) from time to time, as and when required by the Employer.
3. We, the Associate*/Collaborator*/Technology provider*/Licensor* do hereby undertake and confirm that this Letter of Technical Support shall be valid until the end of defect liability period of the contract.

Signature of authorized signatory.....

Signature of the Authorised Representative...
For M/s
(Associate*/Collaborator*/Technology provider*/Licensor*)
Address
Name
Designation
Date:.....
Common Seal of the Company

***: Strike off whichever is not applicable.**

Note : The above format to be referred for auxiliary related to Steam Generator, Electrostatic Precipitator (ESP), Flue Gas Desulphurization (FGD) sub systems as applicable as per the proveness criteria given at sub-section-IA, Part-A of proveness of Technical Specification (Sub-section-VI).

Signature of authorized signatory.....

SUB-SECTION-I-B

PROJECT INFORMATION

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

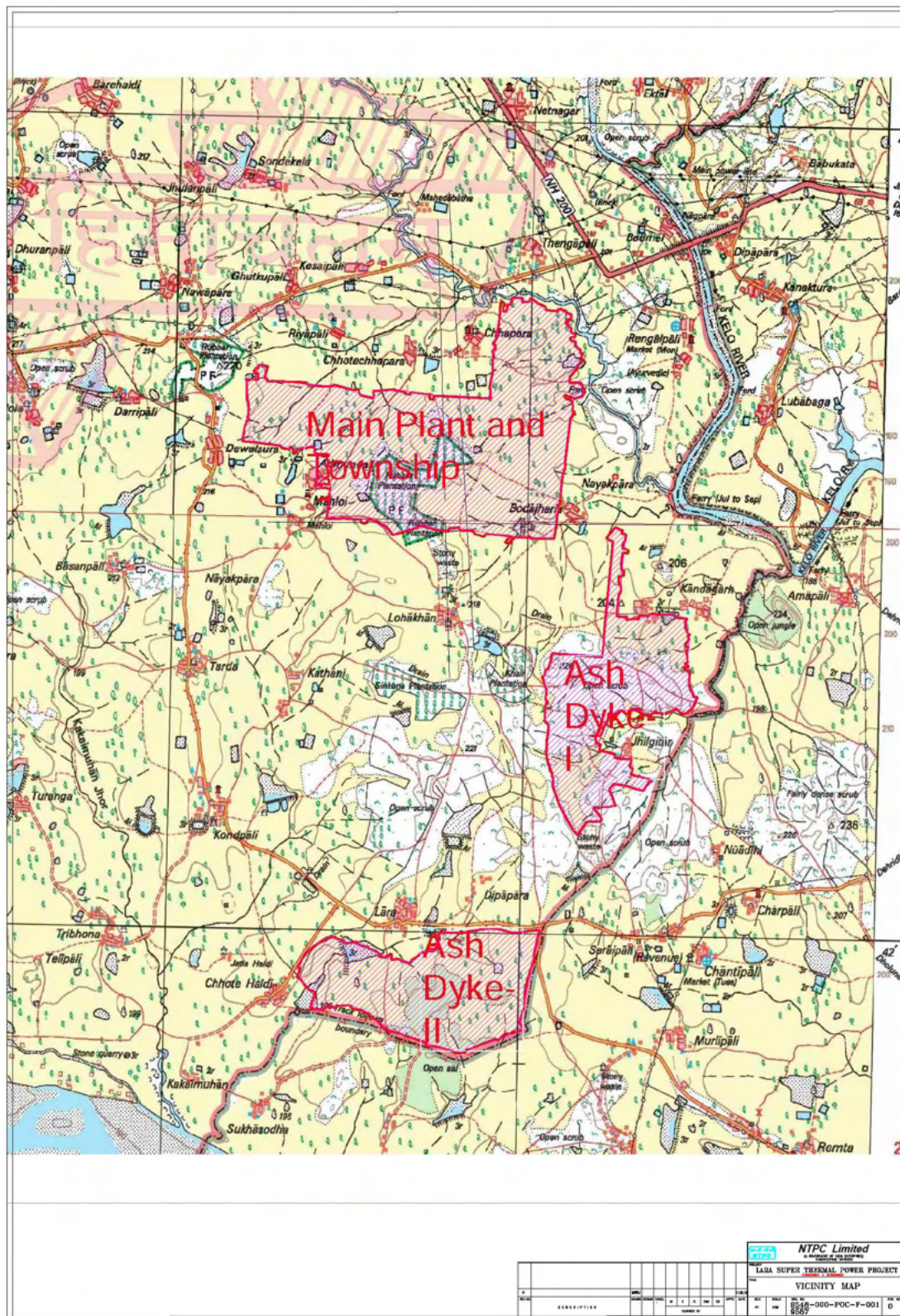
CLAUSE NO.	PROJECT INFORMATION			 A Maharatna Company						
1.00.00	BACKGROUND Lara STPP Stage-I(2X800 MW) units are in operation near Lara village in Raigarh Distt. of Chhattisgarh. The Present proposal is for Lara STPP, Stage-II (2x800 MW) as extension of existing stage-I.									
2.00.00	LOCATION AND APPROACH The project is located in Raigarh district of Chhattisgarh State. The project is located south-east of Raigarh town near village Lara, bounded by villages Lara, Chhapora & Lohakhan and on the western side of Odisha State boundary.									
2.01.00	RAIL LINK The project site is approachable from NH-200 (Raigarh–Sarangarh) via Kondatarai through State PWD Road. The nearest rail head Raigarh Railway Station (on South East Central Railway, Howrah-Bilaspur Broad Gauge), is approximately 30 kms from the project site.									
2.02.00	AIRPORT The nearest commercial airport, Raipur is about 250 kms from the project site. Vicinity Plan is placed at Annexure-I .									
3.00.00	CAPACITY <table border="1"><tr><td>Stage-I</td><td>:</td><td>1600 MW (2x800 MW) – Under Operation</td></tr><tr><td>Stage-II</td><td>:</td><td>1600 MW (2x800 MW) - Present proposal</td></tr></table>				Stage-I	:	1600 MW (2x800 MW) – Under Operation	Stage-II	:	1600 MW (2x800 MW) - Present proposal
Stage-I	:	1600 MW (2x800 MW) – Under Operation								
Stage-II	:	1600 MW (2x800 MW) - Present proposal								
4.00.00	LAND About 2450 Acre of Land has been acquired for Lara Super Thermal Power Project. The expansion project is envisaged to be accommodated with in the land already acquired during Stage-I.									
5.00.00	WATER Water Cooled Condenser is envisaged for Lara Stage-II of 2 X 800 MW units. Make up water requirement for this project would be about 4800 Cu.M/hr. The make-up water will be drawn from Mahanadi river. Raw water will be drawn to supply to PT Plant & Ash Handling Plant. WRD, Govt. of Chhattisgarh have accorded Water availability confirmation of 45 MCM for Stage-I (2x800 MW) and 68 MCM for Stage-II of Lara STPP from Saradih Barrage on river Mahanadi. Thus the total committed water by WRD, Govt. of Chhattisgarh for Lara STPP is available for 113 MCM. Closed cycle cooling water system using cooling towers is envisaged for Stage-II of the project.									
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION						
PAGE 1 OF 22										

CLAUSE NO.	PROJECT INFORMATION			 A Maharatna Company
6.00.00	COAL			
6.01.00	Coal requirement for Lara STPP, Stage-II (2x800 MW) would be about 7.0 MTPA million at 90% PLF and shall be met from Talaipalli coal blocks (Mand-Raigarh coal fields) allotted to NTPC.			
6.02.00	Coal Transportation The envisaged mode of coal transportation from the coal mines to the power plant is by MGR/IR in BOBR wagons.			
6.03.00	Coal Quality The primary fuel for the main steam generator shall be coal. The coal quality parameters are indicated in Annexure-IV-2 are to be considered for steam generator design.			
7.00.00	Fuel Oil The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Light Diesel Oils having the characteristics given at Annexure-IV-1 .			
8.00.00	MODE OF OPERATION : Middle load (two shifting and load cycling)			
9.00.00	STEAM GENERATOR TECHNOLOGY The steam generators shall be super critical, once through, water tube type, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.			
10.00.00	FLUE GAS DESULPHURIZATION SYSTEM (FGD) & DeNOx ready System: The project is envisaged with Flue Gas Desulfurization (FGD) system and DeNOx ready System.Limestone to be used for design of FGD system shall be as per the characteristic given at Annexure-IV-5 .			
11.00.00	CONSTRUCTION POWER The requirements of the construction power supply for the project would be met from the stage-I 11 kV Miscellaneous Switchgear located in Stage-I area. Necessary 11 kV interconnection, Ring main/LT sub-stations shall be provided by the bidder for the required power plant area.			
12.00.00	POWER EVACUATION SYSTEM LARA STPP -II shall be the extension project of LARA STPP-I (2X800 MW) and would comprise of two (2) Nos. of coal fired unit of capacity 800 MW each. Step up/power evacuation voltage of Stage-I of the project is 400KV. Under Stage-I of the project, provision of One no. 400kV twin D/C line up to Raigad Kotra pooling station has been considered for connectivity. One no. 400kV Quad D/C line to Champa pooling has also been kept for evacuation of power as finalized in Western Region Standing Committee Meeting/LTA& Connectivity meeting. Under stage-II, two more units of 800 MW units are considered making the ultimate project capacity as 3200 MW.. A number of IPPs are coming in this vicinity of Raigarh-Korba complex of Chhattisgarh., the bulk power generated in this region			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION
PAGE 2 OF 22				

CLAUSE NO.	PROJECT INFORMATION			 A Maharatna Company
	shall be exported to power deficit region of WR and NR. Major 765 kV/400 kV pooling stations in this vicinity are being implemented by Central Transmission utility for bulk transmission of power through high capacity 765 kV and 800 kV HVDC corridors to facilitate exchange of the quantum of power from generation projects proposed to be located in eastern part of WR to Central/Western part of WR and NR. Considering above aspect, the step up/power evacuation voltage for stage-II has been considered at 400 kV. As elaborated above, the power generated need to be transmitted through high capacity corridors to load centers in Central/western part of WR and NR. The nearest 765/400 kV pooling station located to this project is Kotra pooling station in Raigarh. This pooling station is interconnected to other two pooling station in this vicinity i.e. Champa and Tamanar pooling station. Also Kotra pooling station is planned to be interconnected with Dhule (PG) thorough a high capacity +/- 600 kV HVDC corridor under common regional transmission system strengthening. Considering overall scenario, presently 4 nos. of 400 kV line bays have been kept in the Generation Switchyard for connecting to 400 kV Raigarh (Kotra) pooling station. 400kV D/C Twin Moose Lara-I-Raigarh (Kotra) line is already available in stage-I. It is proposed to upgrade this line to Quad capacity and use it for evacuation of power from stage-II. However, in line with CERC regulation on Grant of Connectivity, Long term Access (LTA) and Medium term open access in Inter State Transmission System (ISTS) and related matter, connectivity and LTA application shall be submitted to Power Grid (CTU) for finalization of ISTS connectivity and Associated Transmission System (ATS) of the project. Based on Connectivity & LTA applications indicating beneficiaries, the ATS would be finalized by Central Transmission Utility (PGCIL) /CEA in the regional Standing Committee Meeting/LTA & Connectivity meeting			
13.00.00	PLANT WATER SCHEME			
13.01.00	Equipment Cooling Water (ECW) System (Unit Auxiliaries)			
	All plant auxiliaries and station auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. It is proposed to provide independent primary cooling water circuit for TG & its auxiliaries and Steam Generator & auxiliaries (including FGD & station auxiliaries) on Unit basis.			
13.02.00	Other Miscellaneous Water Systems			
	CW system blow down water shall be used in Ash Handling System, FGD process water and CHP dust suppression, service water etc. (Refer Plant Water Scheme). Further, the plant service water requirement, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water system, APH wash & FGD system (gypsum cake wash) make up shall be met from PT plant of CW system (PT-CW). The waste service water collected from various areas and coal-laden water from coal handling plant shall be treated as per requirement and reused. The quality of Raw water, & DM water is given in this sub-section at Annexure-III-A, and IIIB.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A	SUB SECTION –IB PROJECT INFORMATION	PAGE 3 OF 22

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13.03.00	Condenser Cooling (CW) Water System It is proposed to adopt a recirculating type cooling water system with Induced Draft type cooling towers for the project. For the re-circulating type CW system it is proposed to supply clarified water as make up. Circulating water from CW pumps to TG area and from TG area to cooling tower will be carried through pipes/ducts. Cooled water from Cooling Tower will be led to CW pump house through the cold water channel by gravity. Plant water scheme is included in Part-E of the technical specification.			
14.00.00	ENVIRONMENTAL ASPECTS Lara STPP, Stage-II is proposed to be constructed on the land already acquired for ultimate capacity of Lara STPP, which conforms to the siting criteria for thermal power plants. Environment and Forest Clearances for Lara STPP Stage-I have already been accorded by MoEF&CC.			
16.00.00	METEOROLOGICAL DATA The meteorological data from nearest observatory is placed at Annexure-II .			
17.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B of this section.			
18.00.00	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part-B of this section			
19.00.00	Vulnerability Atlas of India(VAI) , prepared by Building Materials, Training and Promotion Council (BMTPC) under Ministry of Housing and Urban Affairs, is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT-wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation and construction stage. The VAI provides necessary information for risk analysis and hazard assessment and is available at website www.bmtpc.org . As per Government's directive, it is mandatory for the bidders to refer VAI for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning, designing and execution of the project in terms of following details: i) Seismic zone (II to V) for earthquakes ii) Wind velocity iii) Area liable to floods and Probable max. surge height iv) Thunderstorms history v) Number of cyclone storms/sever cyclone storms and max sustained wind specific to coastal region vi) Landslides incidences with Annual rainfall normal vii) District wise Probable Max. Precipitation			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION
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CLAUSE NO.	PROJECT INFORMATION			
	Accordingly, bidder should refer VAI while planning, designing and execution of the project. However, for design of structures/facilities and equipment, the criteria for earthquake resistant design of structures and equipment, the criteria for Wind Resistant Design of Structures and Equipment and design parameters for drainage facilities, stipulated in the Technical Specification shall be followed. For other information like area liable to floods, probable max. surge height, landslide, thunderstorm, cyclone etc. agencies are required to refer the VAI.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A	SUB SECTION –IB PROJECT INFORMATION	PAGE 5 OF 22



CLAUSE NO.

PROJECT INFORMATION



Annexure-II

BACK

जलवायवी सारणी CLIMATOLOGICAL TABLE

स्टेशन : रायगढ़ STATION : Raigarh		अक्षांश LAT. 21°53'		देशांतर LONG. 83°23'		समुद्री तल माथ से ऊंचाई HEIGHT ABOVE M.S.L. 220 METRES		मॉडर BASED ON OBSERVATIONS 1971-2000		प्रक्षेपी पर आधारित												
मास MONTH	स्टेशन का सतह दाब STATION PRESSURE	मास्य MONTHLY				चरम EXTREMES		आर्द्रता HUMIDITY		मेघ की मात्रा CLOUD AMOUNTS		मार्मिक MONTHLY TOTAL		वर्षा RAINFALL		मास पतन DATE						
		दिनांक DATE		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME								
		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME								
		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME								
STATION PRESSURE		WET BULB TEMP.		HIGHEST IN THE MONTH		LOWEST IN THE MONTH		RELATIVE HUMIDITY		ALL CLOUDS		MONTHLY TOTAL		TOTAL IN DRIEST MONTH		TOTAL IN WETTEST MONTH		HEAVIEST FALL IN 24 HOURS		MEAN AND WETTEST DATE		
हफ्ता WEEK		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		दिनांक और समय DATE AND TIME		
I	991.6	17.9	14.2	28.0	13.4	31.3	9.1	33.4	2	6.8	22	65	13.5	1.5	0.3	14.5	1.2	88.4	0.0	50.8	8	3.2
II	987.6	25.1	17.8					14.6	14.6	1.9	0.3	46	14.6	1.9	0.3	14.5	1.2	88.4	0.0	50.8	1985	
I	989.4	20.9	16.1	30.8	16.3	35.0	11.5	38.2	22	7.8	8	60	14.8	1.2	0.2	14.5	1.1	76.2	0.0	29.0	1	4.2
II	985.6	28.4	18.7					13.9	13.9	1.7	0.3	36	13.9	1.7	0.3	14.5	1.1	76.2	0.0	29.0	1973	
I	987.4	26.2	18.5	35.8	20.7	40.1	16.1	43.0	29	12.5	4	46	15.3	1.4	0.2	17.6	1.5	143.5	0.0	81.0	29	4.3
II	982.6	33.6	20.4					13.4	13.4	1.5	0.2	26	13.4	1.5	0.2	17.6	1.5	143.5	0.0	81.0	1967	
I	983.5	31.4	21.5	40.3	25.1	43.4	21.0	46.0	28	16.8	26	39	17.7	1.7	0.0	12.8	1.2	78.0	0.0	64.6	23	4.8
II	978.5	38.0	22.3					1973			1963	22	14.3	2.4	0.3	12.8	1.2	78.0	0.0	64.6	1984	
I	979.7	33.3	23.8	41.8	27.7	45.3	23.1	48.3	8	20.0	4	44	22.0	2.3	0.1	38.8	2.6	184.6	0.0	80.2	30	5.3
II	974.8	39.5	24.1					1973			1987	26	17.7	3.4	0.5	38.8	2.6	184.6	0.0	80.2	1990	
I	978.1	30.7	25.2	37.6	27.1	43.6	23.2	47.2	6	19.5	19	64	27.5	5.2	2.3	204.3	9.4	543.7	36.2	212.4	29	5.9
II	972.2	34.6	25.6					1955			1963	51	25.7	6.1	2.5	204.3	9.4	543.7	36.2	212.4	1979	
I	976.4	27.4	25.2	31.9	25.0	36.0	22.5	41.8	6	18.6	25	83	30.4	6.7	4.6	399.3	17.5	952.7	131.6	261.0	10	5.1
II	973.5	29.5	25.9					1962			1995	75	30.6	6.9	4.6	399.3	17.5	952.7	131.6	261.0	1998	
I	977.2	27.2	25.3	31.2	25.0	34.3	22.9	37.0	1	19.5	20	84	30.7	6.8	4.7	441.9	16.8	813.5	117.2	315.2	25	5.1
II	974.3	29.0	25.9					1972			1975	78	31.0	7.0	4.6	441.9	16.8	813.5	117.2	315.2	1979	
I	981.3	27.8	25.2	32.3	24.7	34.9	22.5	38.0	1	20.2	4	80	30.1	4.8	2.9	234.0	10.9	886.2	51.4	212.0	14	3.9
II	977.8	29.3	25.7					1969			1991	74	30.0	5.9	3.1	234.0	10.9	886.2	51.4	212.0	1981	
I	986.6	26.6	22.8	32.6	22.3	34.9	18.2	37.1	11	13.4	23	71	25.0	2.3	0.8	42.2	3.0	140.2	0.0	83.6	14	3.3
II	982.8	29.5	23.7					1976			2000	60	24.7	3.5	1.4	42.2	3.0	140.2	0.0	83.6	1998	
I	990.3	22.8	18.3	30.3	17.9	33.1	13.5	36.6	3	9.3	30	64	17.8	1.5	0.3	7.5	0.7	39.4	0.0	51.2	10	3.1
II	986.4	27.1	20.2					2000			1970	51	18.4	2.2	0.5	7.5	0.7	39.4	0.0	51.2	1991	
I	992.5	18.0	14.2	28.0	13.2	30.5	10.0	33.0	4	6.4	24	65	13.3	1.2	0.0	2.0	0.2	65.5	0.0	27.3	11	2.8
II	988.3	24.6	17.7					1962			1959	47	14.8	1.8	0.1	2.0	0.2	65.5	0.0	27.3	1967	
I	984.2	25.9	21.0	33.3	21.5	45.2	8.9	48.3	8	6.4	24	64	21.7	3.1	1.4	1429.3	65.9	2973.8	957.3	315.2	25	4.3
II	980.2	30.7	22.4					5	1973	12	1959	49	20.8	3.7	1.6	1429.3	65.9	2973.8	957.3	315.2	1965	
I	28	28	28	29	29	29	29	50	50	50	24	28	28	28	28	23	23	44	44	44	47	23
II	28	28	28	29	29	29	29	50	50	50	24	28	28	28	28	23	23	44	44	44	47	23

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स्टेशन : रायगढ़
STATION : Raigarh

[illegible]

RAW WATER ANALYSIS

SI No.	Parameters	Unit	Results	Suggested By COS-Chem
1	pH		8.0	8.2
2	Turbidity	NTU	84	500
3	P-Alkalinity	mg/l as CaCO ₃	nil	--
4	M-Alkalinity	mg/l as CaCO ₃	108	149
5	Total Hardness	mg/l as CaCO ₃	164	216
6	Calcium	mg/l as CaCO ₃	100	132
7	Magnesium	mg/l as CaCO ₃	64	84
8	Chloride	mg/l as Cl	28	40
9	Sulphate	mg/l as SO ₄	80	84
10	Total Silica	mg/l as SiO ₂	14.4	24.6
11	Colloidal Silica	mg/l as SiO ₂	6.3	4.8
12	Reactive Silica	mg/l as SiO ₂	8.4	19.8
13	Sodium + Potassium	mg/l as Na	52	56
14	Total Organic Carbon (TOC)	mg/l	7.2	5
15	Chemical Oxygen Demand (COD)	mg/l	12	15
16	Biological Oxygen Demand (BOD)	mg/l	3.8	5
17	Equivalent Mineral Acid (EMA)	mg/l	98	124
18	Total Suspended Solids (TSS)	mg/l	78	
19	Total Iron	mg/l as Fe	0.56	0.92
20	KMnO ₄ No.	mg/l	1.6	2.8
21	Dissolved Oxygen (DO)	mg/l	7	7-8
22	Temperature	Deg C	29	28-36
23	TDS	ppm		307
24	Total cations	mg/l as CaCO ₃	216	272
25	Total anions	mg/l as CaCO ₃	216	272

ANNEXURE-III B

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO ₂
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 to 7.2
5.	Conductivity	Not more than 0.1 μ S/cm

ANNEXURE-IV-1

LIGHT DIESEL OIL CHARACTERISTICS**AS PER IS 15770-2008**

Characteristics	LDO
1. Pour Point (max)	21 °C & 12°C for Summer and Winter respectively
2. Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.0
3. Sediment percent by mass (max)	0.10
4. Total sulphur percent by mass (max)	1.5
5. Ash percentage by mass (max)	0.02
6. Carbon residue (Rams bottom) percent by pass (max.)	1.50
7. Acidity inorganic	Nil
8. Flash point (Min.) - Pensky Martens	66 deg.C
9. Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
10. Water content, % by volume (max)	0.25
11. GCV(kcal/kg)	10,000

CLAUSE NO.	PROJECT INFORMATION						Annexure-IV-2	
	S.No,	Characteristics (as received basis)	Range of 95 % coal supplies			Range of 5 % coal supplies		
			Column - 1	Column -2	Column - 3			
	1.0	PROXIMATE ANALYSIS	Design	Worst	Best	Worst	Best	
	1.1	Total Moisture() %	15	17	17	Later		
	1.2	Ash (%)	40	43	39.27			
	1.3	Volatile Matter (%)	21	19	18.32			
	1.4	Fixed Carbon (%)	24	21	25.41			
	1.5	Total	100	100	100			
	2.0	ULTIMATE ANALYSIS						
	2.1	Carbon (%)	33.64	30.4	32.6	Later		
	2.2	Hydrogen (%)	3.1	2.3	3.8			
	2.3	Sulphur (%)	0.4	0.5	0.47			
	2.4	Nitrogen (%)	1.2	0.9	0.46			
	2.5	Oxygen (%)(By difference)	6.62	5.84	6.17			
	2.8	Total Moisture (%)	15	17	17			
	2.9	Ash (%)	40	43	39.27			
	2.10	Chloride (%)	0.04	0.06				
		Total	100	100	100			
	2.11	GCV (Kcal/Kg)	3500	3000	3645			
	2.12	Hard Grove Index	50	48	54			
	2.13	YGP (mg/Kg)	75	80	-			
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION		PAGE 12 OF 22	

CLAUSE NO.	PROJECT INFORMATION						 A Maharatna Company
	3.0	ASH ANALYSIS					
	3.1	Silica (%)	58.59	56.81	64.8	Later	
	3.2	Alumina (%)	26.77	27.42	24.21		
	3.3	Iron Oxide (%)	8.8	9.8	6.29		
	3.4	Titania	1.66	1.78	1.89		
	3.5	Phosphoric Anhydride (%)	0.19	0.1	0.15		
	3.6	Lime (%)	1.38	1.48	0.22		
	3.7	Magnesia (%)	1.0	1.13	0.82		
	3.8	Sulphuric Anhydride (%)	0.05	0.04	0.43		
	3.9	Na ₂ O	0.1	0.08	1.19		
	3.9	K ₂ O (by difference)	1.46	1.36			
		Total	100	100	100		
	4.0	ASH FUSION RANGE					
		REDUCING ATMOSPHERE					
	4.1	Initial Deformation Temp .(°C)	1150	1100	-	Later	
	4.2	Hemispherical Temp.(°C)	1300	1250	-		
	4.3	Fusion Temperature (°C)	1400	1400	-		
	Note: For FGD design and guarantee condition-HCL (ppm), wet-45 & HF (ppm) wet-12 may be considered respectively.						
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION		PAGE 13 OF 22

METHANOL CHARACTERISTICS

SN	Fuel Property	Unit	Methanol
1	Chemical Formula		CH ₃ -OH
2	Fuel Carbon	Wt%	38
3	Fuel Oxygen	Wt%	12
4	Density at 20 deg C	kg/m ³	792
5	LHV	Kcal/kg	4800
6	Boiling Temp	°C at 1 bar	65
7	Vapour Pressure	bar at 20°C	0.13
8	Kinematic viscosity	cSt at 20°C	0.74
11	Auto Ignition	°C	470
12	Heat of Vapourization	kcal/kg	260
15	Flammability limit	vol %	6-36
16	Flash Point	°C	12

CLAUSE NO.	PROJECT INFORMATION				एनटीपीसी NTPC A Maharatna Company
					Annexure-IV-7(A)

Annexure-IV-7(B)

The sample was prepared by torrefying rice straw at 300 deg C with a holding time of one hour. Following analysis are carried out at NETRA using the powdered torrefied rice straw samples and the results of various testing for the specific sample is tabulated below:

a. Proximate Analysis (wt %, Air Dried Basis)

M	Ash	VM	FC
6.68	21.66	47.68	23.98

b. Ultimate Analysis (wt %, Air Dried Basis)

C	H	N	S	O
46.65	3.93	1.13	0.14	19.81

c. GCV : 4201 kcal/kg

d. Ash Fusion Temperature under reducing conditions: °C

IDT	ST	HT	FT
1134	1357	1374	1422

e. Ash Elemental Analysis (Elements expressed as Oxides in %w/w)

Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	SO ₃	K ₂ O	CaO	TiO ₂	MnO	Fe ₂ O ₃
2.423	7.783	4.623	67.48	1.9	1.9	6.15	4.21	0.39	0.03	2.83

CLAUSE NO.	PROJECT INFORMATION  A Maharatna Company			
	Annexure-IV-7(C) For the Torrefied Rice Straw Pellets (Prepared by torrefaction of rice straw at 300 deg C with holding time of 1 hr) tested at NETRA, the test results are as follows: A. For Anion (ISO 16994:2016 E-Solid Biofuels- Determination of total content of sulphur and chlorine)-reported as wt % dry basis a. Chlorine (Cl): 0.32% b. Fluorine (F) : 0.09% B. For Cation (ISO 16967:2015 E-Solid Biofuels- Determination of major elements ...)- Reported as wt % dry basis a. Sodium (Na): 0.31% b. Potassium (K): 2.04% Note: The above details as at Annexure-IV-7(A), IV-7(B & IV-7(C) are indicative only and shall vary based on the exact raw material and its subsequent processing.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A	SUB SECTION –IB PROJECT INFORMATION	PAGE 17 OF 22

ANNEXURE-IV-1

HIGH SPEED DIESEL OIL CHARACTERISTICS

[AS PER IS 1460-2005 (BS-II)]

S. No.	Particulars	Unit	Value
1.	PHYSICAL PROPERTIES		
	a. Distillation volume recovery @ 350 ⁰ C	% vol. (min)	85
		% vol. (min)	95
	b. Distillation volume recovery @ 370 ⁰ C	cSt	2.0 – 5.0
		kg/m ³	820 – 860
	c. Kinematic Viscosity @ 40 Degree C	Degree C	15
	d. Density @ 15 Degree C	(max)	03
	e. Pour Point	Degree C	
	- Summer	(max)	18
	- Winter		06
	f. Cold Filter Plugging Point	Degree C	35
	- Summer	(max)	460
	- Winter	Degree C	
	g. Flash Point (Abal)	(max)	
	h. Lubricity WSD 1.4 @ 60 Degree C	Degree C	
		(max)	
		Microns (max)	
2.	HEATING VALUE		
	a. Higher Heating Value (HHV)	Kcal/Kg	11,000
	b. Lower Heating Value (LHV)	Kcal/Kg	10,300
3.	ACIDITY		
	a. Inorganic	mg KOH/g	Nil
	b. Total	mg KOH/g	0.2 (max.)
4.	Copper Strip Corrosion 3 hours @100 ⁰ C	No.	1 (max)
5.	RCR on 10% residue	% wt.	0.3 (max)
6.	CONTAMINANTS		
	a. Ash	ppm (wt.)	100 (max)
	b. Sediments	% wt	0.05
	c. Total Sulphur	% wt	(max)
	d. Water Content	% volume	0.05
	e. Trace Metals		(max)

CLAUSE NO.	PROJECT INFORMATION				एनटीपीसी NTPC A Maharatna Company
		- Na + K	ppm (wt)	0.05	
		- Vanadium	ppm (wt)	(max)	
		- Lead	ppm (wt)		
		- Calcium	ppm (wt)	0.30	
		- Ni + Zn	ppm (wt)	(max)	
				0.50	(max)
				0.50	(max)
			2.0		
			Nil		
7.		Nitrogen content (FBN)	% wt.	0.015	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART A		SUB SECTION –IB PROJECT INFORMATION	PAGE 19 OF 22

ANNEXURE-IV-4

TYPICAL IMPORTED COAL AND ASH CHARACTERISTICS

Sl.No.	Characteristics	Imported Coal	
		Worst	Best
	(as received basis)		
1.0	Proximate Analysis		
1.1	Total Moisture (%)	20	16
1.2	Ash (%)	10	10
1.3	Volatile Matter (%)	30	45
1.4	Fixed Carbon (%)	40	29
1.5	Total (%)	100	100
2.0	Ultimate Analysis		
2.1	Carbon (%)	56.4	62.4
2.2	Hydrogen (%)	4.5	4.9
2.3	Sulphur (%)	0.9	0.8
2.4	Nitrogen (%)	0.9	0.5
2.5	Oxygen (%) (By difference)	7.3	5.4
2.6	Carbonates (%)	0	0
2.7	Phosphorous (%)	0	0
2.8	Total Moisture (%)	20	16
2.9	Ash (%)	10	10
	Total	100	100
2.10	GCV (Kcal/Kg)	5800	6500
2.11	Hard Grove Index	45	60
2.12	YGP (mg/kg)	100	70
3.0	Ash Analysis		

3.1	Silica (SiO ₂) (%)	32.74	34.94
3.2	Alumina(Al ₂ O ₃) (%)	30.5	28.43
3.3	Iron Oxides(Fe ₂ O ₃) (%)	18.2	15.2
3.4	Titania (TiO ₂)	1.56	1.76
3.5	Phosphoric Anhydride(P ₂ O ₅) (%)	0.44	0.54
3.6	Lime (CaO) (%)	6.12	7.62
3.7	Magnesia (MgO) (%)	1.83	1.93
3.8	Sulphuric Anhydride (%)	6.95	7.65
3.9	Sodium Oxide (Na ₂ O) (%)	0.3	0.4
3.10	Balance alkalies (by difference)	1.36	1.56
	Total	100	100
4.0	Ash Fusion Temperature		
	reducing temperature		
4.1	Initial deformation Temp (°C)	1100	1250
4.2	Hemispherical Temp. (°C)	1300	1350
4.3	Flow Temp. (°C)	1400	1400

ANNEXURE-IV-5

LIMESTONE CHARACTERISTICS

Chemical Analysis (% by mass)			
1.	CaO	%	47-51.0*
2.	MgO	%	0.9-2.0
3.	Fe ₂ O ₃	%	0.45-1.0
4.	Al ₂ O ₃	%	1.19-2.1
5.	Si ₂ O ₃	%	2.1-4.5
6.	Mn ₂ O ₃	%	<0.12
7.	P ₂ O ₅	%	Traces
8.	Cl ₂	%	<0.015
9.	Na ₂ O	%	<0.16
10.	K ₂ O	%	<0.01
11.	TiO ₂	%	<0.02
12.	Total Sulphur	%	<0.1
13.	LOI	%	39.0-41.3
Physical Properties			
1.	Bond Index	kWh/sh.T	13
2.	Granule Size		Medium

Notes:

- *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO₃ content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaCO₃ content of 79%.
- For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m³. However for torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m³. For gypsum, the bulk density shall be taken as 900 kg/m³ for volumetric computation and 1250 kg/m³ for torque, drive & structural load requirements.
- For the purpose of sizing of equipments and guarantee, MgCO₃ shall be considered as unreactive dolomitic form.
- The above represent limestone quality to be considered for basic sizing and guarantees. Further the bidder is required to collect limestone samples from site for analysing is characteristic including reactivity. Bidder shall indicate in its bid the quantity of limestone required for such testing.

SUB-SECTION–IIA

SCOPE OF SUPPLY & SERVICES

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

SUB-SECTION–IIA-04

FLUE GAS DESULPHURISATION SYSTEM

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	SCOPE OF SUPPLY			
1.00.00	The contractor's scope of supply shall include engineering, design, manufacture, supply, erection, commissioning and testing of complete mechanical, electrical, C&I and associated civil and structural works for Flue Gas Desulphurization system and its auxiliaries for two (02) number Steam Generators of 800 MW nominal rating, as detailed in this specification. The FGD system shall be necessarily based on Wet Lime Stone FGD technology and is intended to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to the limits specified elsewhere in the technical specification.			
1.01.00	Complete Electrical &Control & Instrumentation system as required for the FGD system shall be included in the scope of supply. All electrical drives and actuators required for the equipment/valves/dampers shall be in the contractor's scope. Complete Civil works, structures, foundation required for all the equipment etc. is included in the contractor's scope of work. The contractor shall also include all supporting and structural works, like pipe trestles, platforms, staircases in their scope of work.			
1.02.00	The scope of supply identified for FGD system here are minimum requirements and unless specifically excluded from the contractor's scope in sub-section-V (Terminal Points and Exclusions), any equipment/system not included in this specification but integral to the system offered by the contractor to meet the intent of this specification, shall also be included in the scope of the contractor. In case of higher pressure /flow requirements are envisaged for instrument & service air and water Contractor shall make its own arrangement.			
1.03.00	The FGD system shall have an independent absorber for each unit and interconnection with common limestone milling systems (as provided for of stage-I) for the two units and common gypsum dewatering system for the two units. The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers and gypsum dewatering system.			
1.04.00	The scope of the contractor for FGD system shall include all items as shown in the applicable Tender drawings of FGD Milling System, Absorber System and Gypsum Dewatering System. All ducting, dampers, expansion joints, pumps, valves, supports, structures etc. as required for completeness of system of absorbers, common limestone grinding system and common gypsum dewatering system shall also be in the scope of the contractor.			
2.00.00	SYSTEM DESCRIPTION			
2.01.00	The FGD system shall be based on Wet Limestone Forced Oxidation process. Each unit shall be provided with an independent absorber.			
2.02.00	Gas from ID fan discharge shall be taken directly to the absorber inlet. In the absorber, SO ₂ in flue gas shall be removed by a spray of recirculating slurry, pumped by slurry recirculation pumps. Alternatively, the gas shall be bubbled through the absorber slurry to remove the SO ₂ from flue gas. Only proven system supplied earlier by the FGD vendor shall be supplied by the contractor.			
2.03.00	Compressed oxidation air shall be blown through the slurry in the oxidation tank, to oxidize the Calcium sulfite to gypsum. The oxidation system may be either grid sprage type or lance jet type or Jet Air Sprager or as per the proven practice of the FGD vendor.			
2.04.00	Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a stack. Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 1 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC	
2.04.01	The FGD System shall be in operation when Steam Generator is in operation. However, provision shall be made for facilitating operation of unit with FGD bypass. This shall also facilitate the online maintenance of absorber system and associated equipment's. The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose Contractor shall provide Motorized Guillotine type gates at (i) hot gas inlet to Absorber, (ii) cold gas outlet from Absorber. The Gates shall be provided with 2x100% seal air fans. Gates at outlet to Absorber and in the by-pass duct shall also be provided with 2x100 electrical heaters. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans & 2x100 electrical heaters shall also be provided by the Contractor in the by-pass duct. The design of the damper shall ensure 99.95% leak tightness, on flow basis, without seal air. The damper shall be 100% leak tight with seal air fans under the above conditions.		
2.05.00	Limestone to the absorbers of the two (2 no) units shall be supplied by the stage-I limestone slurry storage tanks with suitable interconnections. The slurry shall be pumped from the existing stage-I limestone slurry storage tanks to individual absorbers by dedicated limestone slurry pumps.		
2.06.00	The gypsum from the two (2 nos.) absorbers shall be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of multiple streams of primary and secondary dewatering equipment. The water removed from the absorber shall be recycled to the absorbers. The waste water from the system shall be collected and neutralized using lime and shall be pumped for utilizing in the Spray water system being provided by the Contractor for spraying water on the dry bottom ash & fly ash conveying system or in the mixing tanks of HCSD System, if provided.		
2.07.00	A common auxiliary absorbent tank shall be provided for storage of absorber slurry of one absorber along with slurry pumps for pumping the slurry back to any of the absorber.		
3.00.00	LIMESTONE GRINDING SYSTEM INTERCONNECTIONS (TO BE UTILISED AS COMMON FOR STAGE-I AND STAGE-II) There is no limestone grinding system envisaged for Lara-II(2X800 MW) and only space will be kept for future provision the system. A common limestone and slurry preparation system as already provisioned at Lara-I (2 x 800 MW) units shall be utilized for Lara-II (2X800MW) with suitable interconnections. For this purpose the contractor shall supply interconnection system from existing stage-I limestone slurry storage tanks with necessary pipings, fittings, supports and isolation & control valves to the stage-II absorbers. The isolation and control valve shall be provided at both end (Limestone slurry storage tanks of Stage-I and absorber(s) inlet of stage-II). The details as shown in respective limestone grinding system P&IDs are indicative, However the scope is limited to interconnections as above.		
4.00.00	ABSORBER SYSTEM		
4.01.00	An independent Limestone Forced Oxidation (LSFO) type absorber system shall be provided for each unit. Each absorber system shall be complete with :		
4.01.01	Absorber tower complete with re-circulating slurry spray header(s) and nozzles, three stage mist eliminators, wash water nozzles, oxidation tank integral to tower, oxidation headers and nozzles, and agitators and all internal systems integral to the working of the absorber.		
4.01.02	2x100% re-circulating slurry pump for each level of spray. Alternately, the contractor may offer a spare level of spray with each spray level served by an independent 100% pump. In case the contractor offers a single level of spray, one number of standby pump of the same		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 2 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	capacity & head as the working slurry recirculation pumps shall be provided. (In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No re-circulating pump and spray header and nozzles shall be required in such case. In such a case Two (2) nos. of Booster fans, if required, can be provided by the Contractor downstream of the ID fans, for each unit, capable of handling the pressure drop in the FGD system & ducting and maintain required chimney inlet pressure) 4.01.03 Complete Ducting System from ID fans to absorber tower, from absorber tower to absorber bypass duct and connecting duct to chimney. 4.01.04 Motorized isolation gates at Absorber gas inlet, Absorber gas outlet and FGD bypass in the main duct to Chimney along with 2x100 seal air fans for each gate and 2x100 heaters for absorber outlet gate & bypass gate. A bi-plane bypass damper along with 2x100 seal air & 2x100 heaters shall also be provided in the bypass duct. 4.01.05 2x100% oxidation blowers. 4.01.06 1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition. 4.01.07 All connecting piping and valves required by the system. 4.01.08 2x100% gypsum bleed pumps. 4.01.09 Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves. 4.01.10 Routing of the duct/piping system complete with supports, structures, trestles, absorber platforms, as required shall be in the contractor's scope of supply. 4.01.11 Passenger cum Goods elevator for each Absorber. 4.01.12 All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a shed provided with roof sheeting to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line, however, if it is not possible due to layout constraints, in such case, arrangement for handling & maintenance should be properly & optimally designed. The shed must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.			
5.00.00	GYPSUM DEWATERING SYSTEM			
5.01.00	The employer envisages a common gypsum dewatering system for the two units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two sets of dewatering equipment.			
5.02.00	Each set (suitable for handling /dewatering of both units) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement: i. One set of primary hydro-cyclones ii. One vacuum belt filter iii. One no. vacuum receiver iv. One no. vacuum pump v. One set of secondary hydro-cyclones vi. Complete piping and valves for the system along with wash water line.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 3 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
5.03.00	This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the two units operating simultaneously at design point, with any coal from the specified range of coals (whichever gives the maximum gypsum flow). All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.			
5.04.00	The filtrate water from belt filter dewatering and washing system and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank to be provided by the contractor. 2x100% pump shall be provided to supply wash water to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. The contractor shall include the necessary piping and valves in their scope.			
5.05.00	The overflow from the primary set of hydro-cyclone shall be taken to a common tank to be provided by the contractor. 2x100% pump shall be provided to feed 2x100% secondary hydro-cyclones. The underflow from the primary hydro-cyclone shall be fed to the 2X100% vacuum belt filter system.			
5.05.01	The under flow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to ZLD System (or as defined anywhere else in the specifications).			
5.05.02	The complete Gypsum Dewatering System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways for easy access & movement of man/materials etc. The building shall be sufficiently vented.			
6.00.00	AUXILIARY ABSORBENT TANK			
6.01.00	The Contractor shall provide a common auxiliary absorbent tank, common for the two units, of sufficient capacity for storage of absorber slurry of one unit.			
6.02.00	The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). All agitators, piping, valves, fittings and other structures required for the system shall be included in the scope of the contractor.			
7.00.00	PROCESS WATER& COOLING WATER STORAGE & PUMPING SCHEME (FOR 2X800 MW)			
7.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of 2 x 800 MW units) along with two numbers of 2x100 % Booster water pumps, if required (Each pump catering to the process water requirements of 2 x 800 MW units) along with all necessary piping, valves, control & instrumentation to feed the tank. Process water Storage level is automatically controlled at operating level by controlling the waterflow from the makeup water from terminal point. The two tanks shall be interconnected with an isolation valve.			
7.01.01	2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit.			
7.02.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 4 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
7.03.00	Any other pump or storage system not specified but required to meet the system requirement shall be provided by the contractor with the approval of the Employer.			
7.05.00	All drains & overflow lines from the tanks shall be terminated to the nearest trench/drain.			
7.05.00	All the storage tanks shall be lined with vinyl ester based flake glass lining from inside.			
8.00.00	SUMP& SUMP PUMPS			
8.01.00	The contractor shall provide sumps of adequate capacity in each of the following area: A. Each Absorber Area B. Gypsum dewatering system Waste water which might be generated during flushing and cleaning procedures of the equipment shall be collected in the sump and shall possibly be reused in the wet absorber. The contractor shall provide agitators and sump pumps of required capacity in each of this area along with necessary pipes, isolation / control valves etc. for pumping back the water in the sump into the respective system. The Interior surface of the Sumps shall be lined with FRP lining / PP lining of minimum 5 mm thickness or acid resistant tiles.			
9.00.00	ELEVATOR			
9.01.00	One (1) number passenger cum goods elevator of minimum capacity of 1000kgs for each Absorber (to be provided in case height of absorber is higher than 15m) and One (1) number passenger cum goods elevator of minimum 1000 kgs for gypsum dewatering building and One (1) no. 680 Kg elevator for control room building shall be provided for easy access & movement of man/materials.			
9.02.00	The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include provision of fireman's switch.			
9.03.00	One (1) nos. adequately sized, Air conditioners each having minimum cooling capacity of 2.5 Ton shall be provided for each elevator machine room to make it dust proof.			
9.04.00	Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection.			
9.05.00	To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby.			
10.00.00	THERMAL INSULATION, LAGGING, CLADDING & REFRACTORIES			
	Thermal Insulation along with aluminum cladding, lagging, reinforcement wiremesh, cleats and supports, shall be provided for all the equipment/surfaces having skin temperature more than 60 degree Celsius. The insulation thickness shall be designed based on criteria specified in Part-B, Section-VI.			
11.00.00	BUILDINGS			
11.01.00	Contractor shall provide buildings for Compressors, Gypsum Dewatering System & FGD			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 5 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	control room. Slurry re-circulating pumps & Oxidation blowers shall be located in a shed provided with roof sheeting. The buildings/structure must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.			
11.02.00	Contractor shall provide air conditioning for the FGD control room and Analyser room (if separately provided) & ventilation for the FGD system buildings.			
12.00.00	Contractor shall provide Corrosion protection painting for structures & equipment as described in the specification.			
13.00.00	Contractor's scope shall include all Platforms, walkways, staircase, safety rails for access of each equipment, valves, dampers, gates, instruments etc. handling facilities adequately each component of FGD system.			
14.00.00	BOOSTER FAN & ISOLATION GATES (If Required) For each unit, two (2) nos. Booster Fans of axial type, Constant speed, variable pitch controlled each with drive motor, base plates, foundation bolts and nuts, inlet box, discharge case, coupling, coupling guard and suitable arrangement to prevent rain water entry to fan motor. Each Booster Fan shall be provided with bearing lubrication and hydraulic blade pitch control unit(s) consisting of (1) 2x100% oil pumps each with motor, coupling and coupling guard. (2) 2x100% oil coolers. (3) 2x100% filters, differential pressure switches, etc. (4) One (1) oil storage tank. (5) Instrumentation, vibration monitoring, inter connected piping, valves and fittings including pressure relief valves and non return valves. (6) Electrical actuator with accessories etc. Alternatively, a forced oil lubrication system (consisting of 1to 6 above) common to bearing lubrication and for servo motor operation to each BF Fan will also be acceptable. At least two (02) nos. of duplex thermocouples or duplex platinum RTDs (100 ohm at 0°C) and one no. of temperature indicators shall be provided for bearing metal temperature measurement, control and monitoring. Booster fans shall be suitable for the type of foundation being provided.			
14.01.00	Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan. 2x100 % seal air fans common for both the guillotine type gates at suction side and 2x100 % seal air fans common for both the guillotine type gates at discharge side of booster fans shall are also be acceptable. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IIA-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 6 OF 6

SUB-SECTION–IIA-12

PLANT UTILITY

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES		
1.00.00	AIR CONDITIONING SYSTEM a) General Complete air conditioning system consisting of water cooled chilling units, condensing units, chilled water pumps & drives, condenser water pumps & drives, piping, valves & fittings, cooling towers, air handling units, VFD drives for motors (wherever applicable), hi-wall / cassette split air conditioners, fresh air fans, air distribution system (ducting, filters, isolation/volume control dampers, motorized fire dampers, diffusers, grills, VAV box as applicable, etc.) along with all electrical equipment and instrumentation as detailed out in Part-B of Section-VI. b) Centralized air-conditioning system for main plant TG building There shall be one (1) central chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater to the A/C requirement of the areas identified for main plant areas like common control rooms, control equipment rooms, UPS/Battery charger rooms, static excitation control rooms (if applicable), SWAS room, water analysis lab, etc. of Unit # 3 and Unit # 4. c) Centralized air-conditioning system for Ash handling control room, ESP control room buildings and FGD control room building There shall be one (1) central, water cooled chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater the A/C requirement of the areas identified for Ash handling control room, FGD control room, ESP control rooms, etc. of Unit # 3 and # 4. d) Air-conditioning system for Water System Control Building Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc. e) Air-conditioning system for switchyard (AIS Control Building) Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc. e) Air-conditioning system for office area in control tower Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc. f) Packaged/Split air-conditioners for various auxiliary control rooms/RIO rooms/VFD rooms and office areas of offsite buildings as detailed out in Part-B of Technical Specification.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES	PAGE 1 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES			
2.00.00	g) Apart from the above, any area/building which are in the scope of the Bidder and require air conditioning, those areas/buildings shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification. h) Supply of mandatory spares as specified. i) Any additional items which may not be specifically stated in the specifications but are required for completeness of the system shall be supplied by the Contractor. j) For air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition. The Bidder shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. k) Control system of air-conditioning system is indicated in Sub-Section-IIC, Control & Instrumentation, Scope of Supply & Services, Part-A of Technical Specifications.			
	VENTILATION SYSTEM a) General Complete Ventilation system consisting of modular type air washer units, supply air fans, roof extractor fans, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the Bidder, as detailed out in Part-B of Section-VI. b) Turbine hall building and associated areas i) Minimum ten (10) nos. of air washer units (of metallic construction-modular type) each of minimum capacity 1,00,000 m³/hr, with all accessories, 1 no. DIDW centrifugal fan, 1 no. circulating water pump, etc. as detailed out in technical specification shall be provided for each unit. ii) Minimum one (1) no. of air washer unit (of metallic construction- modular type) of minimum capacity 50,000 m³/hr, with all accessories, 1 no. DIDW centrifugal fan, 1 no. circulating water pump, etc. as detailed out in technical specification shall be provided for boiler MCC of each unit. iii) Ventilation of turbine hall is further assisted by means of roof extractor located suitably at the roof of TG hall building. The number and capacity of these roof extractor shall be selected in such a way that, it extracts approx. 60% of total discharge of air washer units. This will maintain a positive pressure within turbine hall and thus stop ingress of dusty outside air within the building. c) E.S.P. Control Room Building (Non-A/C areas) Minimum One (1) no. of Unitary Air Filtration (UAF) unit (of metallic construction-modular type) of minimum capacity 75,000 m³/hr, with all accessories, 1 No. DIDW			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES	PAGE 2 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 		
3.00.00	centrifugal fan, 1 No. circulating water pump, etc. as detailed out in technical specification shall be provided for each unit. d) FGD Control Room Building (Non-A/C areas) Minimum One (1) no. of Unitary Air Filtration (UAF) unit (of metallic construction-modular type) of minimum capacity 75,000 m³/hr, with all accessories, 1 No. DIDW centrifugal fan, 1 No. circulating water pump, etc. as detailed out in technical specification shall be provided. e) Miscellaneous areas: All other areas like compressor house, ash silo utility building, transport air compressor house, conveying air compressor house, Mill Reject Conveyors Tunnel (if applicable), all pump houses, MCC/switchgear rooms, Electrical & C&I battery rooms, AIS control room building, water system control building, workshops, stores, etc. covered under Bidder's scope and shall be ventilated by a combination of 'supply air fans & roof exhausters fans' or 'supply air fans & exhaust fans' or 'supply air fans & back draft dampers' or 'fresh air in-take louvers & exhaust air fans'. For ventilation of battery rooms and oil rooms, flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans. f) Apart from the above, any area/building which are in the scope of the bidder and require ventilation, those areas/buildings shall be provided with ventilation system, as detailed out in Part-B of Technical Specification. g) Supply of Mandatory spares as specified. h) Any additional items which may not be specifically stated in the specifications but are required for completeness of the system shall be supplied by the Contractor. i) For ventilation system, the Bidder shall provide all instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. j) Control system of ventilation system is indicated in Sub-section IIC, Control & Instrumentation, Scope of Supply & Services, Part-A of Technical Specifications.		
	COMPRESSED AIR SYSTEM a) Four (04) numbers (3 working+ 1 standby) oil free, rotary screw/centrifugal type air compressors for instrument air duty for the complete plant each of adequate capacity & adequate pressure, with their motor drives and other accessories.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES PAGE 3 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 			
	b) Four (04) numbers (3 working+ 1 standby) Air Drying Plants (one for each instrument air compressor) of minimum capacity same as instrument air compressor with all interconnecting piping, valves, fittings, etc. c) Three (03) numbers (all working) oil free, rotary screw/centrifugal type air compressors for service air duty for the complete plant each of adequate capacity & adequate pressure, with their drives and other accessories. d) One number of air receiver of minimum capacity 10 m³ at the discharge of each air compressor (Total: 07 numbers). e) One number unit air receiver of minimum capacity 10 m³ for each unit to be located in TG building. (Total: 02 numbers). f) One number unit air receiver of minimum capacity 10 m³ for each unit to be located near ESP Buffer Hopper Area for Ash Handling System. (Total: 02 numbers). g) One number of air receiver of minimum capacity 10 m³ for Fly ash storage Silo area and Ash classification system to be located near Silo Utility building. h) One number of air receiver of minimum capacity 2 m³ for DM plant to be located in Water Treatment Area. i) Electrically operated overhead traveling type crane of minimum 8 tonne capacity (capacity of crane shall be 25% above the weight of the heaviest equipment to be lifted during operation and maintenance work.) in air compressor building for handling of various equipments. j) Complete instruments, control system with panels as required for compressor house. k) The compressed air scheme and piping network shall generally be in line with the enclosed tender drawing. l) Supply of mandatory spares as specified. m) Any additional items which may not be specifically stated in the specifications but are required for completeness of the system shall be supplied by the Contractor. n) For detailed specification of compressed air system and selection of the required capacity and discharge pressure of air compressors, please refer part B of technical specification.			
4.00.00	FIRE DETECTION AND PROTECTION SYSTEM The fire detection and protection system shall consist of: a) Fire Water Pumping System Fire water storage tanks and pumping system provided in Stage-I shall be used for fire water requirements for Stage-II also. Fire water mains (Hydrants & Spray) shall be interconnected at multiple locations suitably. Further, hydrant booster pumps & drives, spray booster pumps & drives, batteries and battery chargers for the diesel engines drives, required instruments, controls, and panels as per the detailed specifications in Part-B of technical specification.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A		SUB-SECTION-A-12 PLANT UTILITIES	PAGE 4 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 			
	Further, the bidder scope of work shall include dismantling, re-erection, commissioning of any system/equipments/items of Stage – I, which are required during/for construction of Stage – II facilities. b) Hydrant System Hydrant system shall consist of network of piping, hydrant valves, etc. and associated civil work shall be provided to protect the following areas/buildings of the entire power plant as per detailed specifications in Part-B of technical specification. 1) Main Plant (Steam generator area & turbine generator building) including transformer yard, feeding & bunker transfer point, feeding & bunker conveyor, etc. 2) ESP building & chimney area. 3) Ash handling plant including its conveying system. 4) Ash silo area 5) Air compressor house 6) CPU regeneration area 7) Flue-gas desulfurization (FGD) area 8) Coal handling plant (CHP) area 9) Biomass handling plant 10) Fuel oil pumping areas 11) Switchyard (AIS building) including AIS control room building. 12) Water treatment plant area 13) Any other area/building in the scope of the Bidder and required to be protected with hydrant system. c) HVW Spray System Automatic fire detection cum high velocity water (HVW) spray system and associated civil works like DV housing, pedestal, etc. shall be provided for the followings as per detailed specifications in Part-B of technical specification: 1) HVW Spray system for boiler burner fronts along with fuel oil rake at boiler. 2) Various transformers of rating 10 MVA and above or in case of oil filled transformers with oil capacity of more than 2000 liters except transformers located at make-up water pump house. 3) Steam turbine lube oil storage tanks, oil coolers & purifiers, etc. 4) Central lube oil storage tanks (clean oil and dirty oil tanks) and purifier. 5) Turbine oil canal pipelines in main plant. 6) Generator seal oil units. 7) Boiler Feed Pump/Lube Oil Console & oil purifier. 8) Apart from the above any other equipment/system in the scope of the Bidder and which requires HVW spray protection. d) MVW Spray System			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A		SUB-SECTION-A-12 PLANT UTILITIES	PAGE 5 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 			
	Automatic fire detection cum medium velocity water (MVW) spray system and associated civil works like DV housing, pedestal, etc. for the following as per the detailed specifications in Part-B of technical specification: 1) Various cable galleries (in Main Plant area, in ESP control Building, in FGD Buildings, Switchyard, AHP control Building, CHP control Building, Water Treatment Control Building, etc.). 2) Boom & tripper conveyors of Stacker Recamier Machines. 3) Coal crusher house, coal transfer points & coal conveyors (excluding open coal conveyors), biomass conveyors & TPs. 4) Fuel oil pump houses 5) Fuel oil tanks of DG sets 6) All cable trestles of main plant area (from transformer yard to chimney) 7) Any other equipment/system in the scope of the Bidder and which requires MVW spray protection. e) Inert Gas Fire Extinguishing System i. One (1) No. automatic total flooding inert gas fire extinguishing system with associated valves, piping, fittings etc. as per NFPA-2001 (latest edition) for main control rooms, control equipment rooms and associated C&I rooms like programmer/server rooms, PC rooms, panel room, UPS/Battery charger rooms of TG building (for both units) and associated civil works like shed for inert gas storage cylinders, etc. as per the detailed specifications in Part-B of technical specification. f) Fire protection for Biomass Silos Gaseous based fire protection system shall be provided for Biomass storage silos as per industry practice. g) Control System for Fire Detection & Protection Fire detection & protection control system shall consists of PLC based control system, Analogue addressable fire alarm system consisting fire alarm panels, repeater panel, various types of fire detectors, control cabling, centralized monitoring station etc. 1) Multi-sensor type detection system-Multi-sensor detectors shall be provided for: (a) All switchgear/MCC rooms/Battery Rooms of the power plant. (b) All cable galleries in TG building, ESP buildings, FGD buildings, Switchyard building, CHP, etc. protected with MVW spray system. (c) Below & above false ceiling areas of all air conditioned rooms of TG building, ESP/FGD/AHP control building, Switchyard building, water system control building, CHP control room, VFD rooms, return air ducts of inert gas protected areas, owner's construction office and other auxiliary control rooms/office spaces/stores/etc. of the power plant. (d) Cubicles/panels of control room/control equipment room/UPS & battery charger room of TG Building in the scope of the Bidder. Detectors shall be provided inside these cubicles/panels.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A		SUB-SECTION-A-12 PLANT UTILITIES	PAGE 6 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 		
	2) Linear heat sensing cable (LHSC) detection system shall be provided for: (a) All cable galleries protected with MVW spray system. (b) All coal conveyors (including bunker conveyors), lime & gypsum conveyors, biomass conveyors. (c) All cable trestles of main plant area (from transformer yard to chimney) 3) Quartzoid bulb heat detection system (QBD) shall be provided for: (a) All equipments protected with HVW spray system. (b) All equipments (except cable galleries) protected with MVW spray system. 4) Infra-red detectors (IRD) shall be provided in all coal conveyors before TP and all biomass conveyors under bidder's scope for detection of moving fire. 5) Adequate numbers of Beam Detectors along with accessories shall be provided for AIS building (if applicable). 6) Suitable detectors for detection of fire inside Biomass Silos (like CO detectors etc). PLC based control panels i) Dual processor PLC based control system with two OWS and one A4 size color Laser printer shall be provided in hydrant & spray booster pump house. ii) In addition to above PLC based control panels, each diesel engine driven drives of Hydrant and Spray system shall be provided with Diesel engine control panel along with 2 X 100 % Battery Charger and 2 X 100% batteries. However the detail spec of Battery charger and the batteries shall be as per sub-section:A-18, Section-VI, Part-B of the Technical specification. Fire Alarm System Bidder to provide fire detection system as described below:- i) Addressable fire alarm panels shall be provided in each CER and shall include but not be limited to the following elements:- Analog Addressable Fire Detection and Alarm System panels with Master processor module, monitoring modules, supervisory control modules, input/output modules, auxiliary relay modules, network modules and Power supply system (batteries and battery chargers, suitable for providing battery backup of 24 hours (stand by) and 30 minutes (in alarm conditions), etc. ii) Addressable fire alarm panels shall be provided in main plant CHP Control room (minimum two nos. fire alarm panels for CHP area), water system control building, ESP/FGD control building, AHP control building, etc. and shall include, but not be limited to the following elements:-		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A		SUB-SECTION-A-12 PLANT UTILITIES PAGE 7 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES			
	Analog Addressable Fire Detection and Alarm System panel with Master system CPU, monitoring modules, supervisory control modules, input/output modules, auxiliary relay modules, network modules, PC based monitoring station with color graphics display monitor, mini UPS, A4 size color printer and Power supply system (batteries and battery chargers, suitable for providing battery backup of 24 hours (stand by) and 30 minutes (in alarm conditions), etc. iii) Centralized PC based monitoring station with color graphics display monitor along with mini-UPS and one A4 size color laser printer shall be provided with Unit-1 FAP and to be located in Unit-1 Central Control Room. It shall serve the purpose of Central PC Station with facility of monitoring information related to all fire alarm system and of operating drives of booster pump house. iv) One number addressable type repeater annunciation panel in Employer's central fire station with power supply system (batteries and battery chargers, suitable for providing battery backup of 24 hours (stand by) and 30 minutes (in alarm conditions), etc v) All the above fire alarm panels shall be interconnected with each other & repeater panel and with PLC panels of booster pump house such that information related to fire alarm system can be viewed from any panel. vi) For fire detection of stacker-reclaimer, a local fire alarm panel for alarms shall be provided on each stacker-reclaimer machine along with interfaces & connectivity with fire alarm panel placed at CHP control room. The communication shall be as per standard and proven practice of the contractor. vii) Software and hardware as required to provide a complete functioning of the system. viii) Fire alarm panels shall provide contacts to CCTV, Air Conditioning system and Coal Handling system for initiating control functions like focusing of CCTV cameras, stoppage of conveyor, closure of fire dampers, shutdown of fans/air conditioning equipment, tripping of transformers, etc. Details for the same shall be finalized during detail engineering. ix) Fire detection & protection system shall be provided with necessary hardware and software for interconnection with LAN/WAN of DDCMIS preferably from a single point. x) Complete wiring/cabling from detectors/field devices to panels/MCC and vice versa including conduits/trays/fixtures etc. xi) Non addressable type conventional detectors (Linear heat sensing cable detector/ Infrared type heat detector) and switching devices each with its own addressable interface units/modules, loop isolators, local hooters/grinders, Siren etc. xii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm control panel through the keyboard operation of PC monitoring station when the system is selected in remote manual mode.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES	PAGE 8 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 		
	Measuring Instruments: The following shall be provided as minimum meeting specification requirements of Sub-section MEAS INST: of Part-B, Section-VI of Technical Specification. (a) All the primary Instruments as indicated in enclosed flow schemes/diagrams and relevant tender drawings/ BOQ, corresponding Mechanical sections and meeting redundancy and other requirements specified under technical specifications are to be provided as a minimum. (b) All Instruments which are Integral to equipment like pumps, motors etc., which are not indicated in enclosed P & IDs but required for control, monitoring and operation of the equipment/plant/ Systems are to be provided. (c) All the instruments which are required to implement the control philosophy as specified in corresponding mechanical sections shall be provided by the Contractor. Power Supply System The DC Power Supply system shall consists of the following system(s):- i) 24 V DC power supply system for each PLC based control system shall comprise of two sets, each set consisting of the following: a) 1x100% microprocessor controlled, intelligent, modular rectifier banks b) 1 no. of Controller for above rectifier banks c) 1x100% Nickel - Cadmium batteries for one (1) hour duty d) 1x100% DC distribution board. Also 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) shall be provided as common for both the sets. ii) One set of 24 V DC power supply system for each fire alarm panel and repeater alarm panel consisting of the following: a) 2x100% Battery Chargers b) 1x100% batteries with battery backup of 24 hours (standby) and 30 minutes (in alarm conditions). Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for (i) & (ii) above. For detailed specification of power supply system, please refer part B of technical Specification. Process Connection and Piping: i) Process connection & piping including all impulse piping, pneumatic		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI , PART-A		SUB-SECTION-A-12 PLANT UTILITIES PAGE 9 OF 11

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES			एनटीपीसी NTPC																														
	piping/tubing, valves, valve manifolds, fittings and all other accessories required for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification. Instrumentation Cables, C&I system cables, power supply distribution cables and other accessories: i) All instrumentation cables twisted & shielded, FRLS PVC insulated and sheathed data highway / fiber optical cables, control cables, prefabricated cables (with plug-in connectors) as applicable for direct interconnection of two equipment/ system/ devices as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR etc. shall be provided by Contractor. ii) Short term fire proof cable shall be provided for all coal conveyors and Biomass fire detection and protection system and inert gas protected areas. iii) For cables related to loop wiring of fire detection and protection system, refer Sub-Section A-18, Section–VI, Part–B of Technical Specifications. iv) Above cables shall be provided along with necessary laying & termination accessories, hardware etc. meeting requirements specified under Part-B, Section-VI of Technical Specification. Type Test Requirement The type tests to be conducted for C&I systems & equipment's shall be as detailed out in Sub-Section Type Test Requirements, Part-B, Section-VI of Technical Specification. h) Fire Extinguishers i) Fire extinguishers shall be installed in all the buildings in the scope of the Bidder as per TAC requirement. ii) The Contractor shall supply the following quantities (minimum) of fire extinguishers and install the same at various locations. <table><tr><td>1.</td><td>Portable type:</td><td></td></tr><tr><td></td><td>Pressurized water type (9 lit. cap.) (IS:15683 operated by CO2 cartridge type)</td><td>160 Nos.</td></tr><tr><td></td><td>Foam type (9 lit. cap. IS: 15683)</td><td>66 Nos.</td></tr><tr><td></td><td>CO2 type (4.5 kg. Cap. IS: 15683)</td><td>160 Nos.</td></tr><tr><td></td><td>Dry Chemical powder (6 kg. Cap. IS: 15683)</td><td>130 Nos.</td></tr><tr><td>2.</td><td>Mobile type:</td><td></td></tr><tr><td></td><td>Foam type (60 lit. cap. IS: 16018)</td><td>6 Nos.</td></tr><tr><td></td><td>CO2 type (22.5 kg. Cap. IS: 16018)</td><td>32 Nos.</td></tr><tr><td></td><td>Dry Chemical powder (50 kg. Cap. IS: 16018)</td><td>28 Nos.</td></tr><tr><td></td><td>Multi-purpose Nozzles</td><td>02 nos.</td></tr></table> i) One (1) number monorail electric hoist of minimum two (2) ton capacity for fire water booster pump house.				1.	Portable type:			Pressurized water type (9 lit. cap.) (IS:15683 operated by CO2 cartridge type)	160 Nos.		Foam type (9 lit. cap. IS: 15683)	66 Nos.		CO2 type (4.5 kg. Cap. IS: 15683)	160 Nos.		Dry Chemical powder (6 kg. Cap. IS: 15683)	130 Nos.	2.	Mobile type:			Foam type (60 lit. cap. IS: 16018)	6 Nos.		CO2 type (22.5 kg. Cap. IS: 16018)	32 Nos.		Dry Chemical powder (50 kg. Cap. IS: 16018)	28 Nos.		Multi-purpose Nozzles	02 nos.
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES	PAGE 10 OF 11																														

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 			
5.00.00	j) All pylons required for transformers, bus reactors, interconnecting transformers etc. shall be anchored to soak pit base slab of individual transformer / shunt reactor, paved area outside soak pit, etc. using anchor fasteners of adequate capacity. Subsequent to fixing the pylons, lower part of pylon which would be within filled up gravel portion shall be encased with concrete by Contractor for corrosion protection. k) Apart from the above, any area/building which are in the scope of the bidder and require fire detection & protection system, the same shall be provided with suitable Fire detection and protection system, as detailed out in Part-B of Technical Specification. l) Supply of Mandatory spares as specified. m) Acoustic enclosure (if required) for diesel engine of booster pumps shall be provided by the Contractor.			
	GENERAL i. Set of commissioning spares as may be required during erection and commissioning. ii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipments under the scope of bidder. iii. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications. iv. Any additional items required to make the system complete. v. Initial charge of all lubricants and grease, etc. Further, all consumables like inert gas, etc. required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc. vi. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer. vii. Painting for all equipments / items and touch-up painting of Employer's structures damaged due to site welding by Bidder as detailed in relevant clauses of technical specification.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI , PART-A	SUB-SECTION-A-12 PLANT UTILITIES	PAGE 11 OF 11

SUB-SECTION–IIA-19

ELEVATORS, CRANES AND HOISTS

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	ELEVATORS, CRANES AND HOISTS 1.00.00 ELEVATOR 1.01.00 Passenger Elevators for TG Building The Passenger elevators for TG Building shall be as under. (i) One (1) no. conventional type elevator having capacity of 13 persons for TG Building for each unit. 1.01.01 The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include but not limited to the following: (a) 1 No. fireman's switch for each elevator. (b) Machinery supporting Beam. 1.01.02 The location of Elevators shall be as per tender drawings enclosed with the specification. 1.01.03 Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection. 1.01.04 To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby. 2.00.00 CRANE & HOIST 2.01.00 Suitable EOT Crane/HOT crane/monorail beams with hoists/chain pulley blocks of adequate capacity, to meet the erection and maintenance requirements are to be provided by the vendors for the various equipment/areas. Some of the areas/equipment not covered by TG hall EOT crane are indicated below. For balance areas/equipment, not listed herein, the requirements of Technical Specification shall be followed. (a) Feed water heaters & deaerator. (b) Various pumps & Heat Exchangers. (c) Fans, motors, gear boxes etc., of Main Condenser, vacuum pumps, control fluid room etc.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, Part-A	SUB SECTION- IIA-19 ELEVATORS, CRANES AND HOIST	PAGE 1 OF 2

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	(d)Auxiliary cooling water pumps and DM cooling water pumps of ECW systems and Plate heat exchangers. (e)Central lube oil system room. (f)Any other equipment. The above requirement is indicative only; the requirement given in the respective chapter is to be adhered to.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, Part-A	SUB SECTION- IIA-19 ELEVATORS, CRANES AND HOIST	PAGE 2 OF 2

CLAUSE NO.	TECHNICAL SPECIFICATIONS			
1.01.00	PROJECT MANAGEMENT SYSTEM:			
	Project Management System is to be implemented under the scope of the work. It shall encompass activities from project award to project closure. The system shall comprise of a project management team and project management tool.			
A.	Project Management Team:			
	The vendor shall deploy a dedicated Project Management Team from the date of award. The Team shall comprise of experienced and qualified project professionals and shall be located at bidder's project management office as well as at site. Site team shall coordinate for L3 Level activities at site and put-up daily status and exceptions to the bidder's Project Management Office for enabling them take timely action for critical works.			
	The Project Management Team shall be responsible for following activities:			
	• Implement, Operate, Maintain the Project Management Tool up to COF of last unit. Subsequently, transfer the Tool and associated data to NTPC with appropriate licenses/Subscriptions (if any) valid for one year after COF of last unit. • Training/familiarization of NTPC team with the project management tool. One nodal person to be identified for providing remote (Telephone/e-mail/Internet) or in-Person (wherever required) support. • Development of L2 network. • Development of L3 network (Three months rolling plan) for different packages/works. • Regular updation of L2 networks based on actual progress including scheduling/rescheduling of intermediate activities. • Data Acquisition & Updating the same in Project Management Tool on regular basis: i. Engineering, Ordering, Manufacturing & Fabrication, Inspection, Dispatch and Receipt of Materials on regular basis. ii. Site Activities like Civil & Structural Works, Mechanical, Electrical, C&I Erection and Commissioning activities based on the stage of the project. iii. Deployment of Vendor's Staff, Workers, T&Ps deployment, and their healthiness iv. Statutory wage payment status. v. Stock of consumables like steel, cement, sand, aggregate, imported electrodes and any other critical consumable. vi. Any other information required for the project management purpose. • Interact with Site and Project Management Team of Owner and facilitate exchange of requisite data. • Co-ordinate with NTPC Team for daily, weekly, and monthly reviews. • Generation of Exception Reports through Project Management Tool. • Conduct statistical analysis of historical data (e.g., trend analysis, benchmarking). • Comply to the requirements of NTPC pertaining to statutory obligations and maintenance of Sequence of events/Hindrancel register.			
LARA SUPER THERMAL POWER PROJECT STAGE- II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure-A to subsection II C (Project Management)	PAGE 1 OF 6

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B.	Project Management Tool: The vendor shall implement a Project Management Tool progressively by four months from the date of award, which shall conform to following requirements: 1. General • Should be implemented as Cloud based solution with web hosting supporting mobile Access/Application. • The access to the tool shall be role based for the security and integrity of the data. Provision for concurrent access by up to 50 users of the owner is to be ensured by the bidder. • Provision for regular back up for all the applications and its data till COF of the last unit. • Provision for monthly data back up to the owner's server. • Security, Integrity and Confidentiality of the data is to be ensured and the same is to be used exclusively for this project only. • Should support integration with existing NTPC Systems viz C-Folder, Dreams, Pradip, Windsor, Team-up etc. with proposed software solution. (APIs will be provided by NTPC, subject to security authentication by NTPC IT team). • The project management tool should be compatible with Microsoft Project. • Online Manuals and documentation for Project Management Tool progressively. • All hardware and software required for the Project Management Tool shall be in the scope of bidder. • Regulatory clearances / licenses (as applicable) shall be in the scope of the bidder. 2. Project Planning Activities: • Online availability of the all the contractual documents including L1, L2 networks with baseline tracking and version control (as applicable). • L3 networks (3 months rolling plan) of the packages/works. • Erection / Construction Methodology and Schedule of T&Ps and manpower deployment. • All the review meetings (Daily/Weekly/Monthly) shall be conducted on this platform and should support upload/generation of record notes. The format for the same should be customizable. 3. Project Monitoring Activities: • Engineering, Ordering, Manufacturing & Fabrication, Inspection, Dispatch and		
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C.	Drone Based Project Monitoring & visualization system: Supply, installation & commissioning of Drone Based Project Monitoring & visualization system with all associated viewing and monitoring platform & its integration with Project Management Tool. The setup shall be implemented, operated, maintained by vendor till completion of the facilities of the last unit. Scope: • Construction Progress Monitoring through high resolution (1080p or higher) drone Videography and Photography on monthly basis for the complete project area as per the scope of the work. • Monthly Progress Reports shall include drone Photographs (High resolution Geo-tagged images) with side-by-side comparison of same location/facility on monthly basis. The drone survey, photography, videography, and report submission (by 1st week of every month) is to be completed in a week's time. • The vendor will also provide unit rate for drone-based survey and reports submission. The same shall be used in case owner decides to conduct more than one survey in a month. • Web-based output for visual monitoring on Project Management Tool. • All the reports/Photographs/Videos are to be made available on Project management tool. • Regulatory clearances / licenses (as applicable) shall be in the scope of the bidder. • All hardware and software required to meet above intent shall be in the scope of bidder.			
D.	Smart Material and Manpower Management Objective of such system is sequential and timely availability of Materials, Manpower and T&Ps as well as ensuring quality during erection which is critical for Project success. It shall cover entire lifecycle of project materials (including mandatory spares) i.e., dispatch from vendor/sub-vendor location, receipt at NTPC Project, in plant material management and status till installation at site with the use of smart material management system and smart monitoring and tracking of construction manpower. The whole system must result in controlling project costs, compressing schedules, improving risk management, ensuring quality during erection and to avoid delay in project execution due to non-traceability of material.			
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	Supply Chain Management Contractor shall ensure implementation of smart material tracking system for all dispatches (SMI/BOIs) including mandatory spares and to the same shall be integrated bidders site inventory management system. Material Information system should be from Shop to Erection. • Each item identifiable with KKS / PGMA-DU / any other identification scheme of the bidder/OEM/OES shall be tracked. • Items which are interchangeable and dispatched together (e.g. Foundation bolts in a box, Identical beams in a single consignment), the entire consignment can be tagged with a single tracking code till receipt at site. • GPS tracking for Over Dimension Consignment (ODC): Contractor shall install GPS trackers (with inbuilt GPRS module) in ODC consignments vehicles and manage the tracking of such vehicles on real time basis. The tracking shall be real time and web based. Entire set of applications and their features shall allow secure web based online access to obtain real time information. • All the data regarding material movement shall be updated in the Project Management Tool and data updation is to be automated. Workflow: • Contractor shall enter the details of material shipment in a Project Management Tool / Web portal / Mobile Application and will generate a unique code before the material is dispatched & affix the same to material package & configure the same with tracking system. • The storage area shall be divided into zones and materials tracking IDs shall be accurately mapped / geotagged with the storage zones. • Contractor will use the same tracking ID to store the material at site. The status will be updated in project management tool regarding storage location at site. • For above functionality vendor shall use RFID, QR Tracker or BLE based beacon solution or any other improved version. • All hardware and software required to meet above intent shall be in the scope of bidder. E. Construction Manpower Tracking: • The vendor should implement mechanism to track daily movement of its workers inside the plant area. • Data regarding mobilization of manpower (agency wise, skill wise and area wise) is to be acquired using appropriate tool and is to be updated in Project Management Tool on daily basis. • Additionally, the vendor shall keep a provision of RTLS (Real Time Location Tracking system) along with the supply of associated wearable tags/ RFID tags affixed to helmet/ID badges/ band or Smart watches for 100 Nos. of workers and 50 Nos for employer's use. The data is to be made available in the project management tool. • Contractor is required to supply Real Time Location Tracking System (RTLS) to		
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	track the near real time location of operator/worker in the plant based on 802.11 active RFID tags or similar other technology e.g., LPWAN LoRa that serves the intent of the specifications here. The system can also make use of the wireless mesh network. All required hardware along with fixed & running charges e.g., RFID readers, BLE beacons & LoRa backhaul shall be in scope of bidder only. • The RTLS is to be implemented anywhere inside the plant as per the instructions of the owner. Provision is to be kept for implementation in up to 04 zones. • Vendor shall provide the price for deployment of a single tracking device along with the bid, in case NTPC decides to implement additional tracking devices as per requirements of the project. • All hardware and software required to meet above intent shall be in the scope of bidder. F. Smart Storage area/yard monitoring: The bidder shall implement, operate, and maintain Smart Storage area/yard monitoring till the COF of last Unit. The storage area including the open yards and covered sheds shall be equipped with smart storage monitoring system. All the boundaries of the storage areas shall be geofenced with fixed camera and entire inside area of storage (both open yards and covered sheds) should be covered with PTZ cameras such that there should not be any dark patch. All the camera should have analytics to identify storage condition, water logging, excess vegetation & any intrusion. Surveillance camera should have a backup of at least two months. All hardware and software required to meet above intent shall be in the scope of bidder. Feed of all these cameras shall be available in Quality control room and the project management tool. G. Quality control Room: Bidder shall establish and maintain a Quality control room till the COF of last Unit. The control room shall be established within 90 days of site mobilization. CCTV cameras feed installed at strategic locations in the plant like SG, TG area where erection work is in progress. 25 Nos of Camera are to be considered for this purpose. It shall have digital records of PWHT (Post weld heat Treatment) & digital NDT . These cameras can be wired or wireless as per suitability at site. Locations of these cameras will keep on changing depending upon the requirement at site. Quality control room shall have two Nos of LED screens of minimum 50 inches will be placed at owners designated place and a feed is to be provided in Project Management Tool. All hardware and software required to meet above intent shall be in the scope of bidder. xxx		
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A	<i>Contract quantities indicated below is the minimum requirements. Additional items / quantity if required, other than those indicated below, for meeting the intent of specification of this EPC package shall also be in the scope of the Contractor.</i>			
	1.00.00	<u>DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM (DDCMIS)</u> The Bidder shall provide DDCMIS complying with requirements specified in Subsection III C-02, Part-B, other sub sections and enclosed drawings. The Contractor shall provide functional groups as per guidelines defined in clause no 2.00.00. Quantity of Process I/Os, Drives, HART signals, Various types of cabinets / equipments, ECP (for mounting synchronizing relays, aux. PTs, other relays etc. shall be provided on as required basis. A minimum of 9 nos. hand-held HART calibrators are to be provided. SOE is to be provided in UNIT DDCMIS for critical conditions like each of the protection condition of HT drives, MFT, TG protection, trip of HT & critical drive and status of some important electrical breakers.		
	1.01.00	Redundancy in analog & binary outputs for OLCS & CLCS drives: Unit DDCMIS SG System: For all drives of following systems ERV, Oil System, coal/mill system, scanner air & seal air system, SADC system, control valves of FOPH & Oil system. TG System: As per the standard practice of TG supplier BOP System: For 10% of drives distributed in various functional groups (Exact application shall be finalized during detailed engg For Other DDCMIS Binary outputs of HT and HTCHP drives		
	1.02.00	Notes for “Drive I/Os The on/off status of HT drives of Unit DDCMIS will be wired to DI modules in parallel. The open/ close status of sync type electrical breakers of Unit DDCMIS will be connected in parallel to DI and DISOE modules. For these types of drives in other DDCMIS systems the status will be connected to only one DI module. Status of remaining signals(other than On/Off as defined above) of HT drives & sync type electrical breakers of Unit DDCMIS are to be connected to DISOE module; for HT drives & sync type electrical breakers in other DDCMIS these will be connected to DI module. Contact type output through relay is to be provided for few types of drives(e.g. solenoids, ILMS, SM,MD, ignitor etc). These relays shall be driven by 24V DC command outputs through DO modules. In case of redundancy in outputs for drives, redundancy shall be provided only in DO modules, but not for the relays. Power supply for energizing such drives in the field shall be routed through contacts of the above mentioned relays using control cable (minimum core dia of 1.5sq.mm).The monitoring of power supply extended to field shall be done in DDCMIS for such drives. In case of Unit system- there shall be separate monitoring for each drive. However, in case of Other systems /offsite systems monitoring can be done for group of drives as finalized during detailed engg. Fieldbus compatible actuators will be interfaced with DDCMIS with Foundation Fieldbus/ Profibus interface modules. Accordingly, the command and feedbacks from these actuators		
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	shall be exchanged through these fieldbus interface network and the corresponding signals in control system shall be used for interlock, protection, information. In View of above reference of discrete/ hardwired limit switch/ other feedbacks / commands will not be applicable, wherever referred in this specification. 1.03.00 Control System Spare Capacity 1.03.01 10 % spare channel shall be provided in each functional groups for each type of input / output fully wired up to the marshalling/ termination TBs. 1.03.02 Wired-in "usable" space for 20% modules along with Field Terminal assemblies, PCB/Connectors (if any in the offered system) in each of the system cabinets for mounting electronic modules shall be provided by the Contractor for future use. For STG Integral Controls, Bidder's standard & Proven practice for keeping usable space is also acceptable. 1.03.03 Each controller shall have 20% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type mentioned in clause 1.03.01 & 1.03.02 above, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of controller. 1.03.04 Contactor to provide thirty (30) percent spare relays for 1 COC Slim Relay (< 7mm) and ten (10) percent spare relays for 2 COC Heavy Duty relays. These relays shall be mounted and wired in relay cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets. In each of the relay cabinets, 10 % spare terminal blocks shall also be provided so that additional relays can be mounted and wired. 1.03.05 Twenty (20) percent spare terminal blocks in each marshalling cabinets. 1.03.06 The spare capacity as specified above shall be uniformly distributed throughout all functional groups. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers/ cabinets in the system delivered at site. Further, these additions shall not deteriorate the system parametric requirements like response time / duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement. For fieldbus based system refer Annexure IIIC-02F of Part-B for spare requirements. 1.03.07 For some RIO applications where I/Os are very less, the RIO panel can be combined for two RIOs with a partition. However, there shall be no common hardware shared between such RIOs e.g. RIO modules, power supply modules, power supply feeders etc. 2.00.00 Guidelines for Functional Grouping of Controllers Keeping in view the functions of various systems/ sub-systems/ equipment of various process, systems (main plant, off sites etc.) are divided in to various sub-systems. Each sub-system is divided in to different process blocks. In some of the process systems, the process blocks and sub-systems will be same. Separate sets of FG(s) are to be provided for each of the process blocks defined below. The functions of two different process blocks cannot be mixed. For some of the process blocks, remote I/Os for some applications is envisaged. Electrical system of Unit DDCMIS will be a separate process block. However, electrical breakers of other DDCMIS shall be distributed along with respective process areas.		
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2.01.00	The exact allocation of areas to different FGs shall be subject to Employer's approval. The process blocks of Control System of various DDCMIS are defined below. It may be noted that in each of the process blocks, the process areas, equipment, logic, loops given below cover major areas of control. The exact areas/ control shall be finalized by Employer during detailed engineering stage.													
	SG System The stream wise process redundancy is to be maintained in SG C&I DDCMIS. That is, if there are more than one main equipment (e.g., A/B/C streams) in a process block, these are to be allocated to different FGs, unless allowed explicitly. In the FGs, thus obtained, main equipments of similar streams are to be allocated. Further, the auxiliaries of main equipment will be allocated in the same FG where corresponding main equipment is allocated. For different streams of process blocks defined below, separate sets of FG(s) are to be provided. Where different streams of process blocks are not defined, separate sets of FG(s) are to be provided for the process blocks. The functions of two different process blocks/ streams cannot be mixed unless explicitly allowed. The information signals of respective process areas will be generally kept along with respective main equipment. The exact allocation of areas to different FGs shall be subject to Employer's approval during detailed engineering stage.													
2.01.01	Burner Management System: <table><tr><td>MFT block:</td><td>This block will consist of MFT protection system employing 2V3 controllers. The configuration of this block shall be generally as per Drg.no.0000-999-POI-A-002.</td></tr><tr><td>Boiler common functions block:</td><td>Common stream-1: This block will consist of RH Protection Logic, Seal air fan-A control, Scanner air fan-A control, boiler common functions like Furnace purge, HOTV, LOTV,HORV, Scanner air emergency damper control, etc. Common stream-2: This block will consist of Seal air fan-B control, Scanner air fan-B control, Atomizing steam/ air press. control, HFO & LDO press. /flow control, SADC, Aux PRDS controls, Boiler Drain tank level control, etc.</td></tr><tr><td>Firing system blocks:</td><td>Maximum two mills and respective oil elevation can be assigned to one FG, e.g., Mill-A, Mill-B & Oil elevation-AB can be kept in one FG. Number of FGs in this block shall depend on actual no. of coal and oil elevations.</td></tr><tr><td>Other SG system block:</td><td>This block will consists of Soot blower control including press & drain temp control, Boiler drains/vents including start up drains/vents, Mill reject system, FTP, ERV, MTM , Mill fire protection, SCAPH, Start-up controls including control of Boiler Recirculation Pump, Separator, Flash tank ,Minimum Economizer flow etc.</td></tr><tr><td>NOx system block:</td><td>This block will consist of control of NH3 unloading, storage and Dosing system, Control and Monitoring of Selective Catalytic Converter (SCR) and associated soot blowing system, etc.</td></tr></table>				MFT block:	This block will consist of MFT protection system employing 2V3 controllers. The configuration of this block shall be generally as per Drg.no.0000-999-POI-A-002.	Boiler common functions block:	Common stream-1: This block will consist of RH Protection Logic, Seal air fan-A control, Scanner air fan-A control, boiler common functions like Furnace purge, HOTV, LOTV,HORV, Scanner air emergency damper control, etc. Common stream-2: This block will consist of Seal air fan-B control, Scanner air fan-B control, Atomizing steam/ air press. control, HFO & LDO press. /flow control, SADC, Aux PRDS controls, Boiler Drain tank level control, etc.	Firing system blocks:	Maximum two mills and respective oil elevation can be assigned to one FG, e.g., Mill-A, Mill-B & Oil elevation-AB can be kept in one FG. Number of FGs in this block shall depend on actual no. of coal and oil elevations.	Other SG system block:	This block will consists of Soot blower control including press & drain temp control, Boiler drains/vents including start up drains/vents, Mill reject system, FTP, ERV, MTM , Mill fire protection, SCAPH, Start-up controls including control of Boiler Recirculation Pump, Separator, Flash tank ,Minimum Economizer flow etc.	NOx system block:	This block will consist of control of NH3 unloading, storage and Dosing system, Control and Monitoring of Selective Catalytic Converter (SCR) and associated soot blowing system, etc.
MFT block:	This block will consist of MFT protection system employing 2V3 controllers. The configuration of this block shall be generally as per Drg.no.0000-999-POI-A-002.													
Boiler common functions block:	Common stream-1: This block will consist of RH Protection Logic, Seal air fan-A control, Scanner air fan-A control, boiler common functions like Furnace purge, HOTV, LOTV,HORV, Scanner air emergency damper control, etc. Common stream-2: This block will consist of Seal air fan-B control, Scanner air fan-B control, Atomizing steam/ air press. control, HFO & LDO press. /flow control, SADC, Aux PRDS controls, Boiler Drain tank level control, etc.													
Firing system blocks:	Maximum two mills and respective oil elevation can be assigned to one FG, e.g., Mill-A, Mill-B & Oil elevation-AB can be kept in one FG. Number of FGs in this block shall depend on actual no. of coal and oil elevations.													
Other SG system block:	This block will consists of Soot blower control including press & drain temp control, Boiler drains/vents including start up drains/vents, Mill reject system, FTP, ERV, MTM , Mill fire protection, SCAPH, Start-up controls including control of Boiler Recirculation Pump, Separator, Flash tank ,Minimum Economizer flow etc.													
NOx system block:	This block will consist of control of NH3 unloading, storage and Dosing system, Control and Monitoring of Selective Catalytic Converter (SCR) and associated soot blowing system, etc.													
2.02.00	TG System													
2.02.01	(a) STG integral controls (i.e. Close loop control (CLC) ,Open loop Control(OLC) and protection pertaining to steam turbine and generator) block:- The contractor shall provide													
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2.02.02	Turbine protection and Turbine EHTC , Automatic Turbine Testing, TSE's, ATRS etc. functionalities in this block. (b) The functionality of Gland steam system controls, Turbine and Generator Auxiliaries including Oil System, Vacuum system, seal oil system, stator water system, Turbine Extraction NRV system etc can be implemented in the above block or a separate block. (c) The configuration (hardware and software) of the above block(s) shall be as per standard and proven practice of the contractor. The exact implementation methodology shall be strictly as approved by employer during detailed engineering			
	Over and above the STG integral control block(s) envisaged above, the Contractor shall also provide functional groups as per the following guidelines. The TG control system is divided into different process blocks. For different process blocks, separate sets of FG(s) are to be provided. The process blocks of the TG control system are defined below. It may be noted that the process areas, equipment, logic, loops given below cover major areas of control. The exact areas/control shall be subject to employer's approval. BFP Drive Turbine-A block: This block will consist of BFP Drive Turbine-A OLCS and CLCS controls, including EHTC/protection of Drive Turbine-A and auxiliaries of Drive Turbine-A. BFP Drive Turbine-B block: This block will consist of BFP Drive Turbine-B OLCS and CLCS controls, including EHTC/protection of Drive Turbine-B and auxiliaries of Drive Turbine-B. MDBFP block: This block will consist of MDBFP OLCS and CLCS controls, including auxiliaries of MDBFP. If more than one MDBFP is being provided in the scope of the package, then separate FG shall be provided for each of the MDBFP. Balance control implementation: The remaining controls envisaged in the scope of the work such as HP/LP bypass system, condenser on load tube cleaning system (as applicable) , Debris Filter (as applicable) , SCS (as applicable), Turbine lube oil purification control, central lub oil purification control etc. can be implemented in any of the above process blocks(i.e. indicated at clause no.:2.02.01 & 2.02.02) or separately as per the Bidder's standard and proven practice. Central Lub Oil Purification system being a common system can also be included in Standalone DDCMIS. The exact implementation methodology, how-ever shall be strictly as approved by Employer. The stream-wise process redundancy is to be maintained in Unit DDCMIS. In the FGs thus obtained, main equipment of similar streams is to be allocated. Further, the auxiliaries of main equipment will be allocated in the same FG where corresponding main equipment is allocated.			
	2.03.00 BOP DDCMIS The stream wise process redundancy is to be maintained. That is, if there are more than one main equipment (e.g., A/B/C streams) in a process block, these are to be allocated to different FGs, unless allowed explicitly. In the FGs, thus obtained, main equipments of similar streams are to be allocated. Further, the auxiliaries of main equipment will be allocated in the same FG where corresponding main equipment is allocated			
	2.03.01 BOP-SG Secondary air block ID fans A&B, FD fans A&B, Secondary Air Heaters-A&B along with flue gas temp control/ fire detection, Secondary SCAPH-A&B; Stack Path;			
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	Steam & Water block	furnace draft control, air flow control, FGD inlet, FGD outlet and FGD bypass dampers etc. Main Steam/SH/RH valves along with temp control, ECW pump-SG-A&B along with DP control, Dosing; FW valves, SG misc drives; Coordinated Master Control (CMC), feed water control, Group controls, SWAS etc.		
	Primary air block	PA fans-A&B, Mills/feeders-controls for outlet temp, PA flow & feeder speed (alternate mills/feeders are to be kept in separate FGs), PA header pressure control, Primary SCAPH-A & B, Primary air heaters A&B along with temperature control/fire detection, etc.		
2.03.02	BOP-TG BOP-TG block	The BOP-TG consists of following major equipment/ control loops:); CEP-A, B & C along with recirculation controls; Gland seal pressure control for condensate; ACW- A, B & C; HP heaters-valves & level control (all HP heaters are to be kept in one FG), LP heaters valves & level control (all LP heaters are to be kept in one FG), hot-well level control, Spill over control, Deaerator level & pressure control, ECW pump-TG-A, B & C along with DP control, TG miscellaneous valves/ controls, etc.		
2.03.03	Electrical block	Electrical breakers – synchronization (sync) and non-synchronization (non-sync) type electrical breakers are covered in this system. The hardwired monitoring signals of power supply (UPS & DC system) will also be connected here.		
2.04.00	Stand-Alone DDCMIS			
2.04.01	Main Plant AC common Block	Common Air conditioning & ventilation system of various areas like CER, SWAS Room etc.		
2.04.02	Main Plant AC Unit#1 Block	Air conditioning & ventilation system of part of CCR/CR, CER, UPS/Battery Charger Room, ESP Control Room of UNIT#1 etc.		
2.04.03	Main Plant AC Unit#2 Block	Air conditioning & ventilation system of part of CCR/CR, CER, UPS/Battery Charger Room, ESP Control Room of UNIT#2 etc.		
2.04.04	Not Applicable			
2.04.05	Not Applicable			
2.04.06	CW System Block	Not more than 2 CW pumps is to be kept in one FG and alternate CW pumps are to be assigned to different FG		
2.04.07	Air Compressor Block and NH3 handling System Block	This block shall include Air compressor for Mill reject system. If the controller (Microprocessor / PLC based control system) is integral to compressor then suitable operator interface as per vendors practice for individual air compressor shall be provided. However, overall control and monitoring shall be through Stand Alone DDCMIS. This block shall also include control of NH3 unloading, storage, transfer and heating system etc.		
2.04.08	CPU Block	CPU regeneration system, CPU service vessel of each unit.		
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2.05.00	Water System DDCMIS The Control System of Water System DDCMIS has following process blocks. The major equipment/ control loops in each block are indicated below.		
2.05.01	DM plant block	DM plant streams, DM make-up pumps, boiler fill pumps, DM storage tanks, DM neutralization pit, DM regeneration system, degasser system, acid/ alkali storage system, Zero liquid discharge, misc pumps, air conditioning of water system control room etc.	
2.05.02	PT plant block	PT DM Clarifier, PT DM Gravity filters, chemical house, PT chlorination system, CW clarifier, CW gravity filters, filter water pump systems, filter water pump B/W system, CL water tank, Sludge pit, Treated water tank, condition monitoring basin, air conditioning for water system control room, waste service water pumps, misc. pumps, Coal decanted water, CSSP, Portable water, CW Blow down system, Raw water, effluent treatment plant etc.	
2.05.03	CW Chemical treatment block	CW chemical treatment, CW chlorination Dosing pumps, Misc. pumps etc.	
2.06.00	Ash handling System (AHP) DDCMIS Ash Handling Control System comprising of binary and modulating controls of dry and wet ash handling system, bottom ash handling system, Fly ash handling system including de-ashing from ESP hoppers, APH hoppers & SCR system hoppers, ash slurry disposal system, high concentration slurry disposal system (if applicable) and associated equipment, Ash water recirculation system (if applicable) and associated equipment, etc. shall be implemented in this DDCMIS. The Control System of AHP DDCMIS has following process blocks. Unit-1 bottom ash and fly ash block Unit-2 bottom ash and fly ash block AHP common system block Ash Silo Block AWRS block High concentration slurry disposal system block (if applicable)		
2.07.00	Coal handling System (CHP) DDCMIS The Control System of CHP DDCMIS has following process blocks: CHP stream-A block CHP stream-B block Separate RIOs shall be provided for each stream (A & B)		
2.08.00	Flue Gas De-Sulphurisation (FGD) DDCMIS FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems etc. shall be implemented in this DDCMIS. The Control System of FGD DDCMIS has following process blocks. i. Unit-1 FGD ii. Unit-2 FGD iii. Gypsum De watering Handling common system block iv. Lime stone preparation and transfer from stage-I common system block		
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2.09.00 2.10.00 2.11.00 2.12.00 2.13.00 2.14.00 B	FOPH DDCMIS This system shall have one block - Fuel oil pump house block consisting of Light oil discharge pressure Control, Controls related to fuel oil unloading system etc. This control block shall be located in the FOPH control room. Make up Water System DDCMIS This system has one process block for Make-up water. Switchgear DDCMIS This system shall have one block. It comprises of monitoring and data acquisition of 20 Signals (both Analog & Digital) from each relay (MV & LV circuit breakers / MV Vacuum contactors on IEC-61850 protocol). This shall be communicated to Switchgear DDCMIS on IEC 61850 protocol. NOT USED The Bidder shall provide requisite number of function groups for each Control System considering the guidelines defined above for functional grouping, and considering all specification requirements defined in the specification. The major aspects to be considered shall be as follows: 1. Hardware capacity, including spare capacity 2. Software capacity, including spare capacity 3. Response time/ signal acquisition time requirement for Control System 4. Parametric requirements of DDCMIS 5. Functional grouping and associated requirements specified under section III C-02 and notes for Contract Quantities of DDCMIS. The Bidder shall furnish functional grouping diagram for Control System of each DDCMIS, in the bid supported by back-up calculations and reasons for proposed functional grouping, and exact functional grouping shall be finalized during detailed engineering stage, as approved by the Employer. Refer Appendix-I (End of this annexure) to this Subsection for IO and Drive count for Employers Makeup water system , AWRS that are to be monitored and controlled by Contractor's Control system		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity	PAGE 7 OF 24

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC	
1.00.00	SIGNALS FROM OTHER SYSTEMS TO BE CONNECTED TO HMIPIS/STATION LAN							
	SI No.	SYSTEM	TOTAL DATA BASE		PERIODICALLY TRANSMITTED		UNIT(U)/ COMMON (C)	
			ANALOG	BINARY	ANALOG	BINARY		
	1.	ESP	On as Required Basis				U	
	2.	FIRE DETECTION & PROTECTION					U	
	3.	FIRE WATER PUMP HOUSE					C	
	4.	Wagon Tippler (if applicable)					C	
	5.	Stacker Reclaimer PLC					C	
	6.	GRP					U	
	7.	PI (ERP)	2000				C	
	8.	3 Spare link (For Future Use)	500 each	500 each	500 each	500 each	C	
	9.	APH PLC-1 & 2 (if applicable)	On as Required Basis				U	
	10.	HYDRAULIC CONTROL VALVE PLC-1 & 2	On as Required Basis				U	
	11.	Vibration Monitoring and Analysis System VMAS	On as Required Basis				U	
	Note:							
1. For Signals from HMIPIS to Station LAN, the total database size is to be estimated by Contractor to meet the spec. requirements. The requirement of periodic transmission shall be as finalized during detailed engineering stage.								
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATIONS SECTION – VI, PART-A			Annexure C to IIC Contract quantity		PAGE 8 OF 24

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.00.00	2. Protocol for data transfer for above systems shall be OPC. It is preferable to provide OPC UA based communication. LIST OF AREAS FROM WHICH SOFT SIGNALS IS TO BE CONNECTED TO DDCMIS (OTHER THAN REMOTE I/O) 1. From Unit and other 24 V DC Charger systems to respective DDCMIS 2. From UNIT and other UPS systems to respective DDCMIS 3. From AHP compressor to AHP DDCMIS 4. From Air compressor (IAC,PAC,Mill Reject system) to SA DDCMIS 5. From air conditioning system to SA DDCMIS Note: No of link and quantity of signals shall be on as required basis and type of communication protocol shall be as per bidder's standard.		
C	<u>CONTRACT QUANTITIES FOR UCD & PANELS</u>		
1.00.00	CONTROL DESKS AND PANELS		
1.01.00	The following are the contract quantities of control desks: Arc shaped Control Desks shall be provided as mentioned below. 1. UNIT Control Room - 8m (1 per unit) 2. Unit Incharge Desk (UID)- 3m (1 common) 3. Centralized Off-site Control Room-4m (for Water System) 4m (for Ash Handling System) 3m (for FGD System) 4. CHP System CR- 4m (1 per system) 5. FGD System CR- 3m (1 per system) Furniture shall be provided as mentioned below. 1. Unit Control Room : Chair-5 nos, Key pad-1 no, Locker set- 2 no , Almirahs- 3 nos , PC Rack- 1 set 2. Programmer Room: Chair-12 nos, Key pad-1 no, Server Rack- 1, workstation Furniture- 1 set 3. C&I Maintenance Room: Chair-2 nos, Computer Table- 2 nos. 4. Unit Incharge Desk (UID): Chair- 2 nos. 5. Centralized Off-site Control Room: Chair-9 nos, Key pad-3 no, Locker set- 3 no, Almirahs- 3 no, PC Rack – 3 set, workstation furniture – 2 set 6. Water system CER: Server Rack- 1 set 7. AHP system CER : Server Rack- 1 set 8. CHP System CR: Chair-4 nos, Key pad-1 no , Locker set- 1 no ,PC Rack – 1 set, workstation furniture – 1 set 9. FGD System CR: Chair-2 nos, Key pad-1 no , Locker set- 1 no , work furniture -1 no.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity	PAGE 9 OF 24

CLAUSE NO.	TECHNICAL REQUIREMENTS 
Note 1:- Note-2: Note-3: Note-4 Note-5:	10. FOPH System Area: Server Rack – 1 no. 11. For each Workstation (located at areas not covered above) and for each Common PC Station: Chair- 1 for each, Computer Table – 1 for each 12. For Printer in area where workstation furniture is not available: 1 Printer table for each printer 13. For each Control Room (Other than those mentioned above: Keypad- 1 no, Locker set- 1no. The UCD in Unit Control Room shall have mechanism for concealing synchroscope (1 no. per unit). For details of this mechanism, refer to Part-E, tender drawing. The exact details shall be finalized during detailed engineering stage. Draw-out section/plaque shall be provided in UCD and CD for CHP as follows: (A) UCD: (i) One no. draw out section for process side (ii) One no. draw out section for electrical side (iii) One no. synchronization plaque - mosaic tiles, of adequate nos so that synchroscope, 2 nos. voltmeters, 2 nos. frequency meters and two indicators are accommodated in the size of one TFT monitor, so that size of concealing arrangement for this plaque is same as that of TFT monitor. (B) CD of CHP: One no. Draw out section for process side- Instruments like Push buttons, LEDS etc shall be furnished for each generating unit on as required basis to be mounted on the draw out section of Unit Control Desk of each unit . For design philosophy of draw out section of process side & electrical side, refer sub section IIIC-11 , Control Desk and Panels The following instruments shall be furnished for each Coal Handling Plant to be mounted on the draw out section of Control Desk of each Coal Handling Control Room. 1. Stop PB: 45 nos. 2. Release PB: 1 no. 3. Emergency stop PB: 1 no. (With cover) One set Conference Table & 15 no's Chairs shall be provided.
D 1.00.00	<u>CONTRACT QUANTITIES FOR INSTRUMENTATION CABLES, CONTROL & POWER SUPPLY CABLES, OTHER CABLES & ACCESSORIES.</u> The Contractor shall supply, erect, lay, terminate and test the following cables ensuring functional completeness of the control system on as required basis. 1. All instrumentation (Type A, B, C, F, & G), control & power supply cables including heat resistant cables. Co-axial cables, network cables including Optical fibre/shielded twisted pair Cat-5e cables for system for connection of peripherals, data highway, network etc. 2. All types of cables related to fire detection and protection system 3. All cable trays/ sub trays, rigid and flexible conduits, HDPE Conduits, conduit fittings, cable glands, junction boxes including temperature transmitter JB's (for DIN rail
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A Annexure C to IIC Contract quantity PAGE 10 OF 24

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																
E	mounted TTs), lugs, pull boxes accessories and all supports between the cable trays (trunk route) and equipments as required for installation of all cables for complete package shall be supplied by Contractor on as required basis																																																																
	4. All grounding cables for control systems, cabinets, equipments etc.																																																																
	5. All special tools required for wiring terminations as recommended by Contractor																																																																
	CONTRACT QUANTITIES OF PA SYSTEM																																																																
	1.00.00	A) The major zones shall be : 1 for each of the generating unit, 1 for common plant system, 1 with at least 2 sub-zones for CHP																																																															
	B) Suitable interface shall be provided for connection with Employer's main telephone exchange and minimum 4 channel GSM connectivity from both the Servers such that it is possible to communicate with any station in any zone from any telephone set.																																																																
	1.01.00	These quantities are minimum required. The exact location of call stations shall be decided during detailed engg:																																																															
	<table><tr><th>S. No.</th><th>Item Description</th><th>Qty/ unit</th><th>CHP /Biomass handling /GHP (no.)</th><th>Common (no.)</th></tr><tr><td>1.</td><td>Call Stations</td><td></td><td></td><td></td></tr><tr><td></td><td>(i) Outdoor wall/column mounting type with amplifier -TYPE A</td><td>45</td><td>90</td><td>25</td></tr><tr><td></td><td>(ii) Indoor desk top mounting type with amplifier- TYPE B</td><td>10</td><td>8</td><td>12</td></tr><tr><td>2.</td><td>Master Control Unit (MCU)</td><td>1</td><td>2</td><td>1</td></tr><tr><td>3.</td><td>Standalone amplifier (50W)</td><td>1</td><td>2</td><td>1</td></tr><tr><td>4.</td><td>(i) Outdoor Industrial Horn type loudspeaker</td><td>45+4*</td><td>90+8*</td><td>25+4*</td></tr><tr><td></td><td>(ii) Indoor wall-mounted Cone type loudspeaker</td><td>10</td><td>8</td><td>12</td></tr><tr><td>5.</td><td>Portable call stations with network connection port</td><td></td><td></td><td></td></tr><tr><td></td><td>(i) Network connection ports</td><td>10</td><td>-</td><td>-</td></tr><tr><td></td><td>(ii) Portable call station with minimum 2m connecting cable-TYPE S</td><td>2</td><td>-</td><td>-</td></tr><tr><td>6.</td><td>Cables & G.I. conduit</td><td></td><td></td><td></td></tr></table>					S. No.	Item Description	Qty/ unit	CHP /Biomass handling /GHP (no.)	Common (no.)	1.	Call Stations					(i) Outdoor wall/column mounting type with amplifier -TYPE A	45	90	25		(ii) Indoor desk top mounting type with amplifier- TYPE B	10	8	12	2.	Master Control Unit (MCU)	1	2	1	3.	Standalone amplifier (50W)	1	2	1	4.	(i) Outdoor Industrial Horn type loudspeaker	45+4*	90+8*	25+4*		(ii) Indoor wall-mounted Cone type loudspeaker	10	8	12	5.	Portable call stations with network connection port					(i) Network connection ports	10	-	-		(ii) Portable call station with minimum 2m connecting cable-TYPE S	2	-	-	6.	Cables & G.I. conduit			
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनडीपीसी NTPC															
		(i)	a.)All cables including power cables. b.) GI conduits		On as required basis																
	7.	Acoustic hood (nos.)			8	2	-														
	8.	Server			Minimum one redundant server																
	9.	PC Station			2 nos., 1 at CER ,1 at CHP CR																
	10.	Network Switches			As required. Minimum 1 no. for each zone.																
	11	a) Layer-III Switch/Router b) Software(s) for PA system			On as required basis																
	note	Refer S.No.6, the cable shall be laid in existing cable trays. If cable is unarmoured, the same shall be laid in G.I. conduits.																			
	note	* These loudspeakers shall be connected to Standalone Amplifiers.																			
	1.01.00	All hardware & software along with necessary licenses shall be capable of handling 30% additional call stations over and above the number of call stations specified in each zone for future use.																			
	F	<u>Contract quantities for CCTV SYSTEM for O&M</u>																			
1.00.00	The complete system shall be divided into the following zones:- One Zone for Each Of The Generating Unit., One Zone For Common Plant System, One Zone For Coal Handling Plant, One Zone for Distant Plant.																				
2.00.00	Cameras (HIGH Definition) along with motorized zoom lens, housings, PAN and TILT mechanism.																				
2.01.00	Unit Areas <table><tr><th>SN</th><th>Locations</th><th>No. of Cameras (per unit)</th></tr><tr><td>1.</td><td>TG hall Elevation 17.0 M(Generator Side, BFP side), 8.5 M, 0 M, Boiler Firing Floor(Front & Rear, Left Side & Right Side)</td><td>15</td></tr><tr><td>2.</td><td>Raw Coal Feeders, Air Heater, ESP Field area (Front & Rear), Bottom Ash Hopper Area, CER, Cable Gallery (at different areas), Switch Gear Room, Coal Mill, FGD (absorber area) , BUNKER FLOOR, Mill Reject Area, APH Hoppers, SCR Hoppers, Duct / Eco Hopper, Transformer Bay, MOT room,</td><td>60</td></tr><tr><td>3.</td><td>Seal Oil Skid</td><td>1 (Refer Note-1)</td></tr><tr><td>4.</td><td>Miscellaneous applications (AHP /ESP area)</td><td>10</td></tr></table>						SN	Locations	No. of Cameras (per unit)	1.	TG hall Elevation 17.0 M(Generator Side, BFP side), 8.5 M, 0 M, Boiler Firing Floor(Front & Rear, Left Side & Right Side)	15	2.	Raw Coal Feeders, Air Heater, ESP Field area (Front & Rear), Bottom Ash Hopper Area, CER, Cable Gallery (at different areas), Switch Gear Room, Coal Mill, FGD (absorber area) , BUNKER FLOOR, Mill Reject Area, APH Hoppers, SCR Hoppers, Duct / Eco Hopper, Transformer Bay, MOT room,	60	3.	Seal Oil Skid	1 (Refer Note-1)	4.	Miscellaneous applications (AHP /ESP area)	10
SN	Locations	No. of Cameras (per unit)																			
1.	TG hall Elevation 17.0 M(Generator Side, BFP side), 8.5 M, 0 M, Boiler Firing Floor(Front & Rear, Left Side & Right Side)	15																			
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4.	Miscellaneous applications (AHP /ESP area)	10																			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.00 distant plants	Common Plant Areas -Other than Coal Handling plant/Biomass handling/GHP and			
	SN	Locations	No. of Cameras	
	1.	Misc AHP area (min. 10 nos.), Ash Silo Area (min. 5), Transport Air Compressor Room , CW Pump House , HCSD Silo Area, FOPH , PT Plant Area, DM Plant Area, Switch yard Control Room, Switch yard, Air Compressor, Condensate polishing Unit- regeneration Plant area, RWPH, Ammonia handling and unloading system (min. 5 nos.), Chimney, Plant Effluent Discharge (outside plant boundary),	42	
	2.	FOPH (including LDO)	2 (Refer Note-1)	
	3.	Miscellaneous applications	10	
2.03.00	Common Plant Areas - Coal Handling Plant/Lime Stone Handling Plant/Gypsum Handling Plant			
	SN	Locations	No. of Cameras	
	1.	Not Applicable	0	
	2.	Pent House (each)	2	
	3.	Crusher House (each)	5	
	4.	Crushed Coal Stock pile (each)	1	
	5.	Stacker Reclaimer-(each)	1	
	6.	Raw Coal Bunkers (each Unit)	2	
	7.	At each Transfer Point	1 (per floor)	
	8.	At each Conveyor Gallery	1 (length ≤ 250 m) 2 (250 m < length ≤ 550 m) 3 (length > 550 m)	
	9.	Track Hopper, CHP Control Room, T/U Tower, MGR Entry/Exit Gate, Reclaim Hopper, Train entry/Exit point near plant boundary,LHP & GHP MCCs	16 (2 nos. at each location)	
	10.	Stockyard area	10	
	11.	To be decided during detailed engineering	5	
2.04.00	Distant plants (Common Plant Areas)			
	SN	Locations	No. of Cameras	
	1	Make Up Water Pump House	02 (see note 3 below)	
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3.00.00	Fixed Cameras (High Definition-HD) along with housings: Contractor shall provide fixed cameras (High Definition-HD) for monitoring ash accumulation above furnace S-panel area and in bottom ash hoppers. The quantity and location of these cameras is indicated in the table below. <table><tr><th>SN</th><th>Locations</th><th>No. of Cameras</th></tr><tr><td>1</td><td>Outside furnace (one each on left and right side waterwall) at about 12 M elevation (Refer Note-1)</td><td>02</td></tr><tr><td>2</td><td>Outside bottom ash hopper at about 2 M elevation (Refer Note-2)</td><td>04</td></tr></table> Note-1: Contractor shall provide suitable opening with seal box in left and right side of boiler water walls, fitted with sight glass. Cleaning arrangement of sight glass using service air shall be provided by the contractor from nearest available tapping point. Note-2: Contractor shall provide suitable opening in Bottom ash hopper with sight glass (if not available in bottom ash hoppers) in front and back side of bottom ash hoppers. Cleaning arrangement of sight glass using service water (if not available) shall be provided by the contractor from nearest available tapping point.				SN	Locations	No. of Cameras	1	Outside furnace (one each on left and right side waterwall) at about 12 M elevation (Refer Note-1)	02	2	Outside bottom ash hopper at about 2 M elevation (Refer Note-2)	04																		
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4.00.00	The following items shall be provided on as required basis without any cost implication to Employer subject to minimum qty. mentioned as under:- <table><tr><th>Sr. No</th><th>Item</th><th>Quantity</th></tr><tr><td>(i)</td><td>Camera/Database Servers with external Speaker (min. 5 W)</td><td>Minimum one set for each zone.(One set comprises of one primary and one standby server)</td></tr><tr><td>(ii)</td><td>Work Stations with Monitor, External Speaker (min. 5 W) Keyboard & Joystick</td><td>One no for each zone and Twelve (12) nos. for plant common area (see note-2 below).</td></tr><tr><td>(iii)</td><td>Work Stations with External Speaker (min. 5 W), Keyboard & Joystick (without Monitor)</td><td>One no for each of the generating units, three for common plant areas (AHP, FGD and water system) and one for CHP.</td></tr><tr><td>(iv)</td><td>Network Switches</td><td>Minimum one set for each zone-</td></tr><tr><td>(v)</td><td>Layer-III Switch/Router</td><td>1 set</td></tr><tr><td>(vi)</td><td>Inter Connecting Cables</td><td>1 lot</td></tr><tr><td>(vii)</td><td>Hardware and Software for interfacing with Large Video Screens (LVS)</td><td>One set for each unit, one for AHP, one for CHP and one for Water system area.</td></tr><tr><td>(viii)</td><td>Wireless Connectivity and its accessories</td><td>1 set</td></tr></table>				Sr. No	Item	Quantity	(i)	Camera/Database Servers with external Speaker (min. 5 W)	Minimum one set for each zone.(One set comprises of one primary and one standby server)	(ii)	Work Stations with Monitor, External Speaker (min. 5 W) Keyboard & Joystick	One no for each zone and Twelve (12) nos. for plant common area (see note-2 below).	(iii)	Work Stations with External Speaker (min. 5 W), Keyboard & Joystick (without Monitor)	One no for each of the generating units, three for common plant areas (AHP, FGD and water system) and one for CHP.	(iv)	Network Switches	Minimum one set for each zone-	(v)	Layer-III Switch/Router	1 set	(vi)	Inter Connecting Cables	1 lot	(vii)	Hardware and Software for interfacing with Large Video Screens (LVS)	One set for each unit, one for AHP, one for CHP and one for Water system area.	(viii)	Wireless Connectivity and its accessories	1 set
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CLAUSE NO.	TECHNICAL REQUIREMENTS																															
5.00.00	Hardware like network switches, camera/database servers, Layer-3 switches/routers PDB & software, Wireless Equipment etc. along with necessary licenses for each zone shall be capable of handling 30% additional cameras over and above the number of camera specified in each zone. Note: - Cameras & its accessories shall be Explosion proof. - Common areas shall include Office of Head of the Project, Office of O & M In-charge, Erection In-charge's Office, Central Fire Station, FGD control room, Water System Control Rooms, Ash Handling System Control Room, Plant Security Control Room, Main Gate of the Plant, Safety control room and any other locations to be decided during detail engineering.																															
G	<u>CONTRACT QUANTITIES FOR SWAS</u> LIST OF ANALYSERS: <table><tr><th>Sample</th><th>Measurements</th></tr><tr><td>Makeup DM water</td><td>Degassed Cation Conductivity (DCC)</td></tr><tr><td>CEP discharge</td><td>Degassed Cation Conductivity (DCC), Sodium, pH, Dissolved Oxygen</td></tr><tr><td>CPU outlet</td><td>Specific Conductivity, Cation Conductivity, Silica, Sodium, pH</td></tr><tr><td>Deaerator outlet</td><td>pH, Dissolved Oxygen</td></tr><tr><td>FW at Eco inlet</td><td>DEGASSED CATION CONDUCTIVITY ANALYSER, Silica, Sodium, pH, Hydrazine, Dissolved Oxygen , Turbidity, Iron Analyser</td></tr><tr><td>Separator outlet (Steam)</td><td>Specific Conductivity, Cation Conductivity</td></tr><tr><td>Sat. Water BCW Discharge</td><td>Specific Conductivity, Cation Conductivity, Silica, Sodium, Hydrazine, Dissolved Oxygen</td></tr><tr><td>Main Steam - HTSH O/L</td><td>Specific Conductivity, Cation Conductivity, Silica, Sodium, pH</td></tr><tr><td>Hot Reheated steam</td><td>Specific Conductivity, Cation Conductivity</td></tr><tr><td>Closed circuit CW (ECW-SG)</td><td>pH</td></tr><tr><td>Condenser CW</td><td>Specific Conductivity, pH</td></tr><tr><td>Hotwell</td><td>Specific Conductivity</td></tr><tr><td>Closed circuit CW (ECW-TG)</td><td>pH</td></tr></table> Note: - Multistream for Silica and Sodium Analyser shall be acceptable. Multistream analysers shall have at least one stream as spare. - Any Other analyser as recommended by Contractor or Equipment OEM shall be supplied by Contractor within the contract price				Sample	Measurements	Makeup DM water	Degassed Cation Conductivity (DCC)	CEP discharge	Degassed Cation Conductivity (DCC), Sodium, pH, Dissolved Oxygen	CPU outlet	Specific Conductivity, Cation Conductivity, Silica, Sodium, pH	Deaerator outlet	pH, Dissolved Oxygen	FW at Eco inlet	DEGASSED CATION CONDUCTIVITY ANALYSER, Silica, Sodium, pH, Hydrazine, Dissolved Oxygen , Turbidity, Iron Analyser	Separator outlet (Steam)	Specific Conductivity, Cation Conductivity	Sat. Water BCW Discharge	Specific Conductivity, Cation Conductivity, Silica, Sodium, Hydrazine, Dissolved Oxygen	Main Steam - HTSH O/L	Specific Conductivity, Cation Conductivity, Silica, Sodium, pH	Hot Reheated steam	Specific Conductivity, Cation Conductivity	Closed circuit CW (ECW-SG)	pH	Condenser CW	Specific Conductivity, pH	Hotwell	Specific Conductivity	Closed circuit CW (ECW-TG)	pH
Sample	Measurements																															
Makeup DM water	Degassed Cation Conductivity (DCC)																															
CEP discharge	Degassed Cation Conductivity (DCC), Sodium, pH, Dissolved Oxygen																															
CPU outlet	Specific Conductivity, Cation Conductivity, Silica, Sodium, pH																															
Deaerator outlet	pH, Dissolved Oxygen																															
FW at Eco inlet	DEGASSED CATION CONDUCTIVITY ANALYSER, Silica, Sodium, pH, Hydrazine, Dissolved Oxygen , Turbidity, Iron Analyser																															
Separator outlet (Steam)	Specific Conductivity, Cation Conductivity																															
Sat. Water BCW Discharge	Specific Conductivity, Cation Conductivity, Silica, Sodium, Hydrazine, Dissolved Oxygen																															
Main Steam - HTSH O/L	Specific Conductivity, Cation Conductivity, Silica, Sodium, pH																															
Hot Reheated steam	Specific Conductivity, Cation Conductivity																															
Closed circuit CW (ECW-SG)	pH																															
Condenser CW	Specific Conductivity, pH																															
Hotwell	Specific Conductivity																															
Closed circuit CW (ECW-TG)	pH																															
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity	PAGE 15 OF 24																												

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC						
H	<u>FLUE GAS ANALYSERS (CEMS)</u>							
1.01.00	LIST OF FLUE GAS ANALYSERS FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)- (PER UNIT QUANTITY) 1. SO2 in stack emission 2. NOX in stack emission 3. CO2 in stack emission 4. CO in stack emission 5. Particulate Matter (Dust Density) in stack emission 6. Mercury (Hg) in stack emission 7. Flue Gas flow at stack Note: Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2							
1.02.00	LIST OF OTHER FLUE GAS ANALYSERS FOR BOILER SYSTEM: 1. O2 ANALYSER AT PLATTEN SH OUTLET 2. O2 ANALYSER AT PLATTEN SH OUTLET 3. O2 ANALYSER AT ECO OUTLET (L) 4. O2 ANALYSER AT ECO OUTLET (L) 5. O2 ANALYSER AT ECO OUTLET (R) 6. O2 ANALYSER AT ECO OUTLET (R) 7. CO ANALYSER AT ECO OUTLET- ECO-3 O/L 8. CO ANALYSER AT ECO OUTLET- ECO-3 O/L NOTES: 1. These are per unit quantities. 2 The O2 Analyzer quantities (except for CEMS system) shall as per mentioned above and same shall prevail as mentioned here irrespective of mentioned elsewhere in the specification including tender drawings.							
1.03.00	SOx ANALYSERS FOR FGD SYSTEM: 1. SO2 Analyser at FGD Outlet 2. SO2 Analyser at FGD inlet							
I	<u>CONTRACT QUANTITIES OF TOOLS AND TACKLES</u> The list of Tools and Tackles to be supplied as part of this package is as follows:- <table><tr><th>Sl no</th><th>Item Description</th><th>Common Qty. for all units</th></tr><tr><td>1.</td><td>Ring spanners set (6mmx7mm to 21mmx23mm sizes, nine pieces per set)</td><td>3 sets</td></tr></table>	Sl no	Item Description	Common Qty. for all units	1.	Ring spanners set (6mmx7mm to 21mmx23mm sizes, nine pieces per set)	3 sets	
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CLAUSE NO.		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
J <					

CLAUSE NO.	TECHNICAL REQUIREMENTS		
L	house and Raw Water Pump House. Contractor shall provide 2 vibration sensors per measurement location. For makeup water system (in Employer scope) and AWRS system (in Employers scope) 12 no. of Vibration sensor for each system are to be provided. Vibration monitor is to be provided on as required basis in Makeup water system CER and AWRS CER. Contractor shall provide Phase marker sensor for ID,FD,PA,BFP,CEP,ACW,ECW,CW drives as a minimum. Contractor shall provide compatible buffered phase marker and vibration signals required for integrated diagnostics and analysis of vibration of all the above equipment's and for crushers as a minimum and other drives as per OEM recommendation for connectivity to the analysis system. For gearbox of Cooling Tower FAN (X/Y), vibration transducers (4-20 mA output) shall be provided and directly connected to DDCMIS system. <u>Other Instruments</u>		
	1	Impact Head type flow element with flow transmitters	2 no per unit
		As an alternate DUAL PATH TRANSIT TIME CLAMP-ON ULTRASONIC FLOW METER can be supplied for this application)	
	2	Instruments to be installed in ECP Transducers (Incoming voltage, Incoming Frequency, Running voltage, Running Frequency) Synchronising relays (Check relays, Guard relays,Auxiliary relay, Auxiliary Potential Transformer 110V/110V, Auxiliary Potential Transformer 63.5 V/110V)	On as required basis
	3	Effluent Quality Monitoring System (EQMS)	Quantity common for all units
	(a-1)	pH Analyser	1 no
	(a-2)	Conductivity Analyser	1 no
	(b)	Chemical Oxygen Demand*(COD) Analyser	1 no
	c	Biological Oxygen Demand *(BOD) Analyser	1 no
	(d)	Total Suspended Solids (TSS) Analyser	1 no
	(e)	Oil In Water (OIW) Analyser	1 no
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी सी NTPC
M	(f)	Temperature Element (RTD)	1 no	
	(g)	Temperature Transmitter	1 no	
	(h)	Flow transmitters	1 no	
	(i)	Power Supply Distribution Board (PDB)	1 no	
	* BOD & COD analysers are shown separately for the purpose of input only otherwise any of the BOD & COD analysers can be clubbed together to be provided as a single unit meeting the specifications			
	List of Temperature Monitoring locations (as referred in Subsection IIA-01 Part A of technical specification) along with minimum quantities for each location:			
	Table-I: Temperature monitoring in Penthouse cavity and ash hoppers			
	S. No.	Location of measurement	Minimum quantity of thermocouple (TC) per boiler	Type of TC
	1	Inside Penthouse cavities at 2/3 of depth from penthouse top.	4 nos. (One no. each near to Divisional header, Platen Header, Reheater header, LTSH header)	Mineral insulated K-type TC
	2	Bottom ash hopper (BAH) below quenching/spray nozzles. Thermowell tip shall be inserted in BAH refractory facing downwards.	One no. in each BAH hopper	K type TC with thermowell
3	Economiser Hopper above hopper discharge gate	One no. in each Economiser hopper	Metal Temperature Thermocouple (MTT) mounted in metallic weld pad	
4	APH Hopper above hopper discharge gate	One no. in each APH hopper	MTT mounted in metallic weld pad	
Table-II: Temperature monitoring in burner area, sootblower area, MS, HRH pipeline				
S. No.	Location of measurement	Minimum quantity of TC per boiler	Type of TC	Remarks
1	Burner area: In each corner of boiler, hanging near to water wall just	One no. in each corner of boiler	K type TC	TC shall be hanging near to water wall with
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N		above windbox top.			suitable support.																		
	2	Soot blower area: In the middle of each wall of boiler, hanging near to water wall just above Separated OFA top.	One no. in middle of each wall of boiler	K type TC																			
	3	Penthouse roof top area: Hanging near the boiler wall	8 nos. (1 no. each on front and rear side, 3 nos each of left and right side of boiler)	Mineral insulated K-type TC																			
	4	Main Steam, HRH piping	4 no. per Main steam piping (Left/Right) and HRH steam piping (Left/Right)	MTT mounted above insulation metal sheet of MS/HRH piping using metallic clamps	TC shall be provided for each vertical portion of the pipeline, clamped at the top end of each of the respective vertical portions.																		
<u>Safety Control Room:</u>																							
Contractor shall supply and install IP based CCTV system along with IP based announcement system which shall be used for monitoring safety during construction from Safety control room. It shall be possible to make announcements to alert the workers whenever required. These cameras shall be installed at all strategic locations in the plant area. These camera can be wired or wireless as per suitability at site. Initially these installations will be temporary & locations will keep on changing depending upon the work in progress. After COF of last Unit these cameras are to be installed permanently at suitable locations in consultation with NTPC. Drone based safety monitoring shall be done during day to monitor critical works at a close range. The images / Video feed from drone shall have sufficient resolution to identify the work under progress. Following quantity of items shall be provided by contractor as a minimum. <table><tr><th>SI No</th><th>Name of Item</th><th>Quantity common for the station</th></tr><tr><td>1</td><td>IP based PTZ dome camera (HD)(wired/wireless)</td><td>25 no</td></tr><tr><td>2</td><td>CCTV camera database redundant server with speaker (Shall work in redundant mode, one primary and another secondary server)</td><td>one set</td></tr><tr><td>3</td><td>Drone</td><td>One no</td></tr><tr><td>4</td><td>LED display panel based video wall (85 “)</td><td>2 no</td></tr><tr><td>5</td><td>Vehicle speed detection system with 5 no of IP based camera at road turning points</td><td>One set</td></tr></table>						SI No	Name of Item	Quantity common for the station	1	IP based PTZ dome camera (HD)(wired/wireless)	25 no	2	CCTV camera database redundant server with speaker (Shall work in redundant mode, one primary and another secondary server)	one set	3	Drone	One no	4	LED display panel based video wall (85 “)	2 no	5	Vehicle speed detection system with 5 no of IP based camera at road turning points	One set
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A		Annexure C to IIC Contract quantity	PAGE 20 OF 24																		

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC									
	<table><tr><td>6</td><td>IP based announcement system with 30 loudspeaker with sufficient power for the intent.</td><td>One set</td></tr><tr><td>7</td><td>Hardware & Software</td><td>On as required basis</td></tr><tr><td>8</td><td>Power supply/cables/desk/furnitures/network switches/joy sticks etc</td><td>On as required basis</td></tr></table> The above quantity is minimum and any additional item or quantity required for meeting the intent of specification shall also be in the scope of this package Analytics for Safety vest and helmet is to be deployed on all 25 nos. of cameras and any safety violation shall be alerted through IP based announcement system. Any over speeding of vehicle should also be warned through speakers automatically. 24/7 safety control room shall be functional from initial stage of the project construction. Temporary safety control room for the same is to be made functional within three (3) months of LOA. Permanent safety control room shall be made functional within six (6) month from LOA	6	IP based announcement system with 30 loudspeaker with sufficient power for the intent.	One set	7	Hardware & Software	On as required basis	8	Power supply/cables/desk/furnitures/network switches/joy sticks etc	On as required basis		
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity	PAGE 21 OF 24									

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Power Supply	24 V DC Power Supply																																																					
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	Annexure C to IIC Contract quantity	PAGE 24 OF 24																																																			

SUB-SECTION–IID

CIVIL WORKS

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	SCOPE OF CIVIL, STRUCTURAL & ARCHITECTURAL WORKS OF EPC PACKAGE The scope of civil, structural and architectural works shall include topographical survey, detailed geotechnical investigation, site clearance, dismantling of existing structures/substructures/facilities, site levelling, preparation of design documents and drawings and getting approval of the same from the Employer and construction of all civil, structural and architectural works including supply of all construction materials for all buildings, equipment and facilities for the project. The nature of work generally involves detailed geotechnical investigation, piling, earthwork in excavation in all types of soil and rock including controlled blasting/ mechanical means, de-watering, backfilling around completed structures, plinth filling, disposal of surplus earth/rock/excavated material/dismantled material, concreting including reinforcement and form work, chimney construction using slip form, masonry work, plastering, corrosion protection measures including painting, un-insulated / sandwiched insulated metal wall cladding, roofing and flooring including permanent steel decking, false ceiling, under deck and over deck insulation, acid and alkali resistant lining, fabrication of all structures at factory, pre assembly of fabricated structures at factory, transportation of pre-fabricated structures and erection of steel structures (with bolted field connections) and miscellaneous steel works (i.e., steel staircase, cable supports, pipe supports, ladders, walkways, railing, chequered plate/grating floors, inserts etc.), painting of structures, paving, gravel filling, providing pre-cast covers, damp proofing, roof water proofing, anti-weed treatment, roads, drainage, sewerage, rain water harvesting, final grading and site clearance before handing over and any other item of work required for completion of all systems under the scope of work complete. The works covered under the scope of the bidder have to be executed in an existing power station. The bidder shall take all necessary precautions to protect the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/staff from the equipment / facilities of the power station. The scope of Bidder for civil, structural and architectural works as defined above shall include but not be limited to the following buildings/ areas/ systems along with their foundations, super structures and finishes complete: 1. Topographical Survey. 2. Detailed Geotechnical Investigation. 3. Site clearance including cutting of trees of girth less than 30 centimeters. Cutting of trees of girth more than 30 centimeters shall be done by the owner. However, removable and disposal of roots, trees of girth less than 30 centimeters and other vegetations in the bidder scope. 4. Construction of Raw Water Reservoir and levelling to FGL. 5. Infrastructure Works a. Rigid pavements Roads in Plant area and all other roads as shown in General Layout plan (GLP)/ Road layout tender drawing including approach road /heavy duty paving/heavy duty passage to buildings/ facilities in the package,			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	PAGE 1 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	including construction of priority roads at onset of project works and maintenance of the roads during the entire construction period. b. RCC Storm water drainage in Plant area (including facilities/structures) and RCC drains along roads in Bidder's Scope including connection upto disposal point as shown in GLP/Layout of drain. Drains to be constructed simultaneously with roads. c. Packaged type Sewerage treatment plant (3 nos. as indicated in tender drawing General Layout Plan) and sewage pumping station including sewage pump, sump & house and connection up to sewage treatment plants (either of owner or bidder); connection of sewage lines of all buildings under Bidder's scope to the nearest sewerage system. d. Complete site levelling of entire plant area as shown in drawing no. 8013-001-POC-A-003 Titled 'Site Levelling Plan'. e. Water supply system for Plant area. f. Safety Control Room at onset of project works. g. Separate RCC drainage network with GI grating cover and sump pit for plant effluents for all buildings and facilities in Bidder's scope including floor wash water from all the facilities in Plant Area upto Effluent Treatment plant including connection of effluent line from structures under the scope of package. h. Hard crusting in plant area and preassembly area to facilitate movement of vehicles and erection of equipment. i. Fencing of height 5m with GI Sheet at the location marked in Tender drawing no 9587-999-POC-F-001 during construction phase, to avoid dust flow from Stage-II area to Cooling Tower area of Stage-I. j. Dust suppression in construction area of Stage-II. Special care to be taken in the area adjacent to Cooling Tower of Stage-I. 6. Foundations for all buildings/ area/ systems including machine foundations. 7. All Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding for entire Plant area covering the following: a. Boiler and ESP supporting structures and foundations. b. Elevator pit & Civil Works for Machine Room for Boiler Elevator. c. Mill Bunker building supporting structures and foundations, floors, roof & side cladding. d. ESP control room building. e. Mill reject silo and associated trenches. f. Compressor house. g. Coal mill foundations & PA/FD/ID Fan foundations. h. Seal air fan foundation and all other equipment foundations. i. Coarse ash hopper tower foundations & FEA tower foundations. j. Coal transfer points, coal conveyor galleries and supporting trestles in the boiler area – foundations, floors, roof & side cladding, staircases, gravity take up structure for conveyors in the boiler area. k. Area Paving and miscellaneous foundations in entire area enclosed within the peripheral roads of the entire plant area from edge of drain along peripheral road beyond transformer yard upto road beyond Ash handling facilities area bound by peripheral roads in orthogonal directions, including heavy duty			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-II D CIVIL WORKS	PAGE 2 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	passages, sump pits, drains, culverts, cable slits, fire water trench, including, rail/ road/ drain crossing of fire water trench & pipes etc. (as shown in tender drawing). I. Bunker MCC including RIO room. m. Main Power House building. n. Foundations for turbine generator, turbine driven boiler feed pumps and motor driven boiler feed pump(s) including steel helical springs and viscous dampers below RCC top deck (The foundation type can be with/without steel helical springs/ dampers as per option provided in specification) o. CW Pit, CEP Pit, and all other equipment foundations in Turbine-Generator (TG) area. p. CW duct /liner including PCC/RCC encasement q. Transformer yard area foundations including rail track cum road along the entire A-Row extending up to peripheral roads on either side and transformer yard, condensate storage tank foundation, condensate transfer pump foundation, fire barrier wall, pit, sump, pipe and manhole, common oil retention pit/oil-water separation pit, gate and fencing etc. r. Diesel generator set foundations & stack foundations along with steel support structure and foundations for stack support. s. Civil, structural, architectural works for CPU system in Main Power House & regeneration area including Switchgear/MCC and control room building and Transformer foundations. t. Civil, Structural & Architectural works for rooms for Owner's Electrical equipment like HT/LT switchgear, cable vault, batteries/battery chargers, foundation of service transformers, space for bus ducts and cable trays etc. as listed in Electrical Chapter & Layout Chapter PART-B. 8. Chimney including elevator, electrical works, aviation obstruction lighting. 9. Civil, structural, architectural works of all facilities associated with complete Flue gas desulfurization (FGD) including Gypsum handling system and DeNOx system. 10. Civil, Structural, Architectural works for all buildings/ structures/ facilities for ash handling along with switchgear building & control room including the following: a. Ash Water Pump House open type b. Ash Slurry Pump house shed as per system requirement c. Switch gear/MCC and Control Room for all buildings. d. Silo area utility building, ash classifier system and bagging plant complex (build type as per system requirement) e. HCSD cum Fly Ash Silo, Foundation for Dewatering bin. Ash classifier and bagging plant including base plate and supporting pedestals f. Transport air compressor Shed with side sheeting g. Conveying air Compressor Shed with side sheeting (if required as per system) h. Steel Trestles including foundation for supporting fly ash Piping within plant area and up to silos.. i. RCC pedestals for ash slurry disposal pipes lines inside plant boundary j. Miscellaneous works like Transformer Foundation, Fencing, Paving etc. k. Culverts/local humps or bridges as per site conditions, for routing of the ash pipes at crossing for nallah /water body crossing /roads/rail lines etc.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	PAGE 3 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	l. Weigh Bridge m. Any other buildings/structures if required as per system. 12. Civil, structural, architectural works for fuel oil pressurizing pump house with switchgear room, MCC cum control room. 13. CW system Civil, Structural and Architectural works a) CW pump house with steel superstructure and metal sheeting at roof including pump foundations, maintenance area, forebay and Transition zone b) CW Switchgear/MCC & control room building including transformer foundation. c) CW ducts including PCC/RCC encasement from CWPH to TG Hall and from TG Hall up to Cooling Towers. d) CW Channel from Cooling Towers up to CWPH forebay. 14. Raw Water system civil Works Raw Water Pump House (RWPH) with steel superstructure and metal sheeting at roof including connection with reservoir outlet pipes, pump foundations, maintenance area, Forebay/Sump and associated Switchgear/Control/Remote IO Room building, Transformer foundation etc. 15. Civil, Structural, Architectural works for the following buildings/ structures/ facilities of Water & Effluent treatment plant: a) Pretreatment plant and associated structure and facilities b) DM plant and associated structure and facilities c) CW Chemical Treatment Plant and associated facilities d) Coal slurry settling pond and associated facilities e) Chlorination(CIO₂) plant and associated facilities f) Water System Control Room Building and remote I/O room associated with PT plant, DM & CW chemical plant. g) DM Plant laboratory h) Zero liquid discharge and associated facilities i) Liquid effluent Treatment Plant & associated facilities required for disposal of liquid effluent. Effluent quality monitoring system(EQMS) j) DM, PT & Service Water Switch Gear & Control/Remote I/O Room Buildings, transformer foundation etc k) DM & CW Chemical plant l) Station Piping Civil works 16. Civil, Structural works for pipe /cable /duct supporting structures, trestles and foundations, Condensate Storage Tank and CST pump house, trenches, duct banks, pedestals, thrust blocks, trenches, Hume pipes & culverts, duct banks etc at crossing in offsite area for pipes and cables, buried pipes and crossing, racks, culverts across rail tracks for pipes/ drains/ sewers and any other facility and thrust blocks etc. associated with all systems covered under the scope 17. All civil, structural & architectural works associated with IDCT including associated facilities.. 18. Civil Works for 400kV AIS Switchyard. All civil, structural & architectural works associated with Switchyard, that is, Switchyard Control Room Building, Towers, Girders, Equipment Supports, Lighting Masts, Lightning Masts, Transformer /Reactor foundations, cable trenches, roads, drains, fence with gate, anti-weed treatment, gravel filling, water supply & sewage system for switchyard buildings, inter-connection with existing			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	PAGE 4 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
1.00.01	switchyard & inter-connections to employers facilities etc. and all other related works complete as per system requirement. 19. Coal, Bio mass and Gypsum Handling Plant All civil, structural & architectural works associated with coal and Gypsum handling plant, i.e. track hopper, transfer points, crusher houses, overhead/ground conveyor galleries, tunnels for conveyor galleries, Bio mass silo ,stacker/reclaimer foundations, pump houses, MCC/Control Buildings, penthouse, Truck tipplers, stock pile area with wind barrier, Gypsum storage shed, drainage, inter-connections with existing transfer points and all other related works complete as per system requirement. 20. Pipe /Cable / duct supporting structures, trenches, culverts, duct banks, pedestals, hume pipe culverts and thrust blocks etc. associated with all systems covered under the scope of EPC package. 21. Civil works for Outdoor transformer foundations 22. Civil, Structural, Architectural, Electrification, air-conditioning and ventilation works, for the following Miscellaneous Buildings/ structures/ facilities: a. Dozer Shed b. O&M Store c. FQA Lab d. Non -Biodegradable waste storage building 23. Earthing mats & risers for all buildings. 24. Sheds for O&M/Workers, including food serving kiosk and bio Toilet Blocks for ladies and gents, in adequate numbers to cater to the workers working in each work area. The sheds should be easily accessible to workers by foot. Minimum 06 numbers of shed in different areas shall be provided. Drinking water facility and maintenance of toilet and shed shall be the responsibility of the bidder till COD of all the units. 25. Facilities for rainwater harvesting in Plant area and other buildings in Bidder's scope. 26. Civil Works associated with fire detection and fire protection system Civil, structural, architectural works for fire water tank foundation, fire water pump house including Switchgear/MCC & Control room, fire water booster pump house & control room, foam system including foam system shed & control room, deluge valve housing, pedestals for pipes, concrete encasement of pylon pipes (within filled up gravel portion) used for HVV spray system for protection of transformers, rail/road crossing of fire water trench etc, civil works associated with buried pipes & crossing etc. 27. Civil works associated with air conditioning & ventilation system. 28. Civil, Structural works for pipe /cable /duct supporting structures, trestles and foundations, trenches, culverts, duct banks, pedestals, hume pipe & culverts, buried pipes, racks, culverts across rail/road tracks for pipes/ drains/ cables and any other facility and thrust blocks etc. associated with all systems covered under the scope. 29. Miscellaneous Switchgear building. 30. Civil, structural, architectural works for SOLAR PV plant on roof top of building/facilities in the bidder's scope. 31. Any other miscellaneous building or facility.	
	All steel structures shall be fabricated in factory, transported and erected at site. All factory-fabricated structures shall have bolted field connections. Coal bunkers with hoppers, Chimney flue liners, CW duct liners can either be fabricated at factory in	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.02 <				

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	Construction water shall be the responsibility of Bidder during all stages of construction. However, construction water may be provided by Owner at one point on chargeable basis. Bidder shall arrange for further distribution/transportation to required location by their own. 2. Construction Power Scope of supply of construction power is specified in SECTION – VI, PART-B, SUB SECTION B-18 of Technical specification. 3. Construction of following temporary facilities of bidder a) Construction office, b) Construction stores (covered) & open stores as per his requirement. c) Workshops for maintenance of construction plant and equipment. d) Material/field testing laboratory facilities and any other temporary building. 4. Providing all necessary fire-fighting devices/equipment/fire tender etc. required during the project execution stage in project areas including laydown/pre-assembly yard area. 5. Providing all tools and tackles required for the work. 6. The Bidder shall arrange skilled/semiskilled/unskilled labour (from local source(s) as far as available) and supervisory staff for quality execution of all civil, structural and architectural works. 7. Development of hard crusted / paved fabrication yard for onsite structural steel fabrication work where permitted. 8. Area lighting at the construction / erection site, fabrication, pre-assembly and storage yard, office areas, labour and staff colony etc. 9. Providing first aid facilities at the construction / erection sites, workshops, laboratories, fabrication, pre-assembly & storage yard, Offices and other places of work as per the requirement. 10. Use of ash and ash based products. In line with Gazette Notification on Ash Utilization issued by Ministry of Environment & Forest and its amendments, Bidder shall use ash and ash based products in all construction. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Contractor shall be responsible for enforcing the same on his sub-vendors Fly ash is available within plant boundary. Bidder to procure Fly ash. Bidder to collect and transport the same meeting environmental norms/ local regulations at his own cost as per operation schedule for fly ash collection. A nominal amount of shall be charged. 11. Repair & Maintenance Facilities by the Bidder : Bidder shall establish/set up at site suitable repair facilities for construction equipment and machinery (like cranes, hydra, forklifts, welding equipment, dumpers, rollers, etc.) Bidder shall also make arrangements /tie-up with manufacturers / suppliers of such construction plant, equipment & machinery, for periodic overhaul/ maintenance and for repair of major breakdown, if any. Bidder shall also keep adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the manufacturer / suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical / electrical foreman & supervisors for manning the repair facilities as specified above. 12. Water sprinkling in construction area and roads, as per requirement/directions of Engineer-in-Charge, to arrest fugitive construction dust.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	PAGE 7 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
2.03.00 2.03.01	13. Dewatering in construction area during construction period for any seepage water as well as accumulated rainwater. 14. Housekeeping of all construction area and disposal of construction/demolition waste. This also includes cutting and removal of vegetation including dry vegetation to avoid fire hazard in the entire project construction area. DEVELOPMENT OF LAYDOWN AREA Bidder shall use a Lay down area as shown in GLP. One area marked in GLP totalling 75 acres (approx.) are identified as laydown /preassembly area. Further, bidder to note that this 75 acres of land shall be converted into reservoir. Fencing of the laydown area in the area marked for laydown is in Owner's scope. Construction of wire fencing in the proposed laydown area shall be completed within 4 months from NOA. Contractor can do the site preparation work parallelly. The contractor shall develop the following facilities before using the allocated laydown area. - Site clearance including cutting of trees of girth less than 30 centimeters. - Bidder shall construct and maintain approach road to laydown area and road network in the interior of laydown area. Further bidder to ensure measures to avoid noise and dust pollution to habitants during the contract period. - Security of material shall be responsibility of the EPC Contractor, including gate control. - RCC drains in the entire laydown area and along roads shall be planned so as to ensure proper disposal of rainwater. - Levelling, compaction backfilling, for purpose of laydown area surface preparation - Hard crusting of Laydown area, fabrication, and pre-assembly yard area has to be carried out as per specifications mentioned elsewhere. The extent of hard crusting shall be decided by the contractor based on their requirement. Material and equipment storage shall be as per guidelines covered elsewhere.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	PAGE 8 OF 8

SUB-SECTION–III

TERMINAL POINTS & EXCLUSIONS AND OWNER’S INPUT

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS AND Owner's INPUT			एनटीपीसी NTPC
1.00.00	TERMINAL POINTS			
	The following terminal points are to be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems.			
1.01.00	Mechanical			
1.01.01	Auxiliary Steam System Headers Interconnection			
	a) TP for Auxiliary Steam interconnection for Auxiliary Steam Station Header with existing Stage-I with motorized isolation valve as indicated in the tender drg. b) The stub/Tee-off connections with Isolating valve and blank flange on the auxiliary steam Unit/Station header for future connections as indicated in the tender drg. All the interconnection with existing piping system to be done by the bidder. All the valves and fittings required for interconnection shall be provided by bidder.			
1.03.00	Ash handling system			
	a) Terminal Point for Ash slurry disposal piping (HCSD pipes) and AWRS piping shall be 5 m inside plant boundary			
1.04.00	Coal Handling Plant			
	a) Feed from Employer's TP-4 of Stage-I to Stage-II b) Feed to Employer's Conveyor 13A/B at TP-14 of Stage-I			
1.05.00	Fire Detection and Protection system			
	Separate Hydrant and spray headers available in plant area for tapping required for Hydrant and Spray system.			
1.06.00	Fuel oil system			
	a) Connection from existing LDO supply to pressurizing pump suction line as indicated in the tender drawing. b) Existing LDO storage tanks (2x4000 kL) for LDO return line from the boiler. c) Furture interconnection tap off at common discharge line of existing LDO pumps			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-III TERMINAL POINTS & EXCLUSIONS	PAGE 1 OF 3

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS AND Owner's INPUT	
2.00.00	ELECTRICAL a) Terminal point for Construction power – 2 Nos of 11KV feeders shall be made available to the bidder from Employers Existing Stage-I 11KV Miscellaneous switchgear of Lara STPP Stage-I. b) Terminal points for switchyard- 400 KV Switchyard at Lara stage-II shall be in the bidder's scope. It shall comprises of switchyard bays in stage-II area as well as in stage-I switchyard area. i) 400KV switchyard at Lara STPP Stage-II along with tie line for interconnection with Stage-II AIS switchyard near stage-I Area with bus sectionaliser shall be in the bidders scope. ii) Bidders scope shall include interconnection of outgoing line bays of LARA-Stage-II AIS switchyard with the existing Tower of LARA-I Raigarh-Kotra line. Any modifications required for this purpose shall be in the scope of the bidder. iii) Terminations at the switchyard line take off gantries for 400KV lines(except tie line) not in bidder scope. The line side insulators shall be provided by the transmission line contractor, however the clamps & connectors for droppers to equipment connections are in the bidder's scope. iii) FOTE equipment , FODP JB, Fiber Approach cable etc required at 400 KV Switchyard at Lara STPP Stage-II shall be in the bidder's scope. a) Terminal point for startup power: Power at 400 KV level shall be made available to the bidder from 400 KV switchyard of LARA STPP Stage-I.	
3.00.00	Control & Instrumentation	
3.01.00	For Makeup water system and AWRS	
3.01.01	TBs of employer's instruments and Local Junction boxes for signals which are being interfaced with the Contractor's control system. All required cables from these TBs to contractors control system shall be supplied, laid and terminated by the Contractor	
3.01.02	For Employer's Fieldbus(FF/Profibus) based Devices:-- a. TBs of Fieldbus positioners and instruments. b. TBs of Fieldbus based non-intrusive actuators for fieldbus cable. All required cables from these TBs to contractors control system shall be supplied,	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-III TERMINAL POINTS & EXCLUSIONS
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CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS AND Owner's INPUT	एनटीपीसी NTPC		
3.01.03	Employer shall provide one (1) number, 415 V, three phase 3-wire, 50 Hz feeder for UPS each at makeup water system and AWRS system. All required Cables from this feeder to Contractor UPS panel will be in contractors scope.			
3.01.04	Employer shall provide two (2) number, 415 V, three phase 3-wire, 50 Hz feeder for 24 VDC system each at makeup water system and AWRS system. All required Cables from these feeder to Contractor 24VDC panel will be in contractors scope.			
3.02.00	For other system: NIL			
4.00.00	EXCLUSIONS			
4.01.00	MECHANICAL			
	a) Manufacturing, supply, erection and commissioning scope of SCR/Hybrid System which shall only be limited to the works required for SCR ready /Hybrid ready plant.			
	b) Supply of limestone & Biomass			
	c) Fuel Oil unloading & storage system			
	d) Fugitive dust suppression system at ash pond			
	e) Ash slurry piping & AWRS from 5 m inside plant boundary to Ash dyke shall be excluded from the Bidders' scope.			
4.02.00	ELECTRICAL			
	a) Supply erection and commissioning of PLCC, HF cable.			
	b) 400kV transmission lines except 400 KV tie line indicated in SLD			
4.03.00	CIVIL			
	a) Green belt development and afforestation			
	b) Township			
	c) Landscaping			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-III TERMINAL POINTS & EXCLUSIONS	PAGE 3 OF 3

SUB-SECTION-IV

FUNCTIONAL GUARANTEES

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2**

CLAUSE NO.	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES			
1.00.00 1.00.01	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term "BMCR" (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-01, Part-B) at super heater outlet at rated parameters. The term "TMCR" (Turbine maximum continuous rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 77 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure. PERFORMANCE GUARANTEES General Requirements a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications. b) The guaranteed performance parameters indicated/furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually. d) All costs associated with the tests including cost associated with the supply, calibration shall be included in the bid price. e) It is the responsibility of the contractor to perform the Performance Guarantee/ Acceptance test as specified in this subsection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits. f) The Contractor shall make the plant ready for the performance guarantee tests before start of Initial Operation. All CAT-1 Performance Guarantee tests shall be conducted along with initial operation except following a) Coal Pulverisor Wear Parts Warranty b) Particulate Emission/ESP Efficiency, FGD. c) Auxiliary power consumption for Station Auxiliaries (PG Test for Station Auxiliary Power Consumption to be done along with unit#2 initial operation) d) "PG test of Cooling Tower (IDCT) shall be carried out by the contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified, preferably in the period from May to September. If Unit			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 1 OF 76

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	trial operation falls in these months then PG test of IDCT can be clubbed with Unit trial operation. e) PG test of A/C System (for aux. power consumption under station auxiliaries) shall be carried out by the contractor within one year of successful completion of trial operation of the respective A/C system during summer in the months of May-August. If unit#2 trial operation falls in these months then PG test of A/C system can be clubbed with unit#2 trial operation. g) Instruments for PG test and instruments for process control of similar applications are envisaged to be of same make and model having same accuracy level. However, instruments for PG test are also acceptable as per standard and proven practice of the contractor/OEM and in such case, instruments for process control shall be as per requirements specified in Part-B of technical specifications. Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs. PG test equipment being supplied, installed and commissioned for each unit, shall be retained by employer after completion of PG test. Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to PG Test / initial operation. All PG test process parameters shall be made available in DDCMIS. h) Tools and tackles, instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost. i) The Performance / Acceptance test shall be carried out as per the standard procedure included in the specification. For some of the PG tests, standard PG test procedures have not been included in the specification. PG test procedure for such PG tests shall be submitted, as per latest International codes / standard meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees, within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. 1. For Cat-I Performance / Acceptance tests to be conducted along with the initial operation: After the conductance of Performance test, the test results shall be calculated in Contractor's PG test program/ software. The correction curves shall be fed/inbuilt in the PG test program/ software. Provision of manual entry of offline data which cannot be captured online (such as Relative humidity, atmospheric pressure, Coal analysis, Unburnt carbon in fly ash and bottom ash, Bottom ash / fly ash collection at various hoppers, Flue gas analysis (grid result) etc.) and necessary for calculation of PG Test result shall also be provided. The contractor shall submit the detailed test evaluation report of Performance test results to Employer promptly but not later than 7 days from the date of conductance of Performance test. 2. For Performance / Acceptance tests other than those identified at 1 above: After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than 7 (seven) days from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.			
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	j) The contractor shall submit for Employer's approval the detailed Performance Test procedure (except for the guarantee tests for which the standard PG test procedure is identified in technical specification) containing the following: - Object of the test. - Various guaranteed parameters & tests as per contract. - Method of conductance of test and test code. - Duration of test, frequency of readings & number of test runs. - Method of calculation. - Correction curves and respective equations for graphs to be fed for the online computation. - Instrument list consisting of range, accuracy, least count, and location of instruments along with reference approved P&IDs. - Scheme showing measurement points. - Sample calculation. - Acceptance criteria. - Any other information required for conducting the test. k) In case during performance guarantee tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However, if the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed Employer will have the right to the following: For Category-I Guarantees Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees. For Category-II Guarantees In case the performance guarantee(s) are not met by the Contractor during demonstration test, the Contractor shall carry out all necessary modifications and/or replacements to comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. If, however, the demonstrated guarantee(s) are not met even after the above modifications / replacements within ninety (90) days, it will be concluded that, the equipment has failed to meet the guarantee(s). In such a case, Employer shall Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory. For Category-III Guarantees Accept the equipment/system after assessing the deficiency in respect of the			
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1.01.00 1.01.01	various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees. GUARANTEES UNDER CATEGORY - I The performance guarantees which attract liquidated damages (LD) are as follows: i) Unit Heat Rate at 100% TMCR load Guaranteed Unit Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up at 800 MW load (i.e. 100% of rated load). ii) Unit Heat Rate at 55% TMCR load Guaranteed Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 Kg/cm² (abs) and rated Main Steam and Reheat Steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 440 MW load (i.e. 55 % of rated load) . iii) TG Output Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions at 77 mm Hg (abs) condenser pressure with zero make-up. iv) Average Condenser Pressure Average Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes with 840 MW output, 0% make up, design CW temperature and design CW flow. Note: (a) The condenser pressure measurement while conducting the guarantee tests from (i) to (iv) above shall be measured at 300 mm above the top row of condenser tubes. v) Steam Generating Capacity Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's discretion) with the coal being fired from within the range specified in the table at Annexure-IV-2, Sub section I-B (Project information), Part A, Section VI . vi) Coal Pulveriser Wear Parts Warranty Life of coal pulveriser wear parts, in hours of operation, for the entire range of coal characteristics specified. (To be demonstrated as per clause 1.01.04 of this sub-section). vii) Particulate Emission/ ESP Efficiency Contractor shall guarantee that the particulate emission from ESP(s) shall not be more than 17 mg/ Nm³ under guarantee point (refer clause no. 1.05.20 related to ESP sizing criteria Sub-Section–A-01, Part-B(Mechanical), Section-VI) condition at 100 %TMCR i.e. at 800 MW unit load with design coal firing. The corresponding ESP efficiency shall be worked out as per the procedure outlined in clause 1.01.06 of this Sub-section. viii) FGD SO₂ Removal Efficiency SO₂ removal efficiency to achieve SO₂ emission in the Chimney to less than 60 mg			
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1.01.02	per Nm³ as per Part-B, Sub-section-A-02. ix) Limestone Consumption Rate Limestone consumption of FGD system in kg/hr under guarantee point conditions (refer clause no. 1.05.21.01 related to FGD sizing criteria, Sub-Section-A-01, Part-B (Mechanical), Section-VI)) shall be demonstrated. Note: Bids with lime stone consumption higher than 9440 kg/hr shall not be accepted and no evaluation credit shall be given for lower consumption rate. x) Unit Auxiliary Power Consumption Unit auxiliary power consumption comprising of all Unit Auxiliaries shall be guaranteed in line with the requirements stipulated in clause 1.01.07.01 of this sub section. Power consumption of all unit auxiliaries shall be taken for continuous unit operation at 800 MW (i.e. 100% rated load) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal. xi) Auxiliary Power Consumption for Station Auxiliaries Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 800 MW (i.e. 100% rated load of all the units) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal shall be guaranteed in line with the requirements stipulated in clause 1.01.07.02 of this sub section. Notes: (a) Power consumption of each of the pump/fan/compressors/ Conveyors etc. wherever mentioned shall be measured with its own drive at the switchgear end. xii) Cooling Tower The cold-water temperature of 32 deg C shall be guaranteed for the design conditions of CW flow, range, ambient WBT and RH as per the performance test procedure of cooling tower elaborated elsewhere in the specification. “Predicted cold water temperature” shall be arrived from the guaranteed cold-water temperature by correcting the same for the test conditions of range, ambient conditions and circulating water flow using the performance curves furnished by the contractor. In case the “Test cold water temperature” is higher than the “Predicted cold water temperature”, Employer reserves the right to accept the tower after assessing the liquidated damages. The liquidated damages for shortfall in cold water temperature shall be worked out for all the cooling towers as per relevant clause & sub-section. xiii) LD for 0.1% increase in APH Leakage against the shortfall (as per part-B guarantee condition description). AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES If the performance guarantee(s) are not met by the Contractor during PG Test, it will be concluded that, the equipment has failed to meet the guarantee(s) and action shall be taken as per the Contract Requirement. If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 of this Sub-section, Employer will accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:			
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	S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
	(i)	For Increase in the Guaranteed unit heat rate in kcal/kWhr at 800 MW under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up	US \$ 605658 (US Dollar Six Lakh Five Thousand Six Hundred Fifty Eight only) per 1 kcal/kwhr increase in unit heat rate	Not more than 2081 kcal/kwhr
	(ii)	For Increase in the Guaranteed unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 kg/cm2 (abs) and rated Main Steam and Reheat Steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 440 MW load (i.e. 55 % of rated load).	US \$ 222075 (US Dollar Two Lakh Twenty Two Thousand Seventy Five only) per 1 kcal/kwhr increase in unit heat rate	Not more than 2185 kcal/kwhr
	(iii)	For deficiency in Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions, 77 mmHg (abs) condenser pressure with 0% make-up.	US \$ 1569 (US Dollar One Thousand Five Hundred Sixty Nine only) per 1 kW shortfall in TG output	
	(iv)	For deficiency in Average Condenser Pressure in mm Hg(abs) measured at 300mm above top row of condenser tube at 840 MW, 0% makeup, design CW temperature and design CW flow	US \$ 6,75,915 (US Dollar Six Lakh Seventy Five Thousand Nine Hundred Fifteen only) per 1 mm Hg increase in condenser pressure	Not more than 65 mmHg (abs)
	(v)	Steam Generator Capacity For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's choice) with the coal being fired from within the range specified	US \$ 2,04,387 (US Dollar Two Lakh Four Thousand Three Hundred Eighty Seven only) for every 1 T/hr short fall in steam output	Not less than 102% of the turbine VVO steam flow requirement
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	S. No	Guarantee	Rate of Liquidated Damages (LD)	
	(vi)	Coal Pulveriser Wear Parts Warranty Life of Coal Pulveriser wear parts in hours of operation	To be calculated as per clause 1.01.04 of the Functional Guarantees subsection	Not less than 8000 hours
	(vii)	ESP Efficiency For shortfall in guaranteed ESP efficiency in percentage points under conditions specified at clause 1.01.01 (vii) of this sub section	US \$ 14,75,463 (US Dollar Fourteen Lakh Seventy Five Thousand Four Hundred Sixty Three only) for every 0.01% point shortfall in ESP Efficiency	Not less than as worked out to limit ODB to 17 mg/Nm ³ (max.) at ESP outlet before FGD inlet.
	(viii)	FGD SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under condition stipulated in clause 1.01.01 (viii) of this Sub Section of Technical Specification	US \$ 31,352 (US Dollar Thirty One Thousand Three Hundred Fifty Two only) for every 0.1% point shortfall in SO2 removal efficiency	SO ₂ removal efficiency to achieve SO ₂ emission in the Chimney to less than 60 mg per Nm ³ as per Part-B, Sub-section-A-01
	(ix)	Limestone Consumption Rate For increase in guaranteed limestone consumption of FGD system in kg/hr/unit under condition stipulated in clause 1.01.01 (ix) of this Sub Section of Technical Specification	US \$ 3,74,272 (US Dollar Three Lakh Seventy Four Thousand Two Hundred Seventy Two only) for every 100 kg/hr increase in limestone consumption rate	Not more than 8700 kg/hr.
	(x)	For increase in the Unit Auxiliary power consumption in kW for unit auxiliaries required for continuous unit operation at 100% TMCR i.e. 800 MW unit load.	US \$ 4642 (US Dollar Four Thousand Six Hundred Forty Two only) per 1 kW increase in Unit Auxiliary Power Consumption.	Not more than 42000 KW
	(xi)	For increase in Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 800 MW (i.e. 100% rated load of all the units).	US \$ 4642 (US Dollar Four Thousand Six Hundred Forty Two only) per 1 kW increase in Station Auxiliary Power	Not more than 20500 KW
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1.01.03	S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
			Consumption.	
	(xii)	Per Cooling Tower - For every 0.2 deg. C rise in Cold Water Temperature from the guaranteed value	US \$ 7,55,054 (US Dollar Seven Lakh Fifty Five Thousand Fifty Four only) per for every 0.2 deg C rise in cold water temperature	
	(xiii)	LD for 0.1% increase in APH Leakage (as per part-B guarantee condition description)	US \$ 1,40,660 (US Dollar One Lakh Forty Thousand Six Hundred Sixty only) for every 0.1% point increase from the guaranteed or specified value (whichever is lower).	The specified value
	NOTE: i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable. ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract. iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC). iv) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed Fifteen percent (15%) of the Contract Price. v) The LD values are applicable on per unit basis except for the value indicated for auxiliary power consumption for station auxiliaries, which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. vi) Bidder not confirming about meeting the limiting values as specified for various guarantees shall not be considered and their bids shall be rejected. UNIT HEAT RATE Following tests for Turbine Cycle Heat Rate and Efficiency of Steam Generator shall be conducted simultaneously but independently:			
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	(i) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load). (ii) Efficiency of the Steam Generator at 800 MW unit load (i.e. 100% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air. (iii) Turbine Cycle Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 to 610 deg C (as selected) at 77 mmHg(abs) Condenser pressure with zero make up at 440 MW unit load (i.e. 55 % of rated load) with one TDBFP in operation. (iv) Efficiency of the Steam Generator at 440 MW unit load (i.e. 55 % of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air. Unit Heat Rate is to be computed as follows: Unit Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load): $= \frac{\text{THR (100\%)}}{\text{SG\_EFF (100\%)}}$ Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 to 610 deg C (as selected) deg C at 77 mmHg(abs) Condenser pressure with zero make up at 440 MW unit load (i.e. 55 % of rated load): $= \frac{\text{THR (55\%)}}{\text{SG\_EFF (55\%)}}$ Where THR (100%) : Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load). (To be calculated as per clause 1.01.03.01 of this sub-section) SG_EFF(100%): Efficiency of the Steam Generator at 800 MW unit load (i.e. 100% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air. (To be calculated as per clause 1.01.03.03 of this sub-section). The efficiency shall be based on Heat Input GCV of coal. THR (55%) : Turbine Cycle Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 to 610 deg C (as selected) deg C at 77 mmHg(abs) Condenser pressure with zero make up at 440 MW unit load (i.e. 55 % of rated load). (To be calculated as per clause 1.01.03.01 of this sub-section) SG_EFF(55%): Efficiency of the Steam Generator at 440 MW unit load (i.e. 55% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air. (To be calculated as per clause 1.01.03.03 of this sub-section). The efficiency shall be based on Heat Input GCV of coal.			
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1.01.03.01	(1) TURBINE CYCLE HEAT RATE Turbine Cycle Heat Rate shall be calculated as follows & indicated in all computed heat balance diagrams: $\text{HEAT RATE} = \frac{M1 (H1-h1) + M2 (H3-H2) + Mir (H3 - hir)}{Pg}$ Where, M1 - Quantity of live steam entering the turbine stop valve including any live steam supplied to valve stems, or glands etc. in Kg/hr. M2 - Quantity of steam from turbine to reheater in Kg/hr. Mir - Quantity of desuperheating water flowing into reheater system for regulation of steam temperature in Kg/hr. H1 - Enthalpy in kcal/kg of live steam. H2 - Enthalpy in kcal/kg of steam to reheat. H3 - Enthalpy in kcal/kg of reheated steam. h1 - Enthalpy of feed water in kcal/kg at the downstream of the junction of feed flow and bypass flow of HP heaters. hir - Enthalpy of desuperheating water flowing into reheat system in Kcal/Kg. Pg - Unit output after deducting the power consumption by auxiliaries as listed below and the same shall be 800 MW, and 440 MW respectively for 100%, and 55% TMCR unit load: (a) Power taken by Excitation system (KW) including transformer losses, as applicable for various guarantee points in case of static excitation system is offered. (The transformer losses at various points shall be based on factory test to be conducted). (b) Power required for ventilation of oil and control fluid tanks, if ventilating fans are separately driven (KW). (c) Power required for lubrication, if lubricating pumps are separately driven (KW). (d) Power required for control fluid pumps, if control fluid pumps are separately driven (KW). (e) Power required for hydrogen, seal oil auxiliaries, if separately driven (KW). (f) Power required for stator water cooling system, if cooling pumps are driven separately (KW). (g) Power required for Gland Steam Exhauster (GSC) if GSC Exhausters are separately driven. (2) APPLICABLE CORRECTIONS FOR HEAT RATE, OUTPUT AND CONDENSER PRESSURE i) Corrections Applicable for Turbine Cycle Heat rate & Turbine Generator Output tests Based on cycle condition & covering entire range of operation for Turbine following correction curves for variation in Turbine Cycle Heat rate at 100% load & 55% load & Turbine Generator output to be furnished along with bid:			
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1.01.03.02	(a) Variation in main steam pressure and temperature. (b) Variation in reheater steam temperature. (c) Correction Curves, if applicable, due to change in reheater spray quantities with respect to coal properties. (d) Variation in condenser pressure for main condenser. (e) Variation in power factor, frequency, generator hydrogen pressure and voltage. (f) Change in system water storage. NOTE: In case any of the above correction curves are not submitted along with price bid, no negative corrections shall be allowed on turbine Heat rate on this account. Positive corrections if required to be applied, the amount shall be decided by Employer. Further, no positive corrections shall be allowed on turbine output on this account. Negative corrections if required to be applied, the amount shall be decided by Employer. Above corrections curve shall be provided for following cases. a) 105% of TMCR for output guarantee. b) 100 % of TMCR for heat rate guarantee. c) 55% of TMCR for heat rate guarantee. (ii) Corrections Applicable for Condenser pressure Guarantee (a) Variation in Cooling Water Temperature (b) Variation in Cooling Water Flow (c) Variation in Heat Load It may be noted that the heat balance diagrams and guarantees shall be furnished considering the quantities of water for reheater sprays with any mill combination in service to the Employer's choice. For reheater, the spray quantities used shall not exceed the limits specified elsewhere in the specification. During Performance Guarantee Testing in case the spray quantity used are at variance from the values used in the heat balance diagrams, the actual values will be used for calculation of heat rate and no correction shall be allowed. However, correction on account of variation in Reheater spray quantities with respect to values used for the purpose of turbine cycle heat rate values shall be permitted only to the extent that such variations are solely attributable to the change in coal properties with respect to those specified for the design coal. Bidders shall necessarily include the correction curves for variation in reheater spray quantities with coal properties in his bid proposal, failing which no corrections shall be permitted. The above list of correction curves is conclusive & curves in addition to above shall not be applied. SPECIFIC AND LIMITING REQUIREMENTS FOR STEAM GENERATOR EFFICIENCY a) Steam generator efficiency shall be calculated as per the requirements of BS EN 12952-15:2003 (by loss method) and as per stipulations of Clause 1.01.03.03 of this Sub-Section. b) The efficiency quoted by the Bidder shall comply with following limiting parameters with design coal firing: a. Excess air at economizer outlet at 100% & 20% (min.) 55% TMCR load)			
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1.01.03.03	b. Corrected flue gas temperature at air preheater outlet at 100% TMCR 125 degree C or as predicted by the Bidder whichever is higher 55% TMCR 115 degree C or as predicted by the Bidder whichever is higher c. Unburned fuel at all efficiency load at 100% & 55% TMCR load 1.0% (min.) c) Bidder/Contractor to note that no credit shall be given in the bid evaluation or in the evaluation of the results of the guarantee tests for performance predictions/ guarantees etc. if the values considered by the Bidder/Contractor for parameters indicated at a), b) & c) above are lower than those specified above. d) For the purposes of guarantees the ambient air temperature and relative humidity shall be taken as 27 degree Celsius and 60% respectively. e) Unless otherwise specified, the guarantees shall be based on design coal firing with coal/ ash analysis as given in the table at Annexure-IV-2, Sub-Section-I-B(Project Information) of Part-A of Technical Specification. The performance guarantee test will be carried out along with the Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the EMPLOYER. In the event of EMPLOYER agreeing to conductance of such tests after Initial Operations, for reasons not attributable to the EMPLOYER, as assessed by the Employer, no factor for ageing shall be considered for computing performance of the equipment									
	MAJOR REQUIREMENTS/ METHOD OF STEAM GENERATOR EFFICIENCY TESTS									
	i. Test Code : As per BS EN 12952-15:2003 (By loss method based on GCV of Coal)									
	ii. Test Loads 100% TMCR (800 MW unit Load) 55% TMCR (440 MW unit Load)									
	iii. Test Conditions Boiler operating with rated excess air, coal fineness and firing design coal.									
	iv. Ambient air condition 27 degree Celsius temperature (Dry bulb) and 60%relative humidity. The reference air temperature for the Steam Generator efficiency guarantee/ testing shall be taken as the temperature of air (i.e. 27 degree Celsius) entering PA and FD fans.									
	v. No. of readings Two sets of consistent readings for each of test loads. Average of the test efficiencies based on above two readings for each load shall be considered for steam generator efficiency.									
	vi. Measurement and computation of heat losses will include but not be limited to the following: <table><tr><th>S.No.</th><th>Losses to be measured</th><th>Remarks</th></tr><tr><td>a.</td><td>Flue gas losses</td><td></td></tr></table>				S.No.	Losses to be measured	Remarks	a.	Flue gas losses	
	S.No.	Losses to be measured	Remarks							
	a.	Flue gas losses								
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1.01.04			shall be same as that of flue gas in these areas.	
	Note to vi: Ratio of unburnt combustible to supplied fuel mass flow (lu) shall be calculated considering unburnt combustible contents in slag and flue dust based on 1% or actual unburnt fuel loss, whichever is higher. vii. The-steam generator efficiency shall be without any heat credit. viii. The Steam Generator efficiency shall be based on ambient air temperature of 27 degree Celsius and relative humidity of 60%. ix. Correction to tested efficiency shall be applicable for variation in following parameter only : a. Ambient air temperature. b. Relative humidity of ambient air. c. Hydrogen in coal. d. Moisture in coal. e. GCV of coal. f. Percentage of ash in coal. x. The duration of the test shall be at least four hours. No soot blowing shall be allowed during the test period or during stabilization period of four hours prior to commencement of the test. xi. The Bidder shall furnish the correction curves, for Employer's approval covering the expected ranges of variations for all these parameters for the range of coal specified. xii. For all other aspects, not spelt out above, or in the specifications, where BS code stipulates the agreement between the parties concerned before commencement of the test, the Bidder shall get these approved by the Employer. However no correction to SG efficiency on account of variation in turbine cycle parameters, or vice versa shall be allowed. xiii. The number, location, type and accuracy of the test grade thermocouples and pressure gauges shall be to Employer's approval. xiv. The Steam Generator efficiency testing shall be carried out with any combination of mills in operation to Employer's choice, with fineness of pulverized coal not exceeding 75% through 200 mesh. Steam generator efficiency shall be with guaranteed or actual air heater leakages, whichever is higher. MAJOR REQUIREMENTS FOR COAL PULVERISER WEAR PART WARRANTY a) The Contractor shall warrant the wear life of all wear parts of the coal pulveriser when grinding the specified range of coal(s). Pulveriser wear parts are defined as those parts of the pulveriser which are in contact with coal or coal dust and are likely to wear out during the operation of the pulveriser. The guarantee/warrantee shall be demonstrated			
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	on each pulveriser during the Guarantee Trial Period (GTP) commencing after establishing successful operation of the pulveriser continuously for a period of not less than twenty four (24) hours, at or near its guaranteed rated capacity. The GTP for the respective wear part(s) shall be at least three years or the wear life of that wear part(s), whichever occurs later. The establishment of the warranty will be based on equivalent running hours of the pulveriser regardless of the specified coal. The average wear life (AWL) of the mill wear parts during GTP shall, however be corrected for the variation in YGP index for the coal fired during GTP. b) Minimum Guaranteed Life for various coal pulveriser wear parts shall be as indicated in relevant clause of sub-section A-01 related to equipment sizing criteria, Part-B, Section VI of technical specification. c) The wear parts shall be considered to have passed their warranted operating life when they have successfully demonstrated their capability to meet the full load rated capacity of the pulveriser (as per requirements of relevant clause of sub-section A-01, Part-B, Section VI of Technical Specification) during the guaranteed life of the wear part. No weld buildup or reversing of grinding elements will be permitted for achieving the guaranteed wear life. In case any of the wear part has worn out to such an extent that either the normal or safe operation of the pulveriser is jeopardized if this part is not replaced/repared, or continuous use with this part may lead to exposure or wear of other parts which are not meant for the purpose of checking the shortfall in wear life, even if there is no reduction in pulveriser rated capacity, then the part shall be deemed to have outlived its wear life. If any of the wear parts fail to meet the warranted life, additional quantities of these wear parts shall be supplied on pro-rata basis as defined in Clause 1.01.04 f) below. For the duration of this warranty period, the replacement wear parts shall be available to the Employer at the spare part price indicated in the Contract, adjusted as per terms and conditions of the Contract. d) Computation of liquidated damages for plant life of 10 years On the expiry of GTP (minimum 3 years), deficiency in the life of each wear part that has not fulfilled the warranty will be worked out on an item wise basis and shortfall so established due to reduced wear life and its implications for the plant life shall be worked out. The contractor at no extra cost to the Employer shall provide one and half times the wear parts needed to make good the shortfall in the wear life for 10 years of plant life. e) The shortfall part settlement (SPS) will be calculated based on the actual wear life of the parts that have worn-out in the GTP on a pulveriser-by-pulveriser basis. In this connection the procedure given below in clause 1.01.04 f) shall be followed. f) Pulveriser Warranty Shortfall Part Settlement (SPS) Procedure (With Example): For all wear parts of each vertical coal pulveriser: <table><tr><th>S.N</th><th>Description</th><th>Procedure</th><th>Example</th></tr><tr><td>(i)</td><td>Guaranteed wear life of wear part</td><td>(say X hours)</td><td>X=16000 Hrs.</td></tr><tr><td>(ii)</td><td>Total life achieved by a particular wear part during GTP (say X1 hours by originally installed part(s) & X2 hours by</td><td>X1= 13000 Hrs X2= 14000 Hrs</td><td>Life of wear parts replaced during guarantee trial period(GTP)</td></tr></table>	S.N	Description	Procedure	Example	(i)	Guaranteed wear life of wear part	(say X hours)	X=16000 Hrs.	(ii)	Total life achieved by a particular wear part during GTP (say X1 hours by originally installed part(s) & X2 hours by	X1= 13000 Hrs X2= 14000 Hrs	Life of wear parts replaced during guarantee trial period(GTP)				
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1.01.05 1.01.05.01		subsequently replaced part(s))		
	(iii)	Average wear life (AWL) of failed wear parts	$AWL = \frac{X1+X2}{2}$	$AWL = (13000+14000)/2 = 13500$
	(iv)	Short fall in Hrs Total shortfall for wear part during GTP.	$S = (X-X1) + (X-X2)$	$(16000-13000) + (16000-14000) = 5000$
	(v)	GTP in years	$GTP = (X1+X2)/8760$	$(13000+14000)/8760 = 3.08$
	(vi)	Shortfall part settlement (SPS)	$= \frac{S \times (10)}{AWL \times GTP}$	$= \frac{5000 \times (10)}{13500 \times 3.08} = 1.202$ (To be rounded off to nearest whole number. In case of 0.5 or higher decimal place, it shall be next higher number.) $= 1.0$
	g) The Contractor shall provide to Employer either the wear parts of original or better quality material in number equivalent to one and half times the quantity worked out based on the method explained in the above example so as to compensate for the shortfall in wear life for a plant life of 10 years as has been established above, or the cost of such number (i.e. one and half times the quantity worked out as per the above example) of wear parts based on the prices agreed for mandatory spares. The final mode of compensation for such shortfall viz. by means of additional quantities of spares worked out or by cost thereof shall be as per employer's discretion. The total cost of such replacements shall be without any limit to the maximum amount recoverable subject to the provisions of Clause 1.01.02 note (iv) of this Sub-Section.			
	The credit of one and half times of shortfall in wear parts life shall also apply for already supplied mandatory spare parts under this contract based on average wear life achieved during GTP period.			
	h) Average Wear Life (AWL) during GTP, to be considered for pulveriser wear part warranty shall be as arrived at from the station record for each pulveriser, and as corrected for variation in YGP index of the coal being fired during GTP. For this purpose the coal YGP shall be the average tested value during GTP. The Contractor shall collect the coal samples and get them tested for YGP index at recognized, Employer's approved test lab, periodically. (The frequency of sampling and testing shall be mutually agreed between Contractor & Employer). The YGP index testing shall be done as per the BS Standard specified. A jointly signed record shall be maintained during GTP.			
	PARTICULATE EMISSION/ ESP EFFICIENCY			
	The performance test on electrostatic precipitator will commence after a minimum period of three thousand (3000) hours of cumulative operation after completion of initial operation. During the interval between the commencement of initial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performance tests.			
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1.01.05.02	The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and allowing the normal operation of the unit including rapping and normal soot blowing and/or when fuel oil is being fired in the igniters and/or warm up guns. The overall test efficiency and test temperature/inlet dust burden for one set of ESP passes (stream) serving one Steam Generator shall be worked out as follows:- a) V_m (guarantee point test flow) shall be the total of inlet gas flows to the six gas streams at the time of test. b) Test inlet dust burden (D_i) shall be weighted mean of the inlet dust burdens for the individual streams i.e.: $D_i = \frac{(V_{m1} \times D_{i1}) + (V_{m2} \times D_{i2}) + (V_{m3} \times D_{i3}) + (V_{m4} \times D_{i4}) + (V_{m5} \times D_{i5}) + (V_{m6} \times D_{i6})}{(V_{m1} + V_{m2} + V_{m3} + V_{m4} + V_{m5} + V_{m6})}$ Where suffix 1,2,3,4,5 & 6 represents the six gas streams. Similarly the test outlet dust burden (D_o) will be calculated based on outlet gas flow. a. The weighted test inlet gas temperature (T_i) shall also be worked out in a similar manner i.e. $T_i = \frac{(T_{i1} \times V_{m1}) + (T_{i2} \times V_{m2}) + (T_{i3} \times V_{m3}) + (T_{i4} \times V_{m4}) + (T_{i5} \times V_{m5}) + (T_{i6} \times V_{m6})}{(V_{m1} + V_{m2} + V_{m3} + V_{m4} + V_{m5} + V_{m6})}$ d) The measured test efficiency shall be : $E_m = \frac{D_i - D_o}{D_i} \times 100 (\%)$ e) The corrections for the flue gas flow and ESP inlet flue gas temperature in excess of the values for these parameters under guarantee point conditions, shall be allowed only in case and to the extent such variations are caused solely due to changes in specified coal properties and ambient conditions. Further, the corrections for the flue gas flow and temperature lower than the guarantee point values shall be applied based on actually measured test values. Subject to the above, the corrections for the variation in flue gas flow, inlet dust burden and ESP inlet flue gas temp. shall be based on the above computed test values and the procedure indicated in the next para.			
1.01.05.03	At the time of performance testing if the inlet flue gas conditions are not consistent with the specified conditions, due to variation in coal characteristics from the design coal and boiler operating conditions the precipitator performance conforming to this specification, shall be determined using performance curves and correction factors accepted at the time of award of contract. However, the test efficiency shall be corrected to the guarantee point conditions in the following manner: 1. $E_c = 1 - e^Z$ Where E_c = Corrected test efficiency to guarantee point conditions.			
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	$Z = C.Ln(1-Eg)$ 1 and $C = \frac{Ca.Cb.Cc}{etc.}$ Ca.Cb.Cc etc. are Correction factors for flue gas at temperature, moisture content in flue gas, ESP inlet dust loading, sulphur and sodium contents of coal ash based on correction curves furnished by the Bidder and approved by the Owner. 2. $Eg = 1 - e^Y$ Where $Y = (Vm/Vg)^{0.5} Ln(1-Em)$ Eg = Measured test efficiency corrected to the specified guarantee point flow Vg = Specified Guarantee point gas flow (m³/sec) Vm = Measured gas flow (m³/sec) Em = Measured test efficiency Ln = Logarithm, natural base. The correction curves should be realistic for expected range of operation and variation in characteristics specified. The test efficiency shall be the average of at least three corrected test efficiencies. . 1.01.05.04 The Performance tests shall be carried out in accordance with method-17 of EPA (Environmental Protection Agency of USA) code. The details of the test shall, however be mutually agreed upon between the Employer and the Contractor. 1.01.05.05 Further, during the performance test of the Electrostatic Precipitator, if the contractor establishes that the average of three tested outlet dust burden (Do) values (uncorrected) are either equal to or less than 14 mg/Nm³ at ESP outlet before FGD system inlet, then the contractor shall also be deemed to have successfully met the guaranteed ESP efficiency 1.01.06 METHOD OF COMPUTING TEST EFFICIENCY OF FGD The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code. The details of the test shall, however be mutually agreed upon between the employer and the contractor. 1.01.07 AUXILIARY POWER CONSUMPTION The respective auxiliary power consumption for unit and the station are to be calculated in isolation to calculate the respective guaranteed power consumption as is illustrated hereunder: 1.01.07.01 Unit Auxiliary Power Consumption The unit auxiliary power consumption shall be calculated using the following relationship with design coal. $P_{au} = P_u + TL \text{ (Unit)}$ P_{au} = Guaranteed Unit Auxiliary Power Consumption.			
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	Pu = Power consumed by the auxiliaries of the unit under test. TL = Losses of the Generator Transformer and Unit Transformers supplied by bidder based on works test reports and the criteria specified under the Clause 1.01.07.02 (h) under the subheading Transformers. The power consumption (Pu) of entire unit auxiliaries fed from unit transformers shall be measured at the incomers of respective unit boards. Suitable correction for auxiliaries not in service at the time of this measured power consumption like MDBFP etc, shall be done on as per the technical specification. If GCB scheme is adopted, suitable corrections for station auxiliaries shall be done. While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit auxiliaries. The auxiliaries to be considered shall include but not be limited to the following: (a) Turbine Unit Oil purifier. (b) Turbine Unit control oil purifier. (c) Electric oil heater for turbine lube oil tank (rated power shall be considered). (d) Feed and discharge pumps of turbine oil purification system. (e) Main turbine Condenser air-evacuation pumps. (f) CW pumps (g) Cooling Towers (h) Condensate extraction pumps. (i) Drip pump (if envisaged). (j) Hydrazine dosing pumps (if required). (k) Ammonia dosing pumps (if required). (l) Oil purifiers of 2x50% TDBFPs and their feed and discharge pumps. (m) Lube oil pumps of 2x50% TDBFPs and the electrical oil heater for lube oil. (n) Auxiliary oil pump for MDBFP. (o) Oil pumps for HP-LP bypass system. (p) Motor Driven Boiler Feed Pump (For this purpose only 15% of the power consumed by the MDBFP and MDBP at design point as determined during shop test shall be considered). (p1) TG - DM Cooling (All working pumps) Water pumps to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxiliaries) water system. (p2) SG - DM Cooling (All working pumps) Water pumps to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxiliaries) water system. (q) Auxiliary Cooling (All working pumps) water pumps to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system. r) Mills. s) PA Fans. t) FD Fans.			
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	u) ID Fans. v) Air Heaters. w) Coal Feeders. x) Steam Generator Start up drain recirculation Pumps (If required). y) Seal Air Fans. z) Lube oil pumps for fans/ Air heaters & mill system etc. aa) Scanner air fans. ab) Electrostatic Precipitator with all TR sets , all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% duty condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature. (Refer Note 4 below) ac) Gas Recirculation Fan (if applicable) ad) FGD System i. Absorber Recirculation Pump(s) ii. Absorber Oxidation Air Blower(s)/Compressor(s) iii. Absorber Oxidation Tank Agitators iv. Gypsum Bleed Pumps v. Limestone Slurry Pump(s) vi. Process water pump(s) vii. Mist Eliminator Wash Water pump(s) viii. Booster Fans in case Booster Fan is provided by the Contractor. ae) Pressurising pumps of fuel oil system af) Power consumption of fans of Air washer units for TG building and fans of air filtration units for ESP and FGD buildings at its rated duty point to be arrived based on shop test. ag) Power consumption of any other continuously operating auxiliary for unit operation at 100% TMCR with Design Coal. ah) GCB Losses of Unit : Losses and fan power for Generator Circuit Breaker (if applicable) Note : 1. The bidder shall furnish a list of equipment to be covered under Unit auxiliary power consumption, which shall be subject to Employer's approval. 2. The bidder shall ensure that power supply to all such equipment to be covered under unit auxiliary power consumption is fed from unit board of the respective unit. 3. Method of Computation of Auxiliary Power consumption for ESP:- The measurement for guaranteed auxiliary power consumption shall be carried out during ESP collection efficiency test. The method for computing the power shall be as described below:-			
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1.01.07.02	a) Power consumption of ESP will be measured pass wise and for one pass (Say ESP-A) at a time with the help of energy meter in ESP MCC. b) Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test. c) Before starting collection efficiency test, switch off all the TR sets, all hopper heaters, all insulator heaters/pent house fans (if applicable) and rapping systems serving to one pass (ESP-A) temporally and note down energy meter readings for period t1 i.e. E1. The power consumption shall be $W2=E2/t1$. d) During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E2. Total time period (t2) of test shall be noted. The power consumption shall be $W2=E2/t2$. During the test all hopper heaters of all ESP passes will be in ON condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature. e) Measured power consumption for one ESP pass (say ESP-A)=(W2-W1) f) Measured Electrostatic Precipitator power of one unit= Power of (ESP-A + ESP-B + ESP-C + ESP-D + ESP-E + ESP-F) 5. Guaranteed Unit Auxiliary Power Consumption of FGD system shall be taken by considering the additional pressure drop in the FGD system during FGD SO2 removal efficiency test at specified guarantee point conditions. For this purpose, difference of FGD system pressure drop during FGD SO2 removal efficiency test and that at Unit Auxiliary Power Consumption test shall be loaded as additional Auxiliary Power Consumption. 6. Generation from roof top solar during the test period shall be added to the total measured power consumption. Station Auxiliary Power Consumption The station auxiliary power consumption shall be calculated using the following relationship with design coal. $P_{Stn} = P_{au} \cdot Stn + T_L \cdot Stn$ $P_{au} \cdot Stn = \sum (P_i \times D_i)$ Where, P_{Stn} = Power consumed by the station auxiliaries $P_{au} \cdot Stn$ = Total Power Consumption, while running at 100% design load for all the auxiliaries of the station supplied by bidder. P_i = Power consumed by each station auxiliary. D_i = Duty factor to be considered for each station auxiliary. $T_L \cdot Stn$ = Transformer Losses of the station transformers and that of any other transformer associated with station auxiliary power supply system (excluding those included in Unit system like GT, UT, UAT,UST etc.) and shunt reactor supplied by the bidder for meeting the station auxiliary power supply shall be included based on work test report. Losses of transformers shall be considered based on the works test reports as per the criteria specified under Clause 1.01.07.02 (h) under the subheading Transformers.			
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	While guaranteeing the station auxiliary power consumption the bidder shall necessarily include all the station auxiliaries <u>running at full load</u> with duty factors as have been defined at the ensuing para of this chapter. The station auxiliaries that shall be running during the guarantee test for calculating " Pau. Stn " shall include but not be limited to the following: (Where duty factor is not indicated the same is to be considered as 1.0) a) Plant & Instrument air compressors & Air drying plant Power consumption of:- <table><tr><td>i) Instrument Air compressor</td><td>3 Nos.</td><td>Duty Factor =0.6</td></tr><tr><td>ii) Plant Air compressor</td><td>2 Nos.</td><td>Duty Factor = 0.33</td></tr><tr><td>iii) Air Drying plant (Heaters) (if applicable)</td><td>3 Nos.</td><td>Duty Factor =0.5</td></tr><tr><td>iv) Air Drying plant (Blowers) (if applicable)</td><td>3 Nos.</td><td>Duty Factor = 1.0</td></tr></table> Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test. b) Air Conditioning & Ventilation System Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, for the Air conditioning system of main plant building, FGD control room, ESP control room of each units, AHP control room. Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of water system control building, switchyard control building, office area in control tower. Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test. (Duty factor for power consumption of A/C equipments of office area in control tower shall be 0.5) c) FGD System <table><tr><td>i.</td><td>Not Used</td></tr><tr><td>ii.</td><td>Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries</td></tr><tr><td>iii.</td><td>Booster water pump</td></tr><tr><td>iv.</td><td>Waste water pump</td></tr><tr><td>v.</td><td>Filtrate Pump(s)</td></tr><tr><td>vi.</td><td>Belt Filter Wash Water Pump</td></tr><tr><td>vii.</td><td>Hydro-cyclone Waste Water Sump Pump and Waste Water Pump</td></tr><tr><td>viii.</td><td>all other continuous running Agitators</td></tr></table> d) Auxiliary Water System Pumps (Working Pumps) <table><tr><td>i.</td><td>Makeup (Clarified water) water pump (if applicable)</td></tr><tr><td>ii.</td><td>AC & Ventilation make-up pumps</td></tr></table>	i) Instrument Air compressor	3 Nos.	Duty Factor =0.6	ii) Plant Air compressor	2 Nos.	Duty Factor = 0.33	iii) Air Drying plant (Heaters) (if applicable)	3 Nos.	Duty Factor =0.5	iv) Air Drying plant (Blowers) (if applicable)	3 Nos.	Duty Factor = 1.0	i.	Not Used	ii.	Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries	iii.	Booster water pump	iv.	Waste water pump	v.	Filtrate Pump(s)	vi.	Belt Filter Wash Water Pump	vii.	Hydro-cyclone Waste Water Sump Pump and Waste Water Pump	viii.	all other continuous running Agitators	i.	Makeup (Clarified water) water pump (if applicable)	ii.	AC & Ventilation make-up pumps			
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	iii. FGD Gypsum wash system make-up pumps iv. DM water make up pumps v. Potable water pumps vi. Filtered water feed pumps for DM plant vii. Degassed water pump (if applicable) viii. High pressure pumps for RO based DM plant (if applicable) ix. UF feed pumps for RO based DM plant (if applicable) x. Service water pumps xi. Raw water (PT) Pumps xii. Raw water (Ash) Pumps (as applicable) e) Ash Handling Plant List of drives with corresponding weightage factors thereof for which power consumption is to be guaranteed is as follows: <table><tr><td>1.</td><td>Bottom Ash Crushers</td><td colspan="2">0.3125 for jet pump system & 1.0 for submerged scrapper conveyor system/dry type bottom ash system.</td></tr><tr><td>2.</td><td>Bottom Ash H.P. Water Pumps</td><td colspan="2">0.625 for jet pump system & 1.0 for submerged scrapper chain conveyor system/dry type bottom ash system.</td></tr><tr><td>3</td><td>Bottom ash L.P. Ash Water Pumps</td><td colspan="2">1.0</td></tr><tr><td>4.</td><td>Fly ash water pumps</td><td colspan="2">1.0</td></tr><tr><td>5.</td><td>Bottom Ash Slurry transportation pumps</td><td colspan="2">1.0</td></tr><tr><td>6.</td><td>Combined High Concentration Ash Slurry disposal pumps</td><td colspan="2">0.5</td></tr><tr><td>7.</td><td>Submerged scrapper chain conveyor/dry type bottom ash conveyors</td><td colspan="2">1.0</td></tr><tr><td>8.</td><td>(i) Fly ash conveying air compressors with air drying plant (ADP)</td><td colspan="2">1.0</td></tr></table>	1.	Bottom Ash Crushers	0.3125 for jet pump system & 1.0 for submerged scrapper conveyor system/dry type bottom ash system.		2.	Bottom Ash H.P. Water Pumps	0.625 for jet pump system & 1.0 for submerged scrapper chain conveyor system/dry type bottom ash system.		3	Bottom ash L.P. Ash Water Pumps	1.0		4.	Fly ash water pumps	1.0		5.	Bottom Ash Slurry transportation pumps	1.0		6.	Combined High Concentration Ash Slurry disposal pumps	0.5		7.	Submerged scrapper chain conveyor/dry type bottom ash conveyors	1.0		8.	(i) Fly ash conveying air compressors with air drying plant (ADP)	1.0				
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		(ii) Fly ash conveying vacuum pumps	1.0	
	9.	Transport air compressor with air drying plant (ADP)	1.0	
	12.	Coarse ash slurry transportation pumps	0.1875 for intermittent system & 1.0 for continuous system	
	13.	Transport air compressor with air drying plant (ADP) for classification system	0.40	
	f) Mill Reject System			
	Mill reject mechanical type Conveying system: Duty Factor 1.0			
	g) Coal & Biomass Handling plant, Gypsum handling plant			
	i. Total power consumption for all the equipments including auxiliaries with single stream operation at its guaranteed capacity for:			
	ii. Coal flow path (Direct stream) and one no. stacker-reclaimer, one no of yard conveyor (maximum of stacking / reclaiming modes)			
	iii. Biomass flow path			
	iv. Gypsum flow path			
	Except following.			
	- Lighting			
	- Hoists			
	- Coal sampling unit			
- Sump Pumps				
- Elevators				
- DS, DE, Ventilation, SW System, Potable water system.				
Duty factor for coal and Biomass handling plant shall be 0.5.				
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1.01.07.03	Duty factor for gypsum handling plant shall be 1.0 The above list is not comprehensive and only indicative. Bidder shall furnish a list of equipment to be covered under station auxiliary system, which is to be considered under station auxiliary power consumption. These are subject to Employer's approvals. h) Transformers NOTE: Transformer losses (TL) shall be considered as per following (as applicable)- - GT - 100% no load loss, 54% of Copper losses & 100% Cooler Loss. - ST- 100% no load loss, 8% of Copper losses & 9% Cooler Loss. - UT – 100% no load loss, 52% of Copper losses & 50% Cooler Loss. - Aux/ LT Outdoor/ LT Indoor Transformer: 100% no load loss & 25% of Copper losses - Reactor – losses at rated voltage i) ECW system Independent ECW system for common station auxiliaries (if provided). Total power consumption of all equipments (excluding envisaged standby ones) shall be included. PG Test Procedure for Rooftop Building The test shall be done for each location having different type of inverter The month wise target Performance Ratio (PR) shall be determined during engineering stage based on the bidder's technical proposal. The target PR shall be supported by energy estimation tool e.g. PVSyst, PVSol. The value of PR shall be determined as follow $PR (\%) = \frac{\text{AC Yield(KWh)}}{\text{Installed Capacity(kWp)} \times \text{Measured Global Inclined Insolation(kWh/m}^2\text{ during the period)}} \times 100$ The assumption for calculating PG Tests are as follow - Temperature as per latest version from PVSyst - Soiling loss=3% - LID=2% - Cable loss=1.5% - Thermal Loss Factor (Uc, Uv)= Uc-24 Watts/m2-K Uv-2.0 Watts/m2-K - PAN and OND file has to be furnished by the bidder. In case same is not available, PAN and OND file of equivalent product may be taken. 1. For the purpose of measuring Global horizontal Insolation (GHI), pyranometer shall be installed on returnable basis, mounted at the plane of the module, free of cost.	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 25 OF 76
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	2. Bidder also install Single Quadrant type of 1.0 accuracy energy meter on all the location(s) based on mutual understanding. 3. In case 1.0 class energy meter is available in inverter, same shall also be accepted. 4. Both the additional supplied items i.e. pyranometer and energy meter shall be returnable basis and free of cost. 5. Measuring instruments to record on site data will include a pyranometers with sensitivity of $7\mu V/(W/m^2)$, temperature sensor, signal converter. 6. The Bidder will be responsible to conduct the PG test only after achieving the physical completion and synchronization of the plant and complying the relevant requirements from utility. 7. If failed to achieve the guaranteed performance levels, the contractor will at its own cost rectify all the defects identified during the test and take necessary steps/efforts to pass the PR test within the stipulated time span. Subsequent to rectification the PR will be restarted. 8. The test shall be conducted for a period of 60 minutes having GHI more than 600 W/m² and the Measured PR shall be determined as per the actual generation. In case the measured PR is less than target PR, then 1. Contractor has to install additional module string equivalent to the percentage shortfall of PR. Or 2. In case there is no scope of any additional of module string, equivalent amount shall be adjusted from the contract value as 3. Contract Value means total contract value for "Solar PV Portion". Applicable $\times$ Contract Value $LD = \frac{\text{Target PR of the Month} - \text{Measured PR}}{(\text{Target Prof the Month})}$			
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1.02.00	<u>GUARANTEES UNDER CATEGORY - II</u> Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 61672-1 & 2 (latest edition) Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.			
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1.03.00 1.03.01 1.03.02	<u>GUARANTEES UNDER CATEGORY – III</u>								
	The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:								
	Not used								
	Steam Generator and Auxiliaries								
	Category-III Guarantees of this sub-section for various systems/ equipment for steam generator and auxiliaries shall be based on and demonstrated corresponding to ambient air condition of 27 deg. C temperature & 60% RH.								
	(i) Coal Pulverizer capacity at rated fineness								
	Performance testing shall be conducted on coal pulverizers toward establishing their guaranteed capacity meeting the specification requirement. Corrections may be applied for the variation in coal characteristics i.e. HGI & Total Moisture of test coal with respect to specified design coal.								
	Capacity demonstration test shall be carried out for the following conditions:								
	(a) The Contractor shall demonstrate capacity output on one coal pulverizer (of Employer's choice) of each Steam Generator for establishing its capacity at 100% mill loading, at rated pulverized coal fineness with specified design coal with new set of grinding elements.								
	(b) Further, Contractor shall also demonstrate capacity output on four coal pulverizers (of Employer's choice) of each Steam Generator, not less than the 90% of guaranteed value of (a) above, at 100% mill loading with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier.								
	Capacity test as mentioned at a & b above shall be demonstrated at the following conditions occurring simultaneously during testing:								
	<table><tr><td rowspan="2">Rated pulverised coal fineness</td><td>i. not less than 75% through 200 mesh and</td></tr><tr><td>ii. not less than 99% through 50 mesh screen</td></tr><tr><td>Test Coal</td><td>Any available coal from the specified range</td></tr></table>				Rated pulverised coal fineness	i. not less than 75% through 200 mesh and	ii. not less than 99% through 50 mesh screen	Test Coal	Any available coal from the specified range
Rated pulverised coal fineness	i. not less than 75% through 200 mesh and								
	ii. not less than 99% through 50 mesh screen								
Test Coal	Any available coal from the specified range								
	In case the Contractor successfully demonstrates the guaranteed capacity of coal pulverizers as stated above, remaining coal pulverizers of corresponding steam generator will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the coal pulverizers not meeting the guarantee test, all the coal pulverizers of corresponding steam generator will have to be tested by the contractor to demonstrate guaranteed capacity.								
	During the demonstration of the mill capacity output, manufacturer's operating instructions will be followed and mill will be operated with the specified range of coals without any such readjustment that requires a shutdown of the mill or reduction of the load and/or any replacement of any mill wear parts.								
	For the purpose of testing to demonstrate the capacity, if HGI (grindability) and total moisture vary from those given in coal characteristics, the above pulverizer								
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	measured capacity shall be corrected using the capacity correction curves furnished by the Contractor and approved by the Employer. HGI versus coal pulverizer capacity curve shall be furnished for HGI variation upto a value above which the capacity remain constant. (ii) Furnace Exit Gas Temperature (FEGT) The Contractor shall conduct a comprehensive thermal performance test (TPT) (on one unit only). Through such TPT the Contractor, by indirect measurement, shall demonstrate that the Furnace Exit Gas Temperature (FEGT) does not exceed the specified maximum temperature limit, with coal pulverizer combinations to Employer's choice and all other requirement in line with sub-section- A-01 ,Part-B(Mechanical) of Technical Specifications. The demonstration shall be done by backward calculations method, after having measured/tested/calculated the economizer outlet gas temperature (average), excess air (average), unit heat load (based on turbine flow and reheater flow), characteristics of coal being actually fired during testing, heat absorption in different stages of heat transfer equipments (based on steam/water temperature and pressure measurements) etc. FEGT for the specified design and worst coals shall be calculated using the measured FEGT (with test coal) as above and using computer modeling technique for necessary conversion of the results to the specified design and worst coals. The FEGT demonstration using computer modeling technique shall involve following steps: - Development of a computer field model (FM) (backward) using above measured/computed field data. This will be used to calculate the surface effectiveness factor (SEF) for each of heat transfer banks including furnace water walls with test coal. - The above field model shall have to be validated by various tests (loads, coal pulveriser combination etc. with test coal) to ensure SEFs for each bank are consistent (within $\pm 5\%$) for all tests. - Using above SEFs, for each heat transfer bank contractor's original boiler design model will be changed to make it "Lara STPP-II specific". - The validity of the above model shall be checked for each test by feeding the test coal both from backward direction FM and the calibrated "Lara STPP-II specific" model as per step-(c) above. The model validity is established if the results for flue gas temperature profile in the boiler, zonal assumptions etc. are identical in both the 'BACKWARD' and 'FORWARD DIRECTION'. - The validated "Lara STPP-II " model shall have "Fuel Switching" capability i.e. it shall be able to appropriately vary the furnace absorption with changes in the coal properties. Validation of the above fuel switching capability will also have to be established to the satisfaction of NTPC. - Having established and demonstrated Fuel Switching capability, the contractual FEGT can be demonstrated by using the site specific calibrated model as per step-(d) and plugging in the specified coal(s). The detailed procedure and the correction curves for the above test shall be to Employer's approval. The contractor through thermal performance test (TPT) as per above shall also demonstrate that the flue gas temperature (Actual/MHVT values) at the entry and exit of various boiler heating surfaces and also the variations across the cross section perpendicular to gas flow do not exceed the values indicated in the data			
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	sheets for 100% TMCR (800 MW). (iii) Run back capabilities Refer Sub section-G-01, Part-B (Mechanical), Section VI of Technical Specifications. (iv) Air Preheater air in leakage Contractor shall demonstrate that the maximum drift in air leakage do not exceed the guaranteed or specified value (whichever is lower) as per Sub section-A-02, Part-B (Mechanical), of Technical specifications. Above requirement needs to be complied with recirculation of flue gas from downstream of ESP. (v) Temperature of tubes at steam generator water wall outlet: The contractor shall guarantee the following temperature values pertaining to steam generator water wall tubing: a) Maximum tube to tube temperature differential between any two adjacent tubes. Water wall tube to tube temperature will be limited to 80 Deg. C. The same shall be further substantiated by the values as achieved by the contractor in its similar reference steam generator which are operating successfully. b) The maximum deviation of temperature of any tube w.r.t. to the average temperature of all the tubes. The tube metal temperatures shall be measured at the intermediate header (spiral to vertical / riffler tube wall to vertical plain tube wall changer over), if provided, and outlet of the water walls (end of furnace) at minimum once through load of the steam generator with firing range of coals along with oil firing. The same shall be demonstrated during plant operation by measuring the tube temperatures by affixing thermocouples as specified in sub section A-02 of Part B of the technical specification. (vi) Water wall corrosion/erosion rate: The contractor shall demonstrate that the average thinning in the water wall tubes in the furnace due to corrosion, erosion etc. does not exceed the specified value as per Sub section-A-02, Part-B (Mechanical), of Technical specifications. The same shall be demonstrated by calculating the average thinning in the water wall tubes in the furnace by measuring the tube thicknesses between two overhauls at about 1500 locations arranged in a grid around the furnace. The areas to be covered under the grid shall include burner zone extended upto the OFA Nozzle location. (vii) NOx Emissions at SCR inlet Contractor shall demonstrate that over entire range of steam generator operation from 40% to 100% TMCR load and for whole range of specified coal(s), the total NOx (from thermal as well as fuel) at the inlet of SCR shall not exceed 325 mg/Nm³ at 6% oxygen (O₂) content in flue gas on dry gas basis. Note: - SNCR system will not be operated during this demonstration in case of Hybrid (SCR+SNCR) system (This 'Note' is applicable if during demonstration hybrid system is implemented).			
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1.03.03	Flue Gas Desulphurisation System (i) Not Used (ii) Not Used (iii) Not Used (iv) Pressure Drop across FGD The contractor shall demonstrate that the total pressure drop in the gas path across the FGD System shall not exceed the guaranteed values for the range of coal and loads specified in the Technical Specification (v) Vacuum Belt Filter Capacity Contractor shall demonstrate the capacity of the Vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification. (vi) Gypsum Purity The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for the range of specified coal(s) and based on CaO content of 51% in limestone. (vii) Waste Water The Contractor guarantees that the maximum purge flow rate to waste water treatment system from FGD system for 2x800 MW units shall be less than 20m³/s averaged over a 24 hour period for a the range of specified coal(s). (viii) Mist Outlet Droplet Content The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20 mg/Nm3 at absorber outlet measured over a period of 24 hrs continuous operation. Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.			
1.03.04	Air Conditioning & Ventilation System (i) Air Conditioning System: A. Following shall be demonstrated at Shop 1) Capacity and discharge pressure of chilled water pumps, condenser water pumps at its rated duty point. 2) Capacity and static pressure of AHU fans at its rated duty point. B. Following shall be demonstrated at Site 1) Capacity (TR) of water cooled chillers for A/C system of Main Plant Area (TG			
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Air Conditioning & Ventilation System

(i) Air Conditioning System:

A. Following shall be demonstrated at Shop

- Capacity and discharge pressure of chilled water pumps, condenser water pumps at its rated duty point.
- Capacity and static pressure of AHU fans at its rated duty point.

B. Following shall be demonstrated at Site

- Capacity (TR) of water cooled chillers for A/C system of Main Plant Area (TG

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	Building) and A/C system of ESP/AHP/FGD control rooms. 2) Capacity (TR) of Air cooled condensing (D-X) unit for A/C system of water system control building, switchyard control building, office area in control tower. 3) Guaranteed room conditions during summer for all the Air conditioned areas. 4) Parallel operation of chilled water and condenser water pumps. 5) Vibration level of chillers, condensing units, centrifugal fans of AHUs and all pumps. (ii) Ventilation System A. Following shall be demonstrated at Shop 1) Capacity and discharge pressure of pumps of air washer units and UAF units at its rated duty point of Ventilation system. 2) Capacity and static pressure of centrifugal fans, roof exhausters at its rated duty point of Ventilation system. B. Following shall be demonstrated at Site 1) Parallel operation, Vibration level of centrifugal fans & pumps of Ventilation system. 1.03.05 Not Used 1.03.06 The parameters/capabilities to be demonstrated for following systems/ equipments of Raw Water Pump House and ACW pump house shall be: 1.03.06.01 (i) GANTRY Cranes: Over load tests, travel and hoist speed checks as per relevant Indian standards IS (latest edition). (ii) Electrically operated hoist etc.: Over load test, Travel and speed checks, functional and performance tests as per relevant Indian standards IS (latest edition). 1.03.07 COAL & BIOMASS HANDLING PLANT, GYPSUM HANDLING PLANT 1.03.07.01 SYSTEM FACILITIES In accordance with Section GTR placed at Part-C after commissioning and before handing over, the entire plant shall be subjected to System Trial Operations.			
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1.03.07.02	The duration of Trial Operations of the complete equipment shall be fourteen (14) days with minimum twelve hours daily operation. For successful Trial Operation, the trial shall necessarily include steady operation of the plant at its rated flow path capacity for at least one hour duration per day on an average. PERFORMANCE REQUIREMENTS The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipments covered in the specification.		
1.03.7.02.1	GUARANTEES The Contractor shall furnish a declaration in the manner prescribed and included in the relevant Attachment of Section-VII for the following guaranteed parameters which shall attract levy of liquidated damages for shortfall in Performance. Capacity in T/Hr (equivalent to 100% of rated) of conveyor system including the intermediate equipments for each of the two parallel conveyor streams separately or any combination thereof to be tested in the following flow path operations. (i) Flow Path IA (Direct Stream): Paddle feeder taking feed of incoming coal from track hopper and discharging crushed coal into last bunker of Unit #2 through travelling tripper mounted on Bunker Conveyor including all intermediate Conveyors and equipments. (ii) Flow Path IB (Stacking Stream) : Paddle feeder taking feed of incoming coal from track hopper and stacking crushed coal in stockyard using yard conveyor with stacker/reclaimer station farthest from yard conveyor tail end and boom conveyor at highest angle including all intermediate equipments. (iii) Flow Path II(Reclaiming Stream): Reclaiming coal from stockyard using yard conveyor with stacker- reclaimer at farthest position from stacker conveyor head end, with the boom conveyor at its lowest position and feeding last bunker of Unit #2 through travelling tripper on bunker conveyor including all intermediate equipments. (iv) Flow Path III (Biomass stream):		
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1.03.08	Bulk receiving unit/Box Feeder/Surface Feeder etc taking feed of incoming Biomass and discharging Biomass into Storage silos/Bin which in turn feeds Biomass into Coal Conveyors through Biomass Conveyors including all intermediate equipments. <u>Bidder shall also demonstrate the guaranteed tipping rate of Truck Tipplers.</u>											
	(v) Gypsum flow path IV: Gypsum conveyor taking feed from gypsum dewatering unit and feeding to gypsum storage shed through travelling tripper provided on last conveyor. Further for the purpose of Guarantee tests all left out Conveyors/bucket elevators not appearing above along with all associated equipments shall also be considered.											
	Major Equipment Capacity Guaranteed capacity in T/Hr of the following: Paddle feeders Crushers (Coal) Stacker cum Reclaimer Vibrating feeder (Coal) Travelling Tripper (Coal & Gypsum) Performance tests and the procedure for performance testing of complete coal & Biomass handling plant and Gypsum handling plant shall be as per Annexure-II.											
	Mill Reject System Continuous effective discharge and conveying at the rated capacity of the mill rejects without spillage , in the system.											
1.03.09	Ash Handling Plant											
<table><tr><td>S. No</td><td>DESCRP TION</td><td>PERFORMANCE GUARANTEE PARAMETERS</td><td>REMARKS</td></tr><tr><td colspan="4"> </td></tr></table>					S. No	DESCRP TION	PERFORMANCE GUARANTEE PARAMETERS	REMARKS				
S. No	DESCRP TION	PERFORMANCE GUARANTEE PARAMETERS	REMARKS									
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	A.	Bottom ash system, APH ash, SCR (design only), Duct Hopper (if applicable)	(i) In case bidder offers intermittent type bottom ash removal system employing triple V type water impounded hopper and jet pump system shall be guaranteed to meet following performance: Continuous effective extraction, crushing and conveying of bottom ash generated during various modes of boiler operation to the ash slurry sump and the continuous effective pumping of slurry from this sump to Dewatering Bins. The extraction of bottom ash shall be done twice in every shift of eight (8) hours. Ash from each individual hopper section in a unit will be removed in parallel. Bottom ash and (APH Hopper + SCR Hopper + Duct Hopper) Ash from each unit shall be removed sequentially to the bottom ash slurry sump in case of Feeder Ejector employed for Ash removal from APH and Duct Hoppers.Total time for evacuating four (4) hours of ash collection from all the hoppers of (APH +SCR +Duct Hoppers) of a unit corresponding to collection rates specified shall not exceed 45 mins (including change over time. The total time for evacuating four (4) hour collection of bottom ash from a unit corresponding to collection rates specified shall not exceed 85 minutes including five (5) minutes time required for starting, stopping, sequential change over from one unit to second unit and water flushing of the system for the following two conditions and with 25 mm wear on the diameter of the throat section of the jet pumps: 1) Maintained water level mode. 2) Complete draw down mode by totally emptying the hopper of all water and ash with the make-up valve closed.	Continuous effective conveying system shall be established by no stagnation of ash or slurry at any point in the complete system.
			(ii) In case the Bidder offers continuous type bottom ash removal system employing submerged scrapper chain conveyors, the system shall be guaranteed to meet the following performance. Continuous effective discharge, crushing and sluicing of bottom ash generated during various modes of boiler operation to the bottom ash slurry sump continuous effective discharge of APH, Duct Hoppe ash to the bottom ash slurry trench and the continuous effective pumping of mixed slurry from this sump to the main slurry sump in ash slurry pump house for onward effective pumping from main sump	Continuous effective mixing and sluicing shall be established by no stagnation of ash or slurry at any point in the complete system.
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			to the Dewatering Bins. Bottom Ash along with APH & Duct Hopper ash removal of the two units shall be done in parallel and continuously. Continuous normal conveying capacity ----- T/hr of the submerged scrapper chain conveyors with the linear speed of chain not exceeding 2.0 m/min. (guaranteed extraction rate). Dead start capability of submerged scrapper chain conveyor i.e. it shall be able to start and discharge the bottom ash with water filled trough full of bottom ash upto maximum water level.	
	B.	Economiz e + Eco duct Hopper (if applicable) ash handling system	In case of wet type Intermittent type bottom ash removal system, the ash collected in economiser hoppers will drop continuously into bottom ash hopper through vertical pipes, flushing connection, flushing equipment in form of slurry. From bottom ash hopper, the economiser ash shall be evacuated and transported to ash slurry sump of bottom ash slurry pump house along with bottom ash. In case of wet type continuous type bottom ash removal system the ash collected in economiser hoppers will be dropped into sluicing trench through flushing equipment. From sluicing trench, the economiser ash slurry will be conveyed upto the ash slurry sump of bottom ash slurry pump house along with bottom ash slurry and the slurry will be transported to Deawatering bins by bottom ash slurry disposal pumps. Economizer ash removal from both units shall be done in parallel and continuously.	The continuously effective conveying of ash as stated above shall be established by no stagnation of ash or slurry at any point in the complete system and will all interlocks. Protections working satisfactorily.
	C.	Fly ash extraction and conveying system	1) Continuous effective conveying of fly ash from all fly ash collection hoppers in each unit i.e. ESP hoppers) generated during various modes of boiler operation upto buffer hoppers/classifier silos and Continuous effective transportation of fly ash from buffer hoppers/classifier silos in each unit either to HCSD cum main ash storage silos and	Continuous effective extraction and conveying system shall be established by no stagnation of ash or slurry at any point in the complete system.
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			Continuous effective pumping of ash slurry to slurry disposal area. The fly ash collected in each unit in every shift of eight (8) hours corresponding to specified ash collection rates shall be removed in six (6) hours. Fly Ash removal from the two units shall be done in parallel and continuously. 2) Parameters of blowers/ compressors/ vacuum pumps including power consumption when operating at the rated capacity and pressure corresponding to the above conditions (shop test).	
	D.	Water pumps for ash handling (ash water, seal water, flushing water, ash conditioning, wash water, sump drain pumps, etc).	Power consumption at motor input terminal (kw) of each pump when operated at rated capacity and head (to be tested and proven at shop).	
	E.	Combined high concentration Ash slurry disposal system	Rated capacity, head and power consumption at motor input terminal of each high concentration ash slurry disposal pump to be tested and proved at shop applying correction for slurry density.	
	F	Weigh bridge below storage silos	Bidder to demonstrate weighment loaded ash truck / Wagons	
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	G	Classifiers	Bidder to demonstrate efficiency of the classification system. The classified fine ash shall have a size of (-) 45 microns (95%).	
1.03.10	POWER CYCLE PIPING			
	Actual hanger readings, under cold and hot condition (at rated parameters) to match with those of design cold and hot hanger readings for MS/CRH/HRH/ HP & LP bypass piping system.			
1.03.11	Not used			
1.03.12	Fire Detection and Protection System			
	a) Following shall be demonstrated at Shop			
	i) Capacity, Head & Power consumption of fire water pumps.			
1.03.13.01	CW Pumps			
	a. Each pump shall be tested at shop/ site (as applicable) for capacity, head, and power consumption. Current, Voltage, Motor input Power, Frequency, Speed, Bearing/ Motor winding Temperature, Vibration and noise level of pumps and drives and parallel operation (as applicable) without hunting & abnormal noise and with load sharing within 10% of each other at the rated duty point of pumps shall be demonstrated at site as a part of Performance & Guarantee test.			
	b. Shop tests conducted with the actual motor shall be considered to determine the guaranteed performance parameters of Flow, Head, Efficiency and Power Consumption. During the shop test no negative tolerance in the guaranteed capacity, head and efficiency of the pump shall be allowed.			
1.03.13.02	Plate Heat Exchanger (ECW system)			
	Heat transfer coefficient determining the performance under design heat load and inlet & outlet temperatures of the plate type heat exchangers on the primary and secondary side to be demonstrated at site. Further, pressure drop across the plate type heat exchanger on the primary and secondary water circuit to be demonstrated at site.			
1.03.14	PRE-TREATMENT PLANT			
	A) CLARIFICATION PLANT			
	1. Each clarifier unit of PT-CW system & PT-DM system shall be guaranteed for design effluent capacity meeting the effluent quality as mentioned below.			
	2. Effluent quality at the outlet of clarifiers (PT-CW system & PT-DM system) shall be guaranteed for the following :			
	i) Organic Matter : Less than 0.05 mg/l (see note below)			
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	ii) Iron Content : Less than 0.3 mg/l iii) Turbidity : Less than 10 NTU Note: Organic matter shall be tested as per KmnO_4 method. 3. Each clarifier shall be tested to demonstrate the above mentioned Guarantees at site under P&G test. In addition, demonstration of satisfactory working of all the clarifiers, its drives, scrapper mechanism, operation of sludge blow-off etc, shall be demonstrated. FILTRATION PLANT 1. Each Gravity filter for PT-DM system shall be guaranteed for design capacity meeting the effluent quality below with one backwash and air scouring in not less than 24 hours or more. Backwash water requirement not to exceed 2% of the water treated between two successive backwashes. 2. Each Gravity filter for PT-Potable system shall be guaranteed for design capacity meeting the effluent quality below with one backwash and air scouring in not less than 24 hours or more. Backwash water requirement not to exceed 2% of the water treated between two successive backwashes. 3. Turbidity at outlet of each gravity filter of PT-DM and PT-Potable system shall not exceed 2 NTU with inlet turbidity of up to 10 NTU. 4. Each filter shall be tested to demonstrate the above mentioned Guarantees at site under P&G test. In addition, demonstration of satisfactory working of all the filters, its backwashing operation, operation of various valves etc shall be demonstrated by Contractor. TUBE SETTLERS/LAMELLA CLARIFIERS 1) Each Tube Settlers/Lamella Clarifier shall be guaranteed for design effluent capacity meeting the effluent quality as mentioned below. 2) Effluent quality at the outlet of Tube Settlers/Lamella Clarifier shall be guaranteed for the following: a) Effluent Turbidity : 10 NTU at design flow b) Effluent Oil & grease : 5 ppm (maximum) 3) Each Tube settler/Lamella clarifier shall be tested to demonstrate the above mentioned Guarantees at site under P&G test. In addition, demonstration of satisfactory working of settler/clarifiers, operation of sludge blow-off etc shall be demonstrated by Contractor. COAL SLURRY SETTLING POND Guaranteed effluent TSS at the outlet of each Coal Slurry Settling Pond during storm water (design) flow condition of 1000Cu.M/hr shall be 100 ppm (max.) and particles of size 50 microns & above shall be arrested in the CSSP. Testing shall be carried out tested to demonstrate the above mentioned Guarantees at site under P&G test. ClO_2 PLANT			
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1.03.15	a) Each ClO₂ generator for both PT & CW - Chlorination system shall be guaranteed for the design capacity. b) Each chlorine di-oxide generator shall have controllable capacity range of 10% - 100% or better. c) Contractor shall guarantee minimum 90% yield of ClO₂ generation as per US-EPA method. d) Quantity of NaClO₂ (in kg) for production of per kg of ClO₂ in the generator shall be guaranteed.			
	DM PLANT (ION EXCHANGE DM PLANT) A) ACTIVATED (AC) CARBON FILTERS a) Each filter shall be guaranteed for the design capacity. A.C. filter shall be backwashed once in 24 hours. b) Free chlorine content in effluent water shall not be detectable as per latest ASTM procedure. c) Organic matter in the effluent water shall be below detectable level. d) Turbidity in the effluent water shall be less than 0.5 NTU. B) ION-EXCHANGER UNITS a) Each ion exchange unit shall be guaranteed for design capacity meeting the effluent quality as mentioned below. However, each ion exchange unit shall be guaranteed for a Design flow (net) after meeting the water requirement for various regeneration steps. Service Cycle (Period between two successive regenerations) shall be 12 hours for each stream of cation and anion exchangers and 108 hours for each MB exchanger. Net output from each cation-anion unit between two regenerations shall not be less than Design flow (net) x 12 m³/hr and for mixed bed Design flow (net) x 108 m³/hr of treated water. b) Chemical consumption of the ion exchange units shall be guaranteed against the regeneration level employed and resin volume provided. Total time requirement for regeneration and backwash operation for each stream (AC filter, cation, and anion) shall not exceed four (4) hours. With mixed bed in regeneration, total time of regeneration of stream shall not exceed six (6) hours. The guaranteed values of chemical consumption shall hold good for chemical conforming to following: • HCl - As per IS: 265 Tech. Grade • NaOH – As per IS: 252 Pure Grade available in Flakes or lye form c) Effluent from the mixed bed unit shall be guaranteed to meet the following requirements, at rated capacity, throughout the period between two successive regenerations: i. Reactive Silica not to exceed: 0.01 ppm as SiO₂ ii. Iron as Fe: Not detectable as per ASTM (ASTM-D-1068)			
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1.03.16	iii. Total Hardness: Not detectable iv. pH Value: 6.8 – 7.3 v. Conductivity: Not more than 0.1 micromhos/cm at 25 deg.C. d) Effluent from the anion exchanger shall be guaranteed as follows at rated capacity throughout the period between two regenerations: i) Reactive silica not to exceed: Not to exceed 0.2 ppm as SiO₂ ii) Conductivity at 25 deg.C : Not more than 10 micro mhos/cm e) Sodium leakage through cation shall not exceed 2 ppm as CaCO₃ throughout the period between two regenerations. f) Effluent from degassifier should not have CO₂ content more than 5 ppm. g) Life of cation resin shall be minimum five (5) years and life of anion resin shall be minimum three (3) years. C) POLSHING UF SYSTEM 1. Net permeate flow rate from each UF train shall be guaranteed for design capacity meeting the effluent quality as mentioned below. 2. Colloidal Silica shall be ≤ 0.01ppm as SiO₂. 3. SDI shall be limited to 3. 4. Life of Ultrafiltration membranes shall be guaranteed for minimum five (5) years. 5. For the guaranteed water quality and the permeate water capacity, UF plant shall give an undiminished recovery of 92% up to the end of 5 years of operation with replacement guarantee of membrane elements. DM PLANT (UF+RO+MB PLANT) The bidder/his sub-vendor shall guarantee that the equipment offered shall meet the ratings and performance requirement stipulated for various equipment covered in this specification. Tests shall be carried out to prove the guaranteed parameters specified here under:- A) All pumps, blowers, degasser & filters shall be guaranteed for capacity, total head and power consumption. B) Effluent from Degasser tower should not have CO₂ content more than 5 ppm. C) Filtration Capacity of Cartridge (PT system of RO) filters shall be guaranteed meeting the effluent quality and the same shall not be less than specified capacity. D) ULTRAFILTRATION (UF) SYSTEM 1. Net permeate flow rate from each UF train shall be guaranteed for design capacity meeting the effluent quality as mentioned below.			
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1.03.17	2. SDI shall be limited to 3. 3. Life of Ultrafiltration membranes shall be guaranteed for minimum five (5) years. 4. For the guaranteed water quality and the permeate water capacity, UF plant shall give an undiminished recovery of 92% up to the end of 5 years of operation with replacement guarantee of membrane elements. E) REVERSE OSMOSIS (RO) PLANT 1. Net permeate flow rate from each RO train shall be guaranteed for design capacity meeting the effluent quality as mentioned below. 2. TDS of RO permeate shall not be more than 20 ppm at 36 deg C. However, the mixed bed unit (MB) at downstream of RO plant shall be designed for inlet TDS of not less than 25 ppm plus 5 ppm of CO₂. 3. For the design water quality and the permeate water capacity, RO plant shall give an undiminished recovery of 85% upto the end of 3 years of operation with replacement guarantee of membrane elements. 4. Performance of Cleaning, Flushing System arrangement shall be demonstrated. 5. Life of RO membranes shall be guaranteed for minimum three (3) years. 6. For power guarantee purpose, RO High Pressure Pumps shall be designed at 20 deg C. F) MIXED BED UNITS Effluent from the mixed bed unit shall be guaranteed to meet the following requirements, at rated capacity, throughout the period between two successive regenerations: 1. Reactive Silica not to exceed: 0.01 ppm as SiO₂. 2. Colloidal Silica shall be < 0.01 ppm as SiO₂. 3. Iron as Fe: Not detectable as per ASTM (ASTM-D-1068) 4. Total Hardness: Not detectable 5. pH Value: 6.8 - 7.3 6. Conductivity: Not more than 0.1 micromhos/cm at 25 deg.C. 7. Mixed Bed shall be regenerated after minimum 30 hours of operation followed by regeneration period not exceeding 6 hours. 8. Life of cation resin shall be minimum five (5) years and life of anion resin shall be minimum three (3) years. CW Chemical Treatment Plant			
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	(1) The bidder shall guarantee that the program offered shall meet the performance requirements stipulated for CW System. Also, the bidder shall demonstrate the guaranteed chemical consumption proposed in the bid, during the contract period. (2) For the purpose of verifying the guarantees on scale, a deposit monitor/test heat exchanger/fouling monitor shall be provided by the bidder stimulating the condenser operating conditions. The deposit monitor shall be weighed in new and clean condition and then weighed again on monthly basis and after completion of the test period. Prior to commencement of treatment program and after chemical cleaning of condenser tubes, the fouling factor shall be calculated for each condenser of 2 x 800 MW units. The fouling factor shall also demonstrate the cleanliness of condenser tubes by visual examination of the same. (3) Corrosion coupons reflecting the metallurgy of the system components shall be supplied and installed by the contractor to measure guaranteed corrosion value and corrosion rate shall be determined based on observations on monthly basis after completion of six months. (4) For the purpose of verifying bio fouling in circulating water system, a bio fouling monitor or bio film activity monitor shall be provided by the bidder. The bio fouling shall be determined based on observation on monthly basis and after completion of six months. (5) Guarantee Values of Scale, Corrosion, Fouling & Bio Fouling a) Cumulative Corrosion Rate on Mild Steel < 3 mils/year b) Cumulative Corrosion Rate on Stainless Steel < 0.1mils/year c) Cumulative Corrosion Rate on Cu/Ni < 0.3 mils/year. d) Cumulative Scaling Rate of Internal Tube Surface Area of Condenser <15mg/dm²/year e) Fouling Factor: Deterioration in Heat Transfer Coefficient shall not be more than 5% of the original value just before commencement of the treatment program. f) TVC (Total Viable Count) (Micro Biological Counts) < 1.2 x 100000 counts/ml of circulating water. g) SRB (Sulphate Reducing Bacteria) <100 organisms/100 ml of circulating water. Bidder shall guarantee the above design parameters in the circulating water system of all the Units of the project.			
1.03.18	CONDENSATE POLISHING PLANT Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations (as defined elsewhere).			
1.03.19	Pumps (Equipment Cooling Water system, Auxiliary Water system, Pre-treatment plant, DM Plant & Condensate Polishing Plant) a) Capacity, head, and power consumption of all the pumps at the rated duty point (to be demonstrated and proved at shop with the respective job motors) and to operate in			
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	accordance with the approved pump characteristic curves. During the shop test no negative tolerance in the guaranteed capacity, head and efficiency of the pump shall be allowed. b) Current, Voltage, Motor input Power, Frequency, Speed, Bearing/ Motor winding Temperature, Vibration and noise level of pumps and drives and parallel operation (as applicable) without hunting & abnormal noise and with load sharing within 10% of each other at the rated duty point of pumps shall be demonstrated at site as a part of Performance & Guarantee test.	
1.03.20	AIR COMPRESSOR UNIT a) Following shall be demonstrated at shop: i) Capacity and discharge pressure of each air compressor. b) Following shall be demonstrated at site: i) Parallel operation of air compressors ii) Dew point of air at the outlet of air drying plants of instrument air compressor. iii) Pressure drop across the air drying plants of air compressors. iv) Vibration level of air compressors, blowers of air drying plant	
1.03.21	The parameters/capabilities to be demonstrated for following systems/ equipment's shall be: (i) EOT Cranes: Over load tests, travel and hoist speed checks as per relevant Indian standards IS (latest edition). (ii) HOT Cranes, Monorails etc.: Over load test, Travel and speed checks, functional and performance tests as per relevant Indian standards IS (latest edition). (iii) Butterfly valves: - The functioning of various Butterfly valves, opening and closing operation as per control logic, accumulator capacity of hydraulic operated valves etc. shall be demonstrated as per the approved design document.	
1.03.22	Passenger & Goods Lift of Various Areas Over load tests, travel and hoist speed checks, functional & performance tests	
1.03.23	(i) Performance Guarantee on Steel Helical Springs and Viscous Dampers for Machine Foundations The contractor shall guarantee the performance of the Steel Helical Springs and Viscous Dampers, to be provided by him for various machine foundations as specified in detailed technical specification, for a period of 24 months from the date of commissioning of each machine. For TG foundation, TDBFP & MDBFP & PA/FD/ID Fan foundations,, in case Alternative-2 (Open Foundations) are adopted by the bidder, then bidder has to furnish extended warranty of Five Years for satisfactory Static & dynamic performance of the respective foundations. (ii) Performance Guarantee on Acid / Alkali Resistant Linings & Anti-Weed Treatment The contractor shall furnish a performance guarantee for the acid/ alkali resistant linings and anti-weed treatment, as specified in detailed technical specification, for a period of three years from the date of completion of work or date of handing over, whichever is later. (iii) Performance Guarantee on HDPE Liner system of Raw water reservoir The contractor shall furnish a performance guarantee for the HDPE liner system to	
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	be provided by him for use in raw water reservoir, as specified in detailed technical specification, for a period of five years from the date of completion of work or date of handing over, whichever is later.			
	(iv) Any defect observed during the guarantee period shall be made good by the contractor by re-carrying out/ replacing or by rectifying (if the defect is localized) the acid-alkali resistant linings, the anti-weed treatment and HDPE liner, to the entire satisfaction of the Employer without any extra cost to the Employer.			
1.03.24	For all other equipment included in the scope of supply of the bidder but not covered above, the demonstration tests to be carried out shall be mutually finalized between contractor & Employer after award of contract.			
1.03.25	Unit Load Ramp rate capability test: Demonstration of $\pm 3\%$ per minute ramp rate for 50% to 100% load range and minimum $\pm 1\%$ per minute below 50% load to minimum boiler once through load, maintaining the parameters within prescribed limits as defined in closed loop control system requirements (Refer clause 1.03.26.02).			
1.03.26	Control & Instrumentation System Requirements			
	(DDCMIS SYSTEM GUARANTEE REQUIREMENTS)			
	These guarantee requirements shall be demonstrated before COD. During demonstration of these guarantees, control system and process experts of both QSGM and QSTGM shall be present at site and participate fully in the demonstration of PG test.			
1.03.26.01	The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:			
1.03.26.02	Performance Requirement of the Closed Loop Control System			
	(i) The closed loop Control System shall provide automatic control of the plant for full applicable operating range of the unit and shall provide a unit operating turndown ratio of not less than six to one. The closed loop Control System shall permit the performance of the dynamic load tests (ramp test, steady state test & step tests) while maintaining safe furnace conditions, major process parameters and without endangering other equipment. All tests will be performed with the system in automatic mode: (a) Drop load from 50% of full load upto boiler minimum once through load at a rate such that actual unit load ramp rate of 1% per minute is achieved without causing deviation in process variables and vice versa. (b) Drop load from full rated output to the lowest runback limit, at a rate corresponding to the fastest run back rate (c) Drop load from 100% to 50% of full load at a rate such that actual unit load ramp rate of 3% per minute is achieved without causing deviation in process variables and vice versa.			
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	During transient conditions causing deviation of process variables, the control system furnished under the specification shall not permit deviations, which exceed those permitted by the manufacturers of the controlled process equipment, for load changes as indicated above. SG and its auxiliaries along with its control system (SG C&I), TG and its auxiliaries along with its control system (TG C&I) when integrated with UNIT C&I systems shall meet the permissible limits for important parameters, under various operating conditions specified. The tentative parameters to be monitored for this test are given in the Table-1, given below and the exact parameters shall be as finalised by the boiler and turbine suppliers. The control loops shall perform to return the controlled variable to the set point in a stable manner without cycling in the shortest possible time and without any loop interactions or cycling of generation when generation matches unit load demand. (ii) The Bidder shall also guarantee that the control system provided by him will be responsive and stable and will maintain the deviation of controlled variables from set point within the limits specified so that the equipment being controlled will operate as specified over the range required. The controls shall operate automatically, with no assistance from the operator. The controller shall successfully demonstrate the performance of Closed Loop Control Systems before acceptance and taking over of this system by the Employer. (iii) The control system including furnace draft & firing rate control shall also comply with all relevant requirements of NFPA code no. 85 'Standard for Prevention of Furnace Explosions in Pulveriser Fired Utility Stations' and other applicable codes regarding safety. (iv) All runback conditions listed below shall be proved by the Contractor without any oil support. -- FD/ID/PA fan trip -- BFP/CEP/ trip -- One mill and two mill trip. -- Any other condition decided during detailed engineering. <table><tr><th colspan="3">PERFORMANCE REQUIREMENTS FOR CLOSED LOOP CONTROL SYSTEM</th></tr><tr><th colspan="3">(TABLE – 1)</th></tr><tr><th>Sl. No.</th><th>Load/Rate of load change</th><th>MAXIMUM DEVIATION OF PARAMETERS FROM SET POINT</th></tr><tr><td></td><td></td><td></td></tr></table>	PERFORMANCE REQUIREMENTS FOR CLOSED LOOP CONTROL SYSTEM			(TABLE – 1)			Sl. No.	Load/Rate of load change	MAXIMUM DEVIATION OF PARAMETERS FROM SET POINT						
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1.03.26.02.01		(% of MCR per min.)	Throttle Pressure Deviation (Kg/cm2)	Flue Gas Oxygen Deviation (%O2)	Furnace Pressure Deviation (mmwcl)	S.H. Steam Temp. Deviation (DegC)	R.H. Steam Temp. Deviation (DegC)	*Max. S.H. Metal Temp. Limit (DegC)	*Max. R.H. Metal Temp. Limit (DegC)							
	A.		Steady State Condition													
		1	100%	± 2.0	± 0.4	± 8.0	± 5.0	± 5.0								
		2	50%	± 2.0	± 0.4	± 8.0	± 5.0	± 5.0								
		3	Boiler minimum once through load	± 2.0	± 0.4	± 8.0	± 5.0	± 5.0								
	B.		Actual Load Cycling RAMP Test (as per clause no 1.03.26.02 (i)- (a) & (c) above).													
		1	± 1%	± 3.0	+0.6/-0.4	± 12.0	± 8.0	± 8.0								
		2	± 3%	± 3.0	+0.6/-0.4	± 12.0	± 8.0	± 8.0								
	C.		Step Load Changes													
		1	From 100% to 80% and vice versa	± 5.0	+1.5/-0.5	± 20.0	± 15.0	± 15.0								
	* For superheater metal temperature and reheater metal temperature, the limits shall not cross the design temperature limit as specified in sub-section-A-01, Part-B of the Specification. Notes <table><tr><td>1.</td><td>Sufficient time shall be allowed as setting period between conducting the tests.</td></tr><tr><td>2.</td><td>Plant operating condition, i.e. main equipment status, availability of auxiliaries, operational and equipment constraints, which can influence the test, shall also be recorded.</td></tr><tr><td>3.</td><td>Control system shall be running in the CMC mode i.e. Boiler master, fuel flow, air flow, feed water and turbine load control shall be in automatic mode Load set point, maximum and minimum load set point, rate of raise/lower of load shall be set through the Operator Work Stations, Large Video Screen.</td></tr></table>										1.	Sufficient time shall be allowed as setting period between conducting the tests.	2.	Plant operating condition, i.e. main equipment status, availability of auxiliaries, operational and equipment constraints, which can influence the test, shall also be recorded.	3.	Control system shall be running in the CMC mode i.e. Boiler master, fuel flow, air flow, feed water and turbine load control shall be in automatic mode Load set point, maximum and minimum load set point, rate of raise/lower of load shall be set through the Operator Work Stations, Large Video Screen.
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	The following parametric tests shall also be conducted under worst case loading conditions as defined in Annexure-I to this sub-section – (details of which shall be as approved by Employer during detailed engineering.)															
(i) For control system																
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1.03.26.02.02	- CPU loading, Cycle time/controller reaction time								
	(ii) For MMIPIS								
	- CPU loading, spare duty cycle, spare memory Capacity								
	(iii) Spare duty cycle for system bus								
	(iv) Various display response time								
	(v) Display update time								
	For the parametric test, the following requirements shall be met								
	(i) Processor Spare Duty Cycle (Free Time)								
	- Under worst case loading of MMIPIS and system bus each MMIPIS processor shall have 40% free time when measured over any two second period and 50% free time when measured over any one minute period.								
	- Under worst case loading conditions of control system control system processor shall have 20% free time when measured over any one minute period.								
- The Bidder shall furnish all necessary data to fully satisfy the Employer that the processor spare duty cycle figures quoted by the Bidder are realistic and based on configuration and computation capability of the offered system and these shall be actually achieved in the fully implemented system as commissioned at project site.									
(ii) System Bus Spare Duty Cycle (Free Time).									
The system bus shall have min. 50% free time during the worst case loading conditions of control system, MMIPIS and the system Bus, measured over any 2 seconds interval									
(iii) Response Time									
(a) Display									
The time from mouse click or last button pressed to the commencement of the requested display under the worst case loading conditions shall not be worse than the following:									
<table><tr><td>All control related displays</td><td>1 sec</td></tr><tr><td>Point Details Display(single point)</td><td>1-2 secs</td></tr><tr><td>Bar chart display (20 points, current data)</td><td>2-3 secs.</td></tr></table>				All control related displays	1 sec	Point Details Display(single point)	1-2 secs	Bar chart display (20 points, current data)	2-3 secs.
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		Operator guide/plant start-up guide message display (full screen of alphanumeric information and a maximum of ten numbers of dynamic data items)	1-2 secs.	
		Plant mimic display of fair complexity with a minimum of 120 numbers of dynamic data items e.g., values, macros, line segment, etc.	2-3 secs.	
		Group review display (current values of twenty points)	2-3 secs.	
		X-Y plot display (2 X-Y- plots and a single display requiring both historical as well as current data)	3-4 secs.	
		X-T plot display (Trend of 6 analog points and a single display requiring both historical as well as current data)	3-4 secs.	
		Plant Summary display (e.g., bad point summary, limit check removed point summary. Assume the whole data base search is required and the summary display contains ten points only).	3-4 secs.	
	(b)	Command: The response time for screen update, after the execution of the control command, from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be within two seconds (excluding the drive actuation time).		
	(iv)	Display Updated Rates All displays shall be updated at least every two seconds.		
	(v)	The spare capacities of working and bulk memory shall meet the requirements indicated in Section-VI, Part-B, Sub-section -DDCMIS.		
	1.03.26. 03	Sequence of Event		
1.03.26.03.01	The sequence of event in operating with 1 m sec. resolution as per Sub-Section-DDCMIS, Part-B, Section-VI.			
1.03.26. 04	Availability Tests			
1.03.26. 04.01	The Bidder shall guarantee 99.7 percent system availability for a continuous period of 180 days. An availability guarantee test shall be conducted to assure this level of availability. If the accrued down time exceeds 0.3 percent of 180 days, during availability test run, a new 180 days test run shall start at the time when the system becomes available again. Loss of availability (unavailable system) shall be defined as the loss of the system's guaranteed accuracy and repeat ability or of any system function, except however, that the loss of a function for not more than five percent of the points shall not be considered loss of availability. Loss of a function for more than five percent of the points shall be treated as partial unavailability and the corresponding outage time shall be weighted with respect to the function and the percentage of the points for which the function is unavailable. Loss of each			
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1.03.26. 04.02 1.03.26. 04.03 1.03.26. 04.04 1.03.26. 04.05	function shall have one weighing factor and unavailability of each equipment, peripheral device or process I/O card etc. shall have another weighing factor. The guaranteed accuracy and repeat ability and system parametric requirements specified in clauses on system parametric requirements shall be maintained for the entire 180 days run without any manual recalibration or any other changes made to the DDCMIS.			
	Downtime shall start upon loss of a system function and shall end upon full restoration of the affected system function. A minimum of one hour's down time shall be charged for each loss of availability in determining system availability.			
	The Bidder shall submit the Availability Test procedure for Employer's approval. The details regarding outage time, weighing factors for various system functions equipments to calculate the down time, test duration etc., shall be discussed and finalised during detail engineering. After conductance of availability test, Contractor shall prepare report covering the methods followed, observations & submit to Employer.			
	If availability is lost due to reasons not attributed to the Contractor / Contractor's system or due to force majeure, then downtime shall not accrue & interrupted test resulting from the same shall be extended by an amount of time equal to the length of interruptions.			
	Loss of each of the following functions shall be treated as full system unavailability (i.e. factor of 1) and the downtime shall accrue individually for each of the following function: (a) Interruption of control command communication between HMI and controllers for a period more than three seconds for any drive (i.e. Unavailability of information in HMI for carrying out the control command shall also be treated as interruption of control commands). (b) Permanent data loss in history functionality for a period more than three seconds for more than five percent of the history database. (c) Delay in reporting of alarms in HMI for more than five percent of the alarms for more than three seconds.			
1.03.26. 05	If loss of function as described at (a) to (c) above is attributed to server changeover, due to system feature, then unavailability due to the above loss of function shall accrue even if the function is not specifically attempted by Employer during the server changeover period. The performance & guarantee test for C&I system shall constitute verification of the parameter as mentioned above & shall be carried out as per agreed procedure. The PG test procedure shall be submitted within 90 days of the date of Notification of Award for Employer's review and approval. After the conductance of Performance test, the Contractor shall submit the test report to the Employer			
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1.03.27	The operating capabilities of the plant as listed out in Sub-section- G-01, (Operating Capability) of Section-VI, Part-B shall also be demonstrated alongwith other parameters/ capabilities specified under category-III guarantees. The treatment of these operating capabilities of compliance/ non-compliance shall be the same as given to other Cat.-III guarantees.			
2.00.00	PERFORMANCE GUARANTEE/ ACCEPTANCE TEST			
2.01.01	TEST INTERRUPTIONS			
	In the event of a test interruption resulting from an Event of Force Majeure or Employer-Caused-Delay, Contractor shall be entitled to relief as provided in the contract, provided that the interrupted Performance Test must be started again and test data that were collected/recorded during the interrupted test must be ignored.			
2.02.00	TURBINE GENERATOR PERFORMANCE/ ACCEPTANCE TEST			
2.02.01	Performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME PTC-6 and as specified otherwise in the specification. Such test shall be binding on the parties to the contract to determine compliance with the guaranteed unit heat rate and heat balance conditions at 800 MW (100% TMCR) MW and 440 MW (55% TMCR) unit outputs corresponding to the conditions specified elsewhere in the specification. Power consumed by the auxiliaries mentioned under clause 1.01.03.01 of this Sub-section which is to be deducted from electrical power generated, shall be measured during the performance / Acceptance Test. Wherever the measurement is not possible, design values of power consumption by an auxiliary shall be considered.			
2.02.02	No shutdown shall be allowed for installation of PG test instrument/ flow nozzle etc. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. However, same shall be installed before start of initial operation of unit. For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap nozzle assembly shall be installed permanently in condensate line prior to initial operation, same shall be also used for process control. All the instruments including the flow nozzle shall be calibrated by the contractor before initial operation in a reputed international institute. All calibrations reports shall be made available prior to the start of initial operation and calibration certificates in original submitted to Employer. All instruments including flow nozzles as necessary for conductance of PG tests shall be installed prior to the start of initial operation.			
2.02.03	Corrections to the test results for steam turbine shall be applied as per the correction curves listed in this subsection. All the efforts shall be made to control the unaccounted for leakage to the minimum, when the system is properly isolated for a performance test. It shall be bidder's responsibility to arrest all the cycle leakages and valves passing before start of initial operation. It will be endeavour of the bidder to keep the unaccounted for leakages below 0.1% of the design throttle flow at that load. In case the value of unaccounted for leakage, is more than 0.1% of design throttle flow at that load, the suitable correction for make-up shall be provided as per approved correction curve.			
2.02.04	The tests shall be arranged in a manner that the EMPLOYER's operation is not disrupted. Duplicate test runs shall be performed at 800 MW and 440 MW unit loads. The results of corrected heat rate shall agree within 0.25%. If they differ by more than 0.25%, third test shall be run at the same point. The corrected result of any one of the three test runs, which			
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2.02.05	deviates from the corrected averaged result of all the runs by more than 0.25%, shall be eliminated; otherwise the results of all the three tests runs shall be accepted.			
2.03.00	Performance test for Water Cooled Condenser (WCC) will be conducted in accordance with the latest edition of ASME PTC. TEST REPORTS The Contractor shall prepare test reports in which the methods followed, instrument readings, graphs, observations, final results obtained online, etc., shall be recorded. Soft copies of each test report shall be submitted to Employer for Approval.			
2.04.00	Performance Guarantee/ Acceptance Tests on the equipments / systems not covered in this Sub-section shall be carried out as per the procedure/ test codes/ specified in respective detailed specifications/ Sub-sections in Section-VI, Part-B.			
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	Annexure-I 1.00.00 <i>Worst Case Loading Conditions for Control System (Definition)</i> The worst case loading conditions shall include the following tasks as a minimum: 1.01.00 All process inputs coming to Control System including SOE/annunciation inputs are being scanned, acquired, conditioned and processed. 1.02.00 All closed loop controls are in operation during a disturbed (non-steady) state of the process. 1.03.00 All open loop controls of DDCMIS are in operation during a disturbed (non-steady) state. 1.04.00 All data being transferred between control system, system bus and HMIPIS. 1.05.00 Three (3) alarms are being generated per second from each of the functional groups of Control System. 1.06.00 Twelve control commands from HMIPIS are being executed in one minute. 1.07.00 All processors (including hot standby) health being monitored. 1.08.00 All standby processors status being updated. 2.00.00 <i>HMIPIS Worst Case Loading Conditions (See note below)</i> The worst case loading conditions shall include the following tasks as a minimum: 2.01.00 Continuous data transfer between System Bus & HMIPIS. 2.02.00 All calculations including performance calculations being performed at the specified rates. 2.03.00 Alarms being reported at the rate of three (3) alarms per second for each of the Control System functional groups. 2.04.00 Two control operator commands for control/ information within a base period of one minute from each OWS & each LVS. 2.05.00 Data collection for all logs/reports in progress. 2.06.00 OWS/LVS displays are in operation as follows: LVS – 1, 4 - Sequence chain display with maximum number of dynamic data items.			
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	LVS - 2, 5 - Individual display with maximum number of dynamic data items. LVS – 3, 6 - Plant mimic display with one hundred and twenty (120) numbers of dynamic data items. OWS - 1 - Overview display with max. no. of dynamic data items. OWS - 2 - Group display (twenty points, current data). OWS - 3 - Alarm display of twenty (20) points. OWS – 4 - 4 Nos. Windows each running current trend. Unit Incharge - Plant overview display OWS All PC Stations X-T plots are displayed & updated. On Station WAN And unit LAN 2.07.00 All printers connected to HMIPIS are in operation at rated speed. 2.08.00 HMIPIS processors and all peripherals health being monitored. 2.09.00 Data collection for trend function and historical data storage in progress. 2.10.00 Four alarm acknowledgements within a base period of one minute from each OWS & LVS. 2.11.00 Calculations for long term storage of data being performed. 2.12.00 SOE printing in progress. 2.13.00 Data transfer with other DDCMIS sub-systems, all PLCs and SG/TG C&I Systems in progress for controls (commands) as well as for information. 3.00.00 <i>The Worst Case Loading Conditions For System Bus</i> The worst case loading condition shall mean continuous data transfer between the distributed modules (Control System/HMIPIS), at their individual worst case loading conditions defined at 1.00.00 & 2.00.00 above respectively. Note : This clause is generally for the unit DDCMIS. This shall be suitably modified for other DDCMIS subsection depending on actual configuration.			
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	ANNEXURE-II 1.00.00 STANDARD GUARANTEE AND ACCEPTANCE TESTS AND TESTING PROCEDURE FOR COAL & BIOMASS, GYPSUM HANDLING PLANT 1.01.01 Power Consumption Total power consumption for all the equipments including auxiliaries with single stream operation at its guaranteed flow path capacity except. - Lighting - Hoists - Coal sampling unit - Sump Pumps - Elevators - DS, DE, Ventilation, SW System, Potable water system 1.01.02 Performance Requirements to be Demonstrated Performance requirements of various individual equipments / systems as specified, including but not limited to certain minimum requirements as spelt out in the Guarantee Test procedure shall also be demonstrated during the Guarantee Tests to the full satisfaction of the Employer. 2.00.00 GUARANTEE TEST PROCEDURE In accordance with Section GTR placed at Part-C, on successful completion of System Trial Operation and commissioning, the plant shall be subjected to guarantee tests. Further, the guarantee tests shall be conducted as per the procedure specified in the following paragraphs. 2.01.00 Pre-Requisites to the Guarantee Tests 2.01.01 The prerequisites to be ensured by NTPC and the Contractor prior to start of the tests are placed at Appendix-I and Appendix-II respectively.			
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2.01.02	After successful completion of trial operation and commissioning the plant shall be jointly inspected by NTPC and the Contractor & a joint protocol shall be signed that the plant is fit for guarantee tests.											
2.02.00	Testing for Guarantees											
2.02.01	Flow Path Capacity Tests											
	1. For each of the Flow Paths, two conveyor streams shall be formed with suitable CRISS-CROSS Combinations of 'A' or 'B' Conveyors/ intermediate equipments. Composition of each stream shall be decided by the Engineer and shall be recorded as per Appendix-III. 2. All above streams formed shall be independently tested for performance & guarantee. Further, the equipments/ conveyors (except common equipments) used for performance testing of one stream shall not be used for performance testing of the other stream. 3. In case of direct flow path, guarantee test should include operation of all the trippers. However, for measurement of guaranteed power consumption farthest tripper shall be operated. 4. Stacking and Reclaiming will be done near the drive house so that the conveyor is tested under fully loaded conditions. 5. While operating the guaranteed capacity of the flow paths, non-spillage of coal and non-choking of chutes/ equipments shall be demonstrated as indication of smooth continuous flow through the conveyor system.											
2.02.02	Major Equipment Capacity Tests											
	(a.) Guaranteed capacity of all the major equipments as identified shall be established separately by operating only one equipment out of the two of a set at a time. Following equipments shall be considered: <table><thead><tr><th>Equipment</th><th>Capacity Requirement</th></tr></thead><tbody><tr><td>(1.) Crusher (after blanking the screen of VGS, where applicable)</td><td></td></tr><tr><td>(2.) Stacker Reclaimer</td><td></td></tr><tr><td>(3.) Height and Base Width of Stockyard</td><td></td></tr></tbody></table>				Equipment	Capacity Requirement	(1.) Crusher (after blanking the screen of VGS, where applicable)		(2.) Stacker Reclaimer		(3.) Height and Base Width of Stockyard	
Equipment	Capacity Requirement											
(1.) Crusher (after blanking the screen of VGS, where applicable)												
(2.) Stacker Reclaimer												
(3.) Height and Base Width of Stockyard												
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2.02.03	(4.) Paddle feeders Power Consumption Measurement (a.) The guaranteed power consumption as total sum of all the equipments as specified shall be measured during capacity test of the identified Flow Paths for both the streams separately. The load of the following items shall not be considered during measurement of Power Consumption for guarantee: Lighting Hoists Sump Pump Coal Sampling Unit Elevator DS, DE, Ventilation, SW system, Potable water system (b.) Measurement Terminal(s) The guaranteed power consumption for the entire Flow Path(s) shall be taken during capacity test as sum of the power measurements at the following terminals. (1.) 3.3/6.6/11 kV CHP incoming terminals (2.) 415 V CHP MCC incoming terminals. (3.) Switchgear terminal of any load connected to Employer's Switchgear. Further the power consumption for the equipments being fed from CHP board/LT board but not to be considered for guaranteed power consumption shall be measured separately at their respective MCC/LT & HT switchgear input terminals and shall be subtracted from the total power consumption measured. However, if conditions permit, such equipments may not be operated during power measurement duration. For Stacker/ Reclaimer machine, the average power consumption shall be measured through energy-meter at HT switchgear feeder of Stacker/ Reclaimer. For Conveyors, the power consumption shall be measured at their respective switchgear terminals.			
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	Guaranteed power consumption of the yard conveyor(s) shall be measured during flow path capacity test in stacking mode whereas for balance equipments (balance conveyors and S/R machine) the power consumption shall be measured during capacity test of reclaim flow path with boom of stacker reclaimer at lowest angle. Lighting, A/C & Ventilation loads on the Stacker/ Reclaimer shall not be considered for guarantee. (c.) Time Duration Power Consumption measurement shall be done only for 30 minutes after the conveyor flow rate stabilizes at the guaranteed capacity. However, for Stacker/ Reclaimer(s), the average power consumption shall be measured for entire duration of reclaim flow path capacity test. (d.) Meters Ammeter/Voltmeter readings shall be noted from the meters mounted on the control desk / LT switchgear / HT switchgear or if necessary by means of clamp type meters. For power measurement two wattmeter method / one wattmeter method (2 or 3 elements) shall be used. Accurate clamp type digital 3 phase wattmeters can also be used. Power measurement shall be taken after stable condition is achieved. Wattmeters shall have a min. accuracy class of $\pm 1\%$ Energy meter shall be of min $\pm 2\%$. CTs & VTs shall have accuracy of $\pm 1\%$. All meter readings shall be recorded. No corrective allowance shall be allowed over the measured values. The details of wattmeters and energymeter alongwith their calibration certificate shall be furnished to NTPC before start of tests. These measuring instruments shall be calibrated from govt. approved test house. Calibration certificates of all instruments must not be more than 1 year prior to test date. Seals of the instruments shall be opened at site in the presence of Engineer-in- charge. Zero error shall be checked before conducting the PG Test.			
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CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
2.02.04	GENERAL (a.) Test Duration (1.) Normal duration of the above capacity tests shall be four hours. However, minimum one (1) hour continuous & steady operation shall be required to establish the guaranteed capacities. (2.) In case of any minor interruption due to operation of electrical protection as well as stoppage due to safety reasons, the duration of test shall be extended by the time lost in such interruptions. In case of exceptionally longer interruptions calling for re-mobilization and re-preparation of plant the implications shall have to be mutually discussed and agreed upon. (b.) Weighing scales (1.) For measurement of flow capacity of a stream and individual equipments, weighing scales installed in the system shall be used. (2.) Belt weigher mounted on the luffable boom of Stacker/ reclaimer shall not be used for this purpose. (3.) Readings for flow rate capacity test shall be taken at intervals of every 3 minutes. (4.) Belt weighers accuracy as demonstrated/ observed jointly before the guarantee testing may be considered for allowing correction factor over the recorded flow capacity reading. (c.) The observations of guarantee test for various streams/ equipments shall be recorded in the formats at Appendix – III to XI.			
2.03.00	Testing for Demonstration Requirements The specified performance parameters of various equipments/ system including but not limited to the following shall be demonstrated to the full satisfaction of the Employer.			
2.03.01	Conveyors (a.) Conveyor Profile (1.) Check against lifting of Conveyor belts over concave curves at the time of start under empty belt condition.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 59 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	(2.) Check against wrapping/folding of belt over convex curves/transition zones. (3.) There should not be any roll back of coal/ gypsum pieces on moving or stopped conveyors (4.) There shall not be build up of coal /gypsum in chutes , spillage of coal from skirt/conveyor/hoods while the belt is running. (5.) Smooth non-jerky running of conveyors with no spillage of coal etc and centric running of conveyors without vibrations of drives and galleries. (b.) Coasting Time Coasting down time of conveyors shall be measured and compared with design values. Check for spillage/blockage of coal from skirts/in chutes to be made. There shall not be build up of coal in chutes after stoppage of fully loaded conveyor so as to cause spillage of coal during next start. (c.) Belt Alignment To check against any sway during operation under different loadings and different conveyor crisscross combinations. (d.) Idlers and self aligning idlers To check for satisfactory performance of idlers and self-aligning idlers (e.) Control/Sequential Operation (a) Performance checks for specified controls including sequential starting/ stopping of conveyors and other equipments as per approved control write-up. (b) Satisfactory operation of PLC and control systems including absence of spurious trips/communication failures of PLC to be demonstrated. (c) Demonstration for detection of operated pull cord/belt sway switch along with display in CRT of conveyor number and operated pull cord /belt sway number. (f.) Protection Switches Satisfactory operation of pull chord, belt sway, zero speed, chute blockage and other safety / protection switches.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 60 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	(g.) Load Start Demonstration of the ability of conveyor to start under full designed load. (h.) Simultaneous Operation Demonstration of simultaneous operation of both the streams under full load for 30 minutes in order to check healthiness of the system, electrical systems etc (i.) Vibration Level in Conveyors/Bucket Elevators Both velocity and amplitudes for all the conveyor/Bucket elevator drives and in each conveyor gallery under different conditions of conveyor operation as desired by site. Vibration limits of drive equipments shall be as per VDI 2056 / equivalent. Observations shall be recorded as per the format at Appendix-V. Vibration of conveyor galleries at trestles and pt. between trestles shall be measured and these values shall be within allowable limits. Vibrations of Crusher houses floors and transfer point floors shall also be measured and these shall be within allowable limits. (j.) Gear Boxes Temperature rise not to exceed design values. No leakages No abnormal sound. Satisfactory performance of hold back devices in preventing running back of conveyor belts in case of conveyor being stopped in fully loaded (at design load) condition to be demonstrated. (k.) Fluid Coupling. No excessive rise of temperature. Satisfactory and quick operation of scoop in manual/remote modes with no oil leakages.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 61 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE			
2.03.02	Stacker cum Reclaimer (a.) Stacking at maximum boom height. (b.) Starting of Boom Conveyor/Intermediate conveyor at full load (at design load = rated capacity +25%) at maximum / minimum inclinations. (c.) Reclaiming at maximum and minimum stockpile heights (d.) Uniform to and fro travel speed and proper reeling / unreeling of flexible cables/energy chain system. (e.) Satisfactory operation of all limit switches, protections and other controls. (f.) No sway of Boom Conveyor during stacking and reclaiming at different loads and inclinations. (g.) Proper hoisting / luffing operation without jerks and operator cabin level adjustment. (h.) Check against folding of belt in spaces between horizontal and inclined troughing idlers at the start of Stacker Reclaimer. (i.) No leakage from hydraulic couplings, seals, heat exchangers, instrument tapplings etc (j.) Demonstration of proper functioning of hydraulic and manual rail clamps and boom locking. (k.) Proper functioning of communication system on stacker reclaimer. (l) Demonstration of Stacker Reclaimer Unmanned Operation for total duration of 24 hrs, with atleast 4 operations of 4 hours of continuous operation each, with in a period of 7 days.			
2.03.03	Travelling Trippers (a.) Check for smooth to & fro travel (b.) Operation of brakes and rail clamps at full load. (c.) Check against dragging during start up or running ("over speed protection"). (d.) Check against blockage of discharge chutes at full load.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 62 OF 77	

CLAUSE NO.	GUARANTEE TEST PROCEDURE			
	(e.) Check against folding of belt in spaces between horizontal and inclined troughing idlers at the start of Tripper. (f.) Proper functioning of communication system on trippers.			
2.03.04	Package Air Conditioning (PAC) Unit			
	(a.) Specified temperature and humidity of conditioned space under worst ambient conditions. (b.) Demonstration of rated capacity of PAC unit.			
2.03.05	Belt Weighers			
	(a.) Demonstration of specified weighing accuracy of $\pm 0.25\%$ ($\pm 1\%$ in case of boom conveyor of stacker reclaimer) between 20% and 120% of rated capacity (b.) Satisfactory operation of flow rate indicator and totaliser etc.			
2.03.06	Deleted			
2.03.07	Crushers			
	Output coal size to be sieve analyzed and (-) 20 mm coal to be more than 98% for ring granulator type crusher. Vibration measurement (velocity and amplitude) is to be recorded at bearings as per appendix. Vibration is to be within allowable limits. No excessive rise of temperature of bearings One crusher is to be tested for output and size. Proper functioning of vibration monitoring system to be checked.			
2.03.08	Noise Levels			
2.03.08.01	Noise level measurement, for conformance to specified levels, to be done around the following equipments/ areas: (a.) Conveyor Discharge Terminal (including discharge chute, gearbox, coupling & motor).			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 63 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE			
2.03.08.02	(b.) Coal discharge chutes on intermediate floors in possible impact zones. (c.) Ventilation fans (d.) Water Supply & Dust Suppression Pumps. (f.) Coal crushers (g.) Vibrating Feeders/ Vibrating Screening Feeder Noise level measurement shall be done around the specified equipment location in the following manner. (a.) The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirements of IS:9779. (b.) Sound pressure level shall be measured all around the equipment at a distance of 1m from the vertical projected plan of the equipment as a whole (this shall include coupling, gear box, motor etc.) at a height of 1.5 m from floor level. Microphone positions shall be at horizontal separations of not more than 1.5m around the equipment. (c.) The measurement shall be done with slow or impulse response, as the case may be on the A-weighting scale. The average of the A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value indicated in the specification. (d.) The tests shall be carried out with the equipments operating at near rated speed & load Correction for background noise will be considered Inline with IS:4758. Noise level measurement shall be recorded as per format at Appendix-VI.			
2.03.09	Belt Scrappers Satisfactory operation of belt scrappers shall be demonstrated even with wet coal/Gypsum as specified. Scrapping efficiency of belt scrapper shall be minimum 95%.			
2.03.10	Paddle Feeders Long travel speed test, i.e., demonstration of speed variation of paddle wheel from 20% to 100% capacity, to be carried out. The paddle feeders should be able to move in both to and fro directions while feeding coal up to rated capacity without slippage of wheels and spillage of coal. Demonstration of variable capacity adjustment.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 64 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
2.03.11	No fouling with paddle table and structure Proper reeling and un-reeling operation of flexible cable/energy chain Demonstration of minimum 50% margin between normal working pressure and stall/trip pressures (Ex: In case normal working pressure is 150 kg/cm² then stall/trip pressure shall be 225 kg/cm² and relief valve setting shall be above 225 kg/cm²). Demonstration of dust suppression system of Paddle Feeders. Dust Suppression System (a) Measurement of head of pumps. (b) Pressure available at nozzle manifolds (on random basis) in running condition not to be less than 2.5 kg / cm² (Dry Fog) or 1000 psi (Cold Fog) (c) Satisfactory spray atomization and dust suppression effectiveness of all the DS systems as per Appendix-XI. (d) Measurement of SPM before and after DS system operation as per Appendix - XI. (e) To measure pressure available at inlet to sprinkler in coal yard in running conditions and this should not be less than 4.5 kg / cm² (f) Complete coverage of yard by spray units in stockyard. (g) Measurement of noise level and vibration (velocity and amplitude) at the bearing of motors and pumps			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 65 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	APPENDIX-I GENERAL PREREQUISITES TO GUARANTEE TESTS TO BE ENSURED BY NTPC 1. Availability of adequate and uninterrupted supply of coal. Specifications of coal as per N.I.T and as observed during the test shall be recorded as per attached format (Appendix-IA). 2. Sufficiently empty bunkers to facilitate continuous tripper dumping of coal during the test. Sufficient space in stockyard towards drive end of yard conveyor during stacking. Sufficient heap of Coal towards tail end of yard conveyor during reclaiming of Coal. 3. Uninterrupted power supply within specified parameters for the duration of the test. 4. Belt protection switches, local stop push buttons, hooters, brakes/rail clamps in working order. 5. Adequate and uninterrupted water supply. 6. Plant communication system 7. Proper lubrication and oil level of all equipments. 8. Free rotation of idlers and pulleys. 9. Cleanliness of plant and removal of coal spillage at the start and during Tests. 10. Power supply voltage and frequency shall be as per technical specifications. 11. Availability of dry coal during testing of DS system.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 66 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	APPENDIX-IA COAL PARAMETERS Project : Package : Date : As specified, As observed during the test - Size - HGI - Moisture - Shale and sand-stone content NTPC Contractor			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 67 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	APPENDIX-II PREREQUISITES TO GUARANTEE TESTS TO BE ENSURED BY CONTRACTOR 1. Deputation of team to site to associate with the Guarantee tests, 2. Calibration of belt weigher scales and accuracy of same to be demonstrated to NTPC. 3. Arrangement of wattmeters / energymeters calibrated and sealed from approved Govt. test house or NTPC site laboratory. Arrangement of any other instrument/ accessory for the test. 4. Proper adjustment of skirt boards and belt cleaners prior to the start of tests. 5. Arrangement of calibrated equipments for measurement of vibration & noise levels. 6. Protection Relays of LT/HT switchgears and all motor feeders shall be checked. 7. Belt protection switches, local push buttons, hooters, brakes/rail clamps to be in working order. 8. Free rotation of idlers and pulleys. 9. Protection relays of LT/HT switchgears and all motors/transformer feeders to be checked. 10. Sufficient illumination.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 68 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 										
	ANNEXURE – IIA FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th> Clause No. as per LOA/ Tech. Specs. </th> <th> Provision of LOA / Tech. Specs. </th> <th> Name and Methodology of Test proposed by Vendor </th> <th> NTPC comments on the tests proposed by vendor </th> </tr> </thead> <tbody> <tr> <td style="height: 494px;"></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor				
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 69 OF 77								

CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	APPENDIX-III GUARANTEE TEST PROFORMA FLOW PATH CAPACITY TEST Project : Package : Date : 1. Composition of Stream i) Conveyor Nos. ii) Stacker / Reclaimer iii) Traveling Tripper Nos. iv) Dust suppression pumps, service water pumps, Ventilation fan drives. v) 2. Location of Belt Weigher (s) : 3. Plant started (Time) : 4. Material started flowing over belt weigher (Time) : 5. Test period Completed (Time) : 6. Reading taken at three (3) minute intervals :			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 70 OF 77

CLAUSE NO.	GUARANTEE TEST PROCEDURE 											
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>SI.No</th> <th>Time</th> <th>Flow Rate</th> <th>Totaliser</th> </tr> </thead> <tbody> <tr> <td style="height: 450px;"></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> Total plant run time : Average Flow Rate : NTPC Contractor				SI.No	Time	Flow Rate	Totaliser				
SI.No	Time	Flow Rate	Totaliser									
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 71 OF 77									

CLAUSE NO.	GUARANTEE TEST PROCEDURE																										
APPENDIX-IV																											
7. Energy meter Readings																											
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <th rowspan="2" style="width: 5%;">Sl.</th> <th rowspan="2" style="width: 10%;">Equip- Ment</th> <th colspan="2" style="width: 15%;">Time Duration</th> <th colspan="2" style="width: 15%;">Energy meter Readings kW Hr</th> <th rowspan="2" style="width: 15%;">Equipmen t kw (R2- R1)/ (t2-t1)</th> <th rowspan="2" style="width: 15%;">Remarks</th> </tr> <tr> <th style="width: 5%;">Initial</th> <th style="width: 5%;">Final</th> <th style="width: 5%;">Initial</th> <th style="width: 5%;">Final</th> </tr> <tr> <td style="height: 200px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>								Sl.	Equip- Ment	Time Duration		Energy meter Readings kW Hr		Equipmen t kw (R2- R1)/ (t2-t1)	Remarks	Initial	Final	Initial	Final								
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		Initial	Final	Initial	Final																						
*Reason and duration for system trip/stop may be recorded in remarks column.																											
NTPC Contractor																											
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A		SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES		PAGE 73 OF 77																					

CLAUSE NO.	GUARANTEE TEST PROCEDURE																						
APPENDIX-V GUARANTEE TEST PROFORMA VIBRATION LEVEL MEASUREMENTS Project : Package : Date : Time : Details of vibration Level Meter 1. Make 2. Model & SI.No. 3. Date of calibration with name of Test House <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 10%;">SI.No.</th> <th style="width: 20%;">Equipment</th> <th style="width: 10%;">Pick *Point</th> <th colspan="3" style="width: 60%;">Vibration level Amplitude/Velocity</th> </tr> <tr> <th></th> <th></th> <th></th> <th style="width: 20%;">Horizontal Micron/ mm/ sec.</th> <th style="width: 20%;">Vertical micron/ mm/sec.</th> <th style="width: 20%;">Axial Micron / mm/sec.</th> </tr> <tr> <td style="height: 40px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> * Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports. NTPC Contractor						SI.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity						Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.						
SI.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity																				
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.																		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATIONS SECTION – VI, PART-A		SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES																		
					PAGE 74 OF 77																		

CLAUSE NO.	GUARANTEE TEST PROCEDURE																
APPENDIX-VI GUARANTEE TEST PROFORMA NOISE LEVEL MEASUREMENT Project : Package : Date : Details of Sound Level Meter 1. Make 2. Model 3. Date of calibration with name of Test House <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 10%;">Sl.No</th> <th style="width: 20%;">Equipment with location</th> <th style="width: 20%;">Equipment load/capacity</th> <th style="width: 20%;">Measurement* point no.</th> <th style="width: 15%;">Sound level dBA.</th> <th style="width: 15%;">Remarks</th> </tr> </thead> <tbody> <tr> <td style="height: 150px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> NTPC Contractor * For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.						Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks						
Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks												
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 75 OF 77													

CLAUSE NO.	GUARANTEE TEST PROCEDURE					
	APPENDIX-VII					
	PROFORMA FOR POWER MEASUREMENT OF STACKER / RECLAIMER 1. Stream composition 2. Description of following Motors a) Boom Conveyor b) Bucket Wheel c) Long Travel d) Main Hydraulic Pump 3. Sr. No. of Energy meter used 4. Date of Calibration of instrument and name of test house. 5. Multiplying factor of Energy Meter. 6. Energy meter Readings (to be taken at H. SWGR. FDR of S/R OR In comer of MCC on S/R)					
	Sl. No.	Equipment	Time Duration	Energymeter Readings KWHR	Equipment KW	Remarks
			Inti al T1	Final T2 Initial R1	Final R2	(R2-R1) / (T2-T1)
	Reason and duration for trip/ stop may be recorded in remarks Sd/ Sd/ NTPC CONTRACTOR					
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATIONS SECTION – VI, PART-A		SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	
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CLAUSE NO.	GUARANTEE TEST PROCEDURE 			
	APPENDIX - XI DUST SUPPRESSION SYSTEM Fixing of acceptance criteria of ambient air quality Acceptance criteria of ambient air quality shall be considered with respect to respirable dust only. Respirable dust is defined as particles having particle size less than 10 microns meter (Not even equal to 10 microns meters). The particle size analysis of dust at any one of the area shall be carried out as a sample by placing the High Volume Sampler in the designated test point (1.5 to 3 M radius of application point) for a period 8 hours without system in operation under load. The sample thus collected will be subjected to the particle size analysis by sieve Analysis method as a standard test laboratory. The quantity respirable dust shall thus be determined from particle size Analyzer, Percentage of quartz in respirable dust will be determined by X-ray diffraction Acceptable Norms : i) If the respirable dust fraction contain less than 5% quartz. The permissible concentration of respirable dust shall be less than 2 Mg/M³. ii) In case, respirable dust has more than 5% quartz, the permissible concentration of respirable dust shall be computed as per following formula. Threshold limit value for respirable coal dust in work environment (Mg/M³) = $\frac{10}{K(\% \text{ Quartz in respect Dust} + 2)}$ iii) % Quartz shall be determined by X-ray diffraction. TEST METHOD (Testing shall not be done during Monsoon) For determining the ambient respirable dust level average 4 hourly sample reading shall be taken with high volume sampler at each test point (1.5 to 3 Metre radius of application point) with DFDS system and material handling system in operation on load. The average of three such readings shall be taken for each test point to compute the respirable dust level. Respirable dust level will be determined by analysis of the sample using sieve analyzer.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 77 OF 77

CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES			
1.00.00	AIR COMPRESSORS / ADP /COMPRESSOR HOUSE CRANE			
1.01.00	Oil free Screw Air Compressor (as applicable)			
(i)	Complete HP Stage with HP element.	1 No.		
(ii)	Complete LP stage with LP element	1 No.		
(iii)	Motor Bearings	2 Sets		
(iv)	LP stage Pinion	1 No.		
(v)	HP stage Pinion	1 No.		
(vi)	Air Oil Filter Kit	4 Nos.		
(vii)	After cooler Safety Valve (if applicable)	1 No.		
(viii)	Inter Cooler Safety Valve (if applicable)	1 No.		
(ix)	Oil Pump kit	2 Nos.		
(x)	After cooler drain valve kit (if applicable)	1 No.		
(xi)	Inter cooler drain valve kit (if applicable)	1 No.		
(xii)	Air receiver drain/moisture trap	1 No.		
(xiii)	'O' Rings for oil cooler	8 Nos.		
(xiv)	Moisture separators for Aftercooler (if applicable)	2 Nos.		
(xv)	Moisture separators for Intercooler (if applicable)	2 Nos.		
1.02.00	Centrifugal Compressor (as applicable)			
1.02.01	Pinion Shaft Journal Bearing Assembly	2 Sets		
1.02.02	Thrust Bearing Assembly	2 Sets		
1.02.03	Shaft Seals for Air-Oil (All stages)	2 Sets		
1.02.04	Gasket / O rings	3 Sets each type/size		
1.02.05	Air Filter Elements	4 Sets each type/size		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-VI CHAPTER-07 PLANT UTILITIES	PAGE 1 OF 15

CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES			
1.02.06	Lub Oil System			
1.02.06.1	Main oil pump complete	1 No		
1.02.06.2	Aux. oil pump complete	1 No		
1.02.06.3	Complete coupling for Main & Aux. oil pump, spacer	1 No		
1.02.06.4	Cartridge filter elements with gaskets and seals	4 Sets		
1.02.06.5	Motor Bearings	2 sets		
1.02.07	Drain / Moisture Trap	2 Set of each type/size.		
1.02.08	Oil Cooler Gaskets & Seals	2 sets		
1.03.00	AIR DRYING PLANT FOR IA SYSTEM (Twin tower Type) (As applicable)			
	1. Pre filter element (Ceramic candle or as applicable)	2 sets		
	2. After filter element (Ceramic candle or as applicable)	2 sets		
	3. Heater element (if applicable)	1 sets		
	4. Blower bearing (if applicable)	1 sets		
	5. Blower motor bearing (if applicable)	2 sets		
	6. Valves & Valve Actuators (pneumatic/hydraulic)	2 sets		
	7. Heater coil for temperature stabilization (for HOC type) (as applicable)	2 sets		
1.04.00	Valves (within the compressor house having actuators) along with actuator	2 Nos. of each type / rating / size		
1.05.00	COMPRESSOR HOUSE CRANE			
	1. All bearings	1 set of each type/rating		
	2. Brake assembly and its liners	1 set of each type/rating		
	3. Wire rope	1 complete length.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-VI CHAPTER-07 PLANT UTILITIES	PAGE 2 OF 15

CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
1.06.00	MEASURING INSTRUMENTS		
	1 Electronic Transmitters		
	(i) Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	2 Nos. of each type and model	
	2 Temperature elements		
	(i) RTD's* of each type and length	2 Nos. of each type and length	
	(ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	2 Nos. of each type and length	
	(iii) Thermowell	2 Nos. of each type and length	
	(iv) Temperature transmitters (if applicable)	2 Nos of each type	
	3 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	2 Nos. of each type and model	
	4 Dew Point meters	1 No.	
1.07.00	MICROPROCESSOR BASED/PLC BASED CONTROL/ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE)		
	1 Fully programmed controller of electronic modules of each type (as applicable)	1 No.	
	2 Power supply module (if applicable)	1 No.	
1.08.00	Rotary drum type Air drying plant for Instrument Air system (As applicable)		
	Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set	
1.09.00	a) Service air compressor motor	1 no.	
	b) Instrument air compressor motor	1 no.	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
2.00.00	<u>AIR CONDITINING AND VENTIALTION SYSTEM</u>		
1.00.00	AIR CONDITINING SYSTEM		
1.0	Screw Compressor Chilling Machine for each type/rating/model		
1.1	Oil filter – O ring	1 Set	
1.2	Refrigerant filter	1 Set	
1.3	Master solenoid valve	1 No.	
1.4	Master solenoid valve coil	1 Set	
2.0	Pumps (for each model)		
2.1	Pump Bearing	1 Set	
2.2	Pump Motor Bearing	1 Set	
2.3	Shaft Sleeve	2 set	
2.4	Screw compressor chilling unit motor	1 no.	
3.0	Air handling unit (for each model)		
3.1	V-belts for AHU Blower	2 Sets	
3.2	AHU Blower bearing	1 Set	
3.3	Blower motor bearing	1 Set	
3.4	Filters at suction and discharge of all AHUs	25% of installed population for each type/rating	
4.0	Cooling Tower (for each model)		
4.1	Nozzles for cooling towers	20 Nos.	
4.2	Float valve assembly	1 No.	
4.3	Fan Bearings	1 Set	
4.4	Motor bearings	1 Set	
5.0	Air Washer Units (for each type)		
5.1	Supply Air fans		
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
5.1.1	V-belts for Supply air fans	2 Sets	
5.1.2	Supply air fan bearings	1 Set	
5.2	Air Washer pump		
5.2.1	Impeller for Pump	1 no of each type.	
5.2.2	Pump Shaft	1 no of each type	
5.2.3	Pump Bearing	1 Set	
5.2.4	Shaft Sleeves	1 Set	
5.2.5	Gland Packings for pumps	2 Sets	
5.2.6	Spray nozzles	5% of total population or 100 numbers whichever is higher.	
5.2.7	Air Washer Pump inlet water strainer	1 No.	
5.2.8	Brass suction screen/strainer for air washer tank	1 Set	
5.3	Fabric filters	1 Set (Quantity to suit one no. of air washer)	
5.4	Metallic filters	1 Set (Quantity to suit one no. of air washer)	
6.0	Electrical Actuators		
6.1	Actuators	1 No. of each type, model and rating.	
6.2	Motor for Centrifugal fan for air washer unit	1 No of each rating	
7.0	Unitary air filtration unit (for each type)		
7.1	<i>Supply Air fans</i>		
7.1.1	V-belts for supply air fans	2 Sets	
7.1.2	Supply air fan bearings	1 Set	
7.2	<i>UAF Pump</i>		
7.2.1	Pump bearings	1 Set	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES			
7.2.2	Impeller for pump	1 no.		
7.2.3	Pump Shaft	1 no.		
7.2.4	Shaft sleeves	1 Set		
7.2.5	Gland Packings for pumps	1 Set		
7.3	Nylon Filter	1 Set (Quantity to suit one no. of UAF unit)		
7.4	Spray nozzles	5% of total population or 50 Numbers whichever is higher.		
7.5	UAF Pump inlet water strainer	1 No.		
7.6	Brass suction screen/strainer for unitary air filtration tank.	1 Set		
7.7	Motor for Centrifugal fan for UAF	1 No		
8.0	Control & Instrumentation			
(I)	Air-Conditioning System			
8.1	Electronic Transmitters			
8.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5 Nos. of each type and model		
8.2	Temperature elements			
8.2.1	RTD's*	5 Nos.		
8.2.2	Thermo well (if applicable) * (With head assembly, terminal block and nipple)	2 Nos.		
8.3	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and differential temperature, level switch Devices.	2 Nos. of each type and model		
8.4	Relative Humidity Sensors	1 No.		
8.5	Geyserstat	1 No.		
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		एनटीपीसी NTPC		
8.6	Local Humidity/Temperature indicators	2 Nos. each			
9.0	Variable Frequency Derive (VFD)				
9.1	Complete VFD derive	1 No of each type & rating			
9.2	Complete Converter & Inverter unit	1 No of each type & rating			
9.3	Set of Cards	1 No of each type & rating			
9.4	Set of fuses	2 Nos of each type & rating			
9.5	Input & Output Chokes (If applicable)	1 Set			
(II)	Ventilation System				
10.0	Measuring Instruments				
10.1	Level transmitter	1 No. of each type and model			
10.2	Pressure transmitter	1 No. of each type and model			
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES			
3.00.00	MANDATORY SPARES FOR FIRE DETECTION AND PROTECTION SYSTEM			
SI.No	ITEM DESCRIPTION	QUANTITY		
1.0	PUMPS	Booster Hydrant	Booster Spray*	
1.1	Impeller	1 Set	1 Set	
1.2	Pump bearing (Incl. thrust brg, journal brg., line shaft brg.)	1 Set	1 Set	
1.3	Pump shaft	1 Set	1 Set	
1.4	Wearing rings	2 Sets	2 Sets	
1.5	Shaft Sleeve	1 Set	1 Set	
1.6	Bushings	2 Sets	2 Sets	
1.7	Bearing housing (if provided)	1 Set	1 Set	
1.8	Coupling bolts & nuts (with bushes)	1 Set	1 Set	
	Above quantity/items are required for each type and rating of pumps being supplied under the contract * if applicable			
2.0	DIESEL ENGINE (1 set means item required for 1 diesel engine)			
		Booster Hydrant	Booster Spray*	
2.1	Sprayers/Injector	1 Sets	1 Sets	
2.2	Piston rings & sealing rings	2 Sets	2 Sets	
2.3	Exhaust valve assembly	1 Set	1 Set	
2.4	Springs	1 Set	1 Set	
2.5	Packings and gaskets	1 Set	1 Set	
2.6	Fuel oil filter elements with seals	2 Sets	2 Sets	
2.7	Fuel oil filter assy	1 Set	1 Set	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES			
SI.No	ITEM DESCRIPTION	QUANTITY		
2.8	Lub. oil filter elements with seals	2 Sets	2 Sets	
2.9	Scraper rings	1 Set	1 Set	
2.10	Solenoid coil for fuel valve	1 No.	1 No.	
2.11	Corrosion inhibitor (if provided)	1 Set	1 Set	
2.12	Big end & small end bearing of connecting rod	1 Set	1 Set	
2.13	Speedometer (if applicable)	1 No.	1 No.	
2.14	Speedometer wire (if applicable)	1 No.	1 No.	
2.15	Rubber hoses of water line with mounting clamps	1 Set	1 Set	
2.16	Cranking starter assembly complete	1 Set	1 Set	
2.17	Lub. oil and fuel oil hoses with end connectors	1 Set	1 Set	
2.18	Water pump belts	2 Sets	2 Sets	
	Above quantity/items are required for each type and rating of diesel engine being supplied under the contract * if applicable			
3.0	Motors (for each type & rating)			
3.1	Bearing	1 set		
3.2	Motors (HT / LT)	1 No of each type & rating		
4.0	FIRE HOSES WITH COUPLINGS			
4.1	7.5m long fire hoses (internal) with end connectors	8 Nos.		
4.2	15m long fire hoses (internal) with end connectors	30 Nos.		
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
4.3	15m long fire hoses (external) with end connectors	24 Nos.	
5.0	BRANCH PIPES WITH NOZZLES		
5.1	Nozzles with branch pipes & quick coupling ends (internal)	20 Nos.	
5.2	Nozzles with branch pipes & quick coupling ends (external)	10 Nos.	
6.0	DELUGE VALVE ASSEMBLIES		
6.1	Complete deluge valve assembly along with internals and accessories		
6.1.1	150 NB	5 Sets	
6.1.2	100 NB	15 Sets	
6.1.3	80 NB	1 Set	
6.2	Clapper assembly complete (consisting of clapper seat rubber, screws, etc.)		
6.2.1	150 NB	5 Sets	
6.2.2	100 NB	15 Sets	
6.2.3	80 NB	1 Set	
6.3	Solenoid coils		
6.3.1	150 NB	5 Sets	
6.3.2	100 NB	15 Sets	
6.3.3	80 NB	1 Set	
8.0	VALVES (GATE/GLOBE/BUTTERFLY/NRV)		
8.1	Complete valves	5% of population of each type & size	
8.2	Reduction gear operator (Gate/Butterfly)	10% of population of each type & size	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
8.3	Flap/door with pin (NRV)	10% of population of each type & size	
8.4	Disc (butterfly)	5% of population of each type & size	
8.5	Gate (Gate valve)	5% of population of each type & size	
8.6	Stem (all types)	5% of population of each type & size	
8.7	Seat rings (all types)	10% of population of each type & size	
8.8	Flap rings (NRV)	10% of population of each type & size	
8.9	Gaskets	10% of population of each type & size	
8.10	Bearing/ Bushing (Butterfly valve)	10% of population of each type & size	
8.11	Motorized actuator of butterfly valve 300 NB	1 No.	
9.0	BASKET STRAINERS / Y-TYPE STRAINERS for HVW/MVW SYSTEM		
9.1	Strainer elements with o-rings and stiffeners.		
9.1.1	Basket strainer		
9.1.1.1	300 NB	1 No.	
9.1.1.2	200 NB	1 No.	
9.1.2	Y- Type strainer		
9.1.2.1	150 NB	10 Nos.	
9.1.2.2	100 NB	30 Nos.	
9.1.2.3	80 NB	2 No.	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
10.0	MVW SPRAY SYSTEM		
10.1	Spray Nozzles	5% of each type & size	
10.2	QB Detectors	5% of each type	
11.0	HVW SPRAY SYSTEM		
11.1	Spray nozzles	5% of each type & size	
11.2	QB Detectors	5% of each type	
13.0	HYDRANT VALVE		
13.1	Hydrant valve complete (internal) single headed with instantaneous female coupling	40 Nos.	
13.2	Hydrant valve complete (external) single headed with instantaneous female coupling	45 Nos.	
13.3	Water monitor sets with nozzle branch pipe etc.	2 Nos.	
13.4	Spindle with nuts of Hydrant valve	40 Nos.	
13.5	Bonnet, gland nut, rubber assembly of hydrant valve	40 Nos.	
13.6	Seat, check nut, washer assembly of hydrant valve	40 Nos.	
13.7	Rubber washer for female coupling	85 Nos.	
13.8	Instantaneous female coupling assembly complete for hydrant valve	85 Nos.	
13.9	Lock pin assembly for hydrant valve	85 Nos.	
14.0	FIRE DETECTORS		
14.1	Multisensor detectors (Addressable)	50 nos.	
14.2	Indicators assembly for smoke detectors provided in false ceiling (Response indicator)	20 nos.	
14.3	LHS cable for coal conveyors	1000 mtr	
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CLAUSe NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
14.4	LHS cable for cable galleries	1000 mtr	
14.5	Manual pull stations	20 Nos. of each type	
15.0	INFRA RED DETECTORS		
15.1	IRD unit with local control unit, purging unit, other accessories (for complete replacement)	2 nos.	
16.0	PORTABLE EXTINGUISHERS		
16.1	Pressurized water type (9 lit. cap.)	15 Nos.	
16.2	Foam type (9 lit. cap. IS: 15683)	6 Nos.	
16.3	CO2 type (4.5 kg. Cap. IS: 15683)	15 Nos.	
16.4	Dry Chemical powder (6 kg. Cap. IS: 15683)	15 Nos.	
17.0	MOBILE EXTINGUISHERS		
17.1	Foam type (60 lit. cap. IS: 16018)	1 No.	
17.2	CO2 type (22.5 kg. Cap. IS: 16018)	3 Nos.	
17.3	Dry Chemical powder (50 kg. Cap. IS: 16018)	3 Nos.	
18.0	INERT GAS EXTINGUISHING SYSTEM		
18.1	Nozzles	2 Nos. of each size/type	
18.2	Automatic & Manual release system	1 No. of each size/type	
18.3	Cylinder valve with safety pressure relief device	1 No. of each size/type	
18.4	Flexible hoses(if applicable)	5 Nos. of each size/type	
18.5	Solenoid coils	2 Nos. of each size/type	
19.0	FIRE ALARM PANEL & REPEATER FIRE ALARM PANEL		
19.1	Power supply modules	2 No. of each type & rating	
19.2	Processor modules, Control modules, loop cards modules, isolator cards	2 No. of each type	
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CLAUSE NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
19.3	LCD display of each type unit of panel	1 No.	
19.4	Interface unit / modules for non-addressable devices, auxiliary / output relay modules, control modules, supervisory control modules and any other electronic modules	50 Nos. of each type	
19.5	Power supervision relay (if applicable)	4 Nos. of each type.	
19.6	Fire screen / alarm buzzer	1 No. of each type	
20.0	ELECTRICAL		
20.1	Electrical Actuator	10% or 1 No. of each type, model and rating whichever is more.	
21.0	CONTROL AND INSTRUMENTATION		
21.1	MEASURING INSTRUMENTS		
21.1.1	Process Actuated Switch Devices : (All types of Pressure, diff. pressure, flow, temperature, level switch devices).	2 Nos. of each type and model	
21.1.2	All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	2 Nos. of each type and model	
21.1.3	Limit switches for isolation valves	2 Nos. of each type	
21.2	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)		
21.2.1	Valves	1 No. of each type, class, size and model.	
21.2.2	2 way, 3 way, 5 way valve manifolds (as applicable)	5 Nos. of each type, class, size and model.	
21.2.3	Fittings	5 Nos. of each type, class, size and model	
21.3	CABLES		
21.3.1	Pre fabricated cable with connector of each type. (as applicable)	1 No. of each type, size and model.	
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CLAUSe NO.	MANDATORY SPARES FOR PLANT UTILITIES		
SI.No	ITEM DESCRIPTION	QUANTITY	
21.3.2	Other cables (including instrumentation cable, core cable, short term fire proof cable, fibre optic cables, etc.)	500 mtr of each type, pair/ core and size.	
21.4	PLC CONTROL SYSTEM		
21.4.1	Power Supply Unit	1 No. of each type and model,	
21.4.2	Electronic modules(I/O modules, communication modules and any other module used in the system)	1 No. of each type and model,	
21.4.3	Central Processor Unit	1 No. of each type and model	
21.4.4	Interconnecting Cables (as applicable)	10% of each type & size	
21.4.5	Cooling Fan in PLC system / cabinet	2 Nos.	
21.4.6	Graphical Interface Unit	1 No.	
21.5	24V – DC POWER SUPPLY SYSTEM		
21.5.1	Current Transducer, Voltage transducer, chokes, AC/DC isolators, contactors, timers, relays (as applicable)	2 Nos. of each type and rating	
21.5.2	Fuses of each type and rating	2 Nos of each type and rating	
21.5.3	Fuse free Circuit breakers	2 Nos. of each type and rating	
21.5.4	Electronic modules of all types	1 No. of each type	
21.5.5	Cooling Fans (as applicable)	2 No. of each type	
21.5.6	Relays of all types including overload relays (as applicable)	2 Nos. of each type and rating	
21.5.7	Batteries	2 nos. of each type & rating	
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NTPC Limited

(A Government of India Enterprise)



LARA SUPER THERMAL POWER PROJECT STAGE-II (2x800 MW)

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – B

(BOOK 4 OF 5 – CIVIL WORKS)

SECTION - VI

BIDDING DOCUMENT NO.: CS-9587-001R-2

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D-1-1 1.01.00	GENERAL This specification is to cover, survey works, site leveling works, design, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour & materials and construction of all civil, structural and architectural works by the Bidder. 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. Various buildings, structures, plant and systems, facilities, etc., covered under the scope is given in Part-A and herein. The work to be performed under this specification consists of design, engineering, construction, erection and providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds, temporary colony for labour and staff, temporary site offices, constructional plants, 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 work. All construction materials including cement, reinforcement steel, coarse & fine aggregate, structural steel and construction water etc., shall be arranged by the Bidder. The scope shall also include setting up by the Bidder a complete testing laboratory in the field to carry out all relevant tests for structural steel, reinforcement steel & reinforced concrete (RCC) works. Preliminary geotechnical investigation in the proposed area has been carried out by the Owner and the bore-log data is furnished in Annexure 'C'. The work shall be carried out according to the design/drawings to be developed by the Bidder and approved by the Employer. For all buildings, facilities, systems, structures, etc., necessary layout and details are to be developed by the Bidder keeping in view the statutory and functional requirements and providing enough space and access for operation, use and maintenance. The Bidder's work shall cover the complete requirements as per IS codes, fire safety norms, requirements of various statutory bodies, International Standards, best prevailing practices and to the complete satisfaction of the Employer. The Bidder shall make the layout and levels of all structures from the general grid of the plot and the nearest GSI benchmark or other acceptable benchmark of Government department. As per the directions of the Engineer. The Bidder shall be solely responsible for the correctness of the layout and levels and shall also provide necessary instruments, materials, access to works, etc., to the Engineer for general checking of the correctness of the civil works. All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site-specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.		
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	In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Employer. Wherever there is an anomaly in the design concept between the data furnished in the General Design Criteria & Design Concept of Buildings, the data furnished in the design concept of buildings shall be treated as final. Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for powerhouse structures or steel plant or Industrial structures like Petro/ Chemical/Refinery/Cement etc.		
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D-1-3 3.01.00	SUBMISSIONS The drawings included in the Bidding Document provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for bidding purposes only and are by no means the final drawings or show the full range of the work under the scope. Work has to be executed according to drawings prepared by the contractor. The following documents and drawing shall be submitted and got approved before commencement of detailed engineering. The list given below is not exhaustive but indicative only. a) Project design intent, design criteria which shall cover all design aspects, design parameters, material of construction and its specifications, structural idealization including framing system for gravity loads and lateral loads(wind and seismic), load cases, load combinations, assumptions, references, basis of analysis & design of all buildings, machine foundations, facilities, systems and structures etc. b) Survey drawings indicating spot levels for the area under the scope of work. c) Plants 'General Layout Plan' drawing with coordinates of roads, boundary wall, buildings and facilities, pipe/cable corridors, railway lines, Green Belt etc.. d) Geotechnical investigation scheme e) Geotechnical Investigation report including foundation system recommendations. f) Typical design of pile, if applicable, in terms of type, rated capacity, length, diameter and the termination criteria to locate the founding level. g) Scheme for initial and routine load test of Pile foundation high strain dynamic load test and pile integrity test methodology. h) Details of corrosion protection measures for all structures, foundations etc. i) Architectural concept designs which shall cover all concept plans and elevations, finishes and area statements of all buildings and facilities j) The following sequence of submission of drawings/ documents is to be followed: - Architectural drawings, wherever applicable - Relevant GA drawings & loading document - Analysis & design of structures/ buildings/ facilities with drawings. - Analysis & design of foundations with drawings.			
	3.02.00	Detailed construction drawings and design calculations for all civil works for static as well as dynamic analysis shall be submitted for approval prior to undertaking construction work.		
	3.03.00	Design calculations shall be done in M.S. Office (latest version) and Drawings shall be prepared in Auto Cad (latest version). The analysis shall be done by using STAAD PRO / ANSYS/SAP2000 (latest version). However, design may be carried out manually, using computer work sheets or by using suitable software programs, as mutually agreed by Employer. Final calculations and drawings shall be submitted as mentioned in General technical specification.		
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3.04.00	Civil Task drawings indicating various equipment loading and supporting arrangement and floor loads shall be submitted along with design calculations. Soft copies of all STAAD/Other Softwares input and output files shall be submitted along with the design calculations for all revisions.			
3.05.00	Structural steel fabrication drawings to be prepared by the contractor will not be approved by the Employer. However, the Contractor shall submit all fabrication drawings for Employer's reference. Copy of detailed bar bending schedule as prepared by contractor shall also be submitted to Engineer in charge for the reference.			
3.06.00	Approval of construction drawings prepared by the contractor shall not relieve the Contractor of his responsibility regarding the safety and adequacy of design and correctness of the drawing.			
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D-1-4	GENERAL LAYOUT PLAN	
4.01.00	The preliminary layout plan proposed for the project is shown in the drawing no 9587-999-POC-F-001 titled "General Layout Plan". It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope. Area identified for facilities remain same as indicated in GLP, however, minor modification of location of building may be done to optimize layout. Bidder shall prepare the detailed layout of the plant facilities which are in his scope and shall submit the same for Owner's approval. While preparing the detailed layout, planning his facilities and deciding upon the transportation and erection strategy he shall ensure the following aspects. - All Statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws are met. - Face of the buildings and facilities are located in such a way so as to have an offset of minimum 15 to 20m with respect to center line of road. - The entire construction activity shall take into account the commissioning of the unit in phases matching with the phased commissioning of the plant. - The interface requirements with the plant construction/erection activities of other contracting agencies engaged by Owner. These agencies engaged will be working simultaneously with the Bidder within the plant premises. - Available Area for laydown, preassembly and batching plant have been earmarked on the General Layout Plan. - No permanent facility shall be located within the safety zone limit around the fuel Oil storage tanks etc., except those permitted by Owner. - Transportation of all equipment and materials shall be by road as envisaged. Any other mode envisaged by the bidder may be proposed. - All parts of the buildings and facilities shall be approachable by fire tenders. - Main roads /peripheral roads are only shown in GLP and road layout tender drawing. Approach made of heavy-duty paving/passage to buildings/structures/facilities in the scope of bidder from nearby plant road/peripheral road/grid road/internal access road shall be provided. Multiple numbers of access to different parts of any building /facility like main plant building, control room, transformer yard etc. should be provided.	
4.02.00	DELETED	
4.03.00	Site Levelling and Slope Protection Work	
4.03.01	Complete levelling of entire plant area as shown in drawing no. 9587-001-POC-A-003 Titled 'Site Levelling Plan' shall be done by the Bidder. Filling in reservoir area below the bed of reservoir and for the reservoir embankment shall also be done by the Bidder. Detailed requirements for the same are specified under head 'Raw Water Reservoir' elsewhere in the specifications. Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire plant area including the areas earmarked for ash based units, ash silos, railyard, raw water pump house & associated facilities, reservoir and the diversion drains in Bidder's scope of work. Based on field observations the contractor shall prepare and submit the survey maps of the surveyed site on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, water-ways, buildings, power lines, natural streams, trees etc. For each area survey maps shall be	
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	prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features. Established methods of surveying like triangulation, traversing, fly leveling etc. shall be adopted for the survey work. Spot levels shall be taken at 25 meter interval and at closer intervals where pits, undulations etc. are met with. These levels shall be taken in two orthogonal directions. Contours shall be plotted at 5m interval. It is proposed that for the purposes of site leveling the entire plant and associated areas will be divided into various blocks as defined in the drawing no. 9587-001-POC-A-003 titled, "Site Levelling Plan". Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule. Preparation of leveling & grading as per proposed finished ground level (FGL) is in the Bidder scope. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise mentioned, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block. The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level. The excavation shall be in all types of soils or rock or a mixture of these. Bidder should assess and satisfy himself about the actual nature of soil present at site, before submitting his bid. All natural materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant in a manner as directed by the engineer. If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise, the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer. Filling with rock shall be done only after the written permission of the Engineer in the following manner: For filling the areas involving water bodies, dewatering, removal of much, dismantling of existing slope protection of water including all other scope of work required for filling of area to be done by the bidder. - Filling with rock shall be done only in areas identified for laydown and preassembly and ash based units. - Maximum size of rock used for filling should not be more than 150mm in all direction. - Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonne roller.			
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4.03.05	The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally.			
4.03.06	The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.			
4.03.07	Material suitable for filling shall be loaded and transported to the filling site by the Bidder. Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling: a) Material from swamps, marshes and bogs. b) Expansive clays c) Peat, logs, stumps, sod and perishable materials. d) Materials susceptible to combustion e) Any material or industrial and domestic produce which will adversely affect other materials in the work. a) Materials from prohibited areas			
4.03.08	Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.			
4.03.09	After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels.			
4.03.10	Filling upto the specified formation level shall extend at least 2.0 m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical: 2 Horizontal).			
4.03.11	For site levelling of railway siding area (as marked in site levelling drawing) shall also comply to Railway Design & Standards Organisation (RDSO) guidelines.			
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D-1-5 5.01.00	SALIENT FEATURES & DESIGN CONCEPT This section of specification covers salient features and design concepts of Civil, Structural and architectural works pertaining to Power Plant components as detailed below. Architectural Concepts & Design: a) All the Architectural design works shall be carried out by professionally qualified architects having adequate experience (minimum five years) in the design and detailing of architectural work of power plant buildings. Bidder may have in-house Architects with the required experience for the above or engage Architect Consultant having similar experience. b) Power plant buildings shall be architecturally treated, based on functional requirements, in such a way that they retain the desired scale, and present a pleasing composition of mass and void. The overall impact of the buildings shall be one of aesthetically unified architectural treatment having a comprehensible scale, blending colour scheme with the surroundings. c) All buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the main plant building, surrounding structures and environment. Due considerations shall be given to orientation, landscape design, and interior design. All finishes for floors, walls, ceiling, structural elements, partitions for offices and industrial areas shall be suitable for their aesthetics, durability and functional requirements and shall include the latest building material & technology. Consideration shall be given for achieving standardization & fast track construction. d) Overall colour scheme of the buildings shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipment, exposed structural elements, piping, trestles, bus ducts, and other service elements. Architectural design of all power plant buildings shall be suitable for installation of photovoltaic panel on rooftop for renewable energy purpose. e) For adequate light and ventilation, National Building Code recommendations shall be followed. All buildings having height more than 4.0 m shall have fixed glazed ventilators. f) Architectural design of all Power Plant Building shall be suitable for installation of solar photovoltaic panels on roof tops for renewable energy purpose. g) All the buildings shall be architecturally designed to meet the National Building Code requirement & Fire Safety Regulations. h) All public buildings shall be designed incorporating the provision of barrier free environment for physically disabled persons. i) All the buildings and site development including landscaping shall be designed to take care of rain water harvesting & ground water recharging. Development of rainwater harvesting scheme for the project and obtaining approval of the scheme from Central Ground water board is in bidder's scope		
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	j) For Control Rooms, CER, UPS Charger Room area in MPH dry wall construction technology shall be incorporated. Control room shall be designed as designer control room with ACP Cladded wall paneling for housing LVS. k) Full glass wall partition with aluminium frame over solid wall with skirting 150 mm high to be provided between CCR and CER of AHP CR, WS CR & CHP control room and MPH Control room. l) All control room shall be provided with air lock lobby. m) The development of green belt is not in bidder scope. However, bidder has to plan the facilities leaving the space for green belt as indicated in "General Layout Plan". In addition to that laydown areas and other vacant land of the plant will be used by owner for the development of green belt. n) All floor areas indicated in subsequent pages shall be total floor area required.		
5.02.00	Main plant Buildings/Structures shall comprise of: a) Mill Bunker Building b) Transfer Points, Conveyor Galleries & Trestles c) Machine Foundations in Main Plant d) Boiler Structure e) Compressor House f) ESP Structure g) ESP Control Building h) Pipe & Cable Gallery i) Main Power House The, Main Power House, Bunker building, transfer points, conveyor galleries and trestles, boiler supporting structure, compressor house, ESP supporting structures including inlet and exhaust duct support structures, Pipe cable Galleries & trestles shall have structural steel framed super structure. All other buildings may have either RCC or structural steel framework. Brief description of the above mentioned Main Plant Buildings is furnished herein:		
5.02.01	Mill and Bunker building i. Salient Features The mill bunker building shall house coal mills, feeders, Cylindrical Coal Bunker & Conical Hopper, Tripper Conveyor & its drive and monorails. All columns, main beams and secondary beams shall be made of structural steel. The RCC floor slabs (supporting the Feeder and Tripper Conveyors) shall comprise RCC slab supported on profiled metal deck sheet (to be used as permanent shuttering) not to be considered for design of RCC slab as composite slab) and shear anchor studs welded to the top flange plate of secondary & main structural steel beams, (which supports the RCC slab & metal deck sheet). Bidder shall integrate the Mill & Bunker Building with boiler supporting structure.		
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5.02.02 5.02.03	Access platforms shall be provided at minimum one (1) level above bunker supporting level for inspection and testing of bunker and hopper connections. Minimum (1) Nos. of man hole/ access window shall be provided for maintenance of silo. The bottom level of base plates of columns shall be 1.20 m below the finished paving level in the Boiler Area. The columns of Mill-Bunker building shall consist of built up structural steel I-sections. Rolled sections with additional cover plates on column flange shall not be acceptable for column sections. The cylindrical coal bunker and conical hopper shall be made of structural steel. The inside surface of hopper shall be lined with stainless steel plates the details of which are mentioned hereafter in this specification. Structural steel brackets with PTFE bearings shall be provided at the end columns to support the external gallery of the Tripper Conveyor The Mill-Bunker building roof shall be provided with Pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described in Clause 9.08.00, Part-B (Civil) of Technical Specification. Adequate slope shall be provided for quick drainage of rain water. The RCC floor supporting the Tripper Conveyor shall be fully covered up to the Roof level with single skin metal sheet (& structural steel runners).			
	ii. Design Concept The Mill Bunker Building shall be conceptualized as moment resisting frames in transverse direction and braced in longitudinal direction. In the transverse direction the bracings may be provided, wherever feasible, in order to meet the deflection requirement specified elsewhere in this section. Bracing member shall be connected to column flange plate through gusset plate (minimum 12mm thick). Minimum thickness of structural steel Bunker plates shall be 12mm inclusive of 4mm corrosion allowance. Minimum wall thickness of Hopper shall be 8mm. Minimum thickness of stainless steel liners on the entire inner surface of hopper wall shall be 4mm conforming to ASTM A240 S304 (Type 304) with Mill finish 2B cold rolled, annealed, descaled (pickled) and skin passed. To ensure smooth flow of coal, the hopper surface shall be provided with minimum angle of 73° with the horizontal plane. The top of the cylindrical bunker shall bear no load/ reaction from the tripper floor and accordingly neoprene bellow strap shall be provided at the interface between the two structures to allow free deflection of the tripper floor. Neoprene bellow strap shall be provided all-round the bunker to effectively seal the gap between top of bunker and sealing plate below bunker. For all other design methodology, refer to Design Criteria specified hereafter in this specification.			
	iii. Architectural Features The Mill & Bunker Building shall be a structural steel framed structure having RCC floors and prefabricated insulated metal sandwiched panel sloped roof. The tripper floor side cladding shall be Single skin Metal cladding with steel louvered windows and fixed windows with poly carbonate sheet glazing. Area of windows shall be minimum 10 % of floor area. Rainwater down comer shall be of galvanized MS pipes and shall be located at every column location.			
	DELETED			
	Machine Foundations in Main Plant Area A. SG Area			
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5.02.04	Alternative-1 TDBFP&MDBFP foundations shall consist of RCC top deck supported on steel helical springs & viscous dampers inside Main Power House. In case the top deck is located at operating floor/mezzanine floor level, the springs/ viscous dampers shall be supported on a group of structural steel columns-beam grid which shall be rigidly integrated with the Main Power House Structural frame. Alternative-2 TDBFP&MDBFP foundations shall consist of RCC top deck directly supported on RCC/ structural beams and columns without any steel helical springs & viscous dampers inside Main Power House. The structural columns and beams supporting the TDBFP / MDBFP shall be independent of the Main Power House Structural frame and shall also have independent foundation without any connection to other nearby foundations. Further each TDBFP / MDBFP shall have independent supporting structural arrangement without any interconnection among themselves. Bidder has the option to choose either Alternative-1 or Alternative-2 based on his design philosophy and practice. However in case Alternative-2 is adopted by bidder, then the bidder has to furnish extended warranty of five years for satisfactory static and dynamic performance of the foundation system. BFPs in ground floor In case the MDBFP/TDBFP foundation is envisaged to be located at ground floor of Main Power House, then these shall be designed as block foundations directly resting on soil / pile. Vertical facing of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/Cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round. ii. Design Concept: - For the foundations of Turbo-generator, Boiler feed pumps, etc. detailed static and dynamic analysis shall be done. - The vibration isolation system (where ever applicable) supplied shall be of proven make and shall be in successful operation supporting machines like steam turbo-generators, BFPs, etc., - Wherever alternative-2 is adopted by the bidder for TG or BFPs, suitable provisions to be ensured by the bidder in their General Arrangement and design to prevent transmission of vibration from these machine foundations to other nearby structures / foundations. - The bidder or his consultant should have adequate prior experience in design of machine foundations for the respective alternative to be adopted by the bidder and the machines should be in successful operation for at least one year prior to the date of submission of bid. For detailed specification of steel helical springs and viscous dampers refer General Specification Chapter. Boiler Structure i. Salient Features The Boiler supporting structure shall be structural steel framed superstructure adequately braced in vertical planes in both the orthogonal directions. The general arrangement & details of structural steel columns, beams, bracings, ceiling girders etc shall be as per the Bidders Boiler Structure design and detailed engineering scheme.		
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5.02.05	The bottom base plates of Boiler structure columns shall be 1.20m below the finished paving level in the Boiler area. The RCC pedestals supporting the column base plates shall be extended in order to provide RCC encasement to the structural steel columns up to at least 350mm above the top of the paving RCC slab. Steam Generator roof (pent house)/canopy/side cladding shall have single skin troughed profile permanent colour coated sheet. Cladding for Boiler elevator enclosure except its machine room shall be with single skin troughed profile permanently colour coated sheet. Bidder shall integrate the boiler supporting structure with Mill & Bunker Building Structure. Waterless Bio Urinals with enclosure are to be provided by the contractor on each floor elevation of each boiler. Maintenance of toilet in hygienic condition till COD of the unit shall be the responsibility of the bidder. ii. Design Concept Boiler supporting structure shall be designed by the Bidder based on provisions of IS 800 for structural steel and IS: 456 for RCC works. Boiler Elevator Machine Room Floor of Machine Room shall be provided with profiled metal decking sheet. Trough shall be filled with Insulating Material (glass wool or rock wool) and thereafter finished with Minimum 50 mm thick wooden flooring, consisting of 37 mm thick hardwood planks, finished with 11mm thick laminated wooden flooring (of 'pergo' or equivalent) with plank size 193x1195mm (material class shall be 34 as per EN13329), over 2 mm expanded polystyrene foam and polythene sheet under laying. Roof and Side enclosure of Machine Room shall be provided with Prefabricated Insulated Metal Sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described in Clause 9.08.00 of Part-B (Civil) of Technical Specification. Doors of Machine Room shall be Double Plate Steel flush doors of thickness 45 mm with steel sheets of 18 gauge with necessary stiffeners. Space between two sheets shall be filled with mineral wool insulation. Frame of doors shall be pressed steel sheets of 16 gauge. All necessary fittings for the doors shall be provided by the Bidder. Rubber sealing, for making the Doors airtight shall also be provided. Windows/ventilators shall be of standard extruded anodised Aluminium Sections of minimum 2 mm thickness with 24 mm hermitically sealed double glazing consisting of two 6 mm thick toughened glass separated by 12 mm. gap. Technical requirements of prefabricated insulated metal sandwich panels/decking sheets shall be same as given elsewhere in this specification.			
	Compressor House i. Salient Features: The compressor house shall be a structural steel framed superstructure with a overhead crane as per requirements specified in Part-A Sub Section IIA-19 and Part-B Sub Section A-25 of Technical Specification. The gantry girder for the crane shall have walkway with chequered plate on both rows and cage ladder access. The roof shall comprise minimum 40mm thick RCC slab (with additional water proofing) supported on profiled metal deck sheet and purlins. The ground floor slab shall comprise of all RCC block foundations, cable trenches and pipe trenches. The building shall be completely covered with vertical cladding and roof. Design Concept:			
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5.02.06	The Design of Compressor House steel structure shall be based on provisions of IS 800 & IS 456 for RCC works. The structural frame shall be moment resisting sway frame in the lateral direction and longitudinally braced in the longitudinal direction. Design shall also be based on the Design Criteria specified elsewhere in this specification. ii. Architectural Features This building shall be steel framed structure with brick wall up to window sill height & Single Skin Metal Panel cladding above it. The roof system shall be as per the detail furnished in the salient features of this building Cut-outs and opening shall be provided in floors and walls as per requirements. Metal Panel cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be of Premium Acrylic Smooth Paint with Silicone additives The size, height, door/window/rolling shutter details and building size shall be as per the approved equipment layout plan of the bidder.			
	ESP Structure i. Salient Features The ESP structure shall be a structural steel superstructure with vertical bracings in the required vertical planes in both longitudinal and transverse directions, the details of which shall be as per the approved ESP equipment GA & details of the bidder. The bottom of base plate for ESP structure columns shall be 300mm above the finished paving level in ESP area. The RCC pedestals supporting the column base plates shall be extended accordingly above the top of the paving RCC slab. Further, the gusset plate / base plate shall be encased in concrete up to the top of bolts. ESP roof (pent house)/canopy/side cladding shall be single skin troughed profile permanently colour coated sheet. ii. Design Concept Design of ESP structure shall be based on provisions of IS 800 for structural steel and IS 456 for RCC works. It shall be an axially braced structure in both orthogonal directions. The ESP supporting columns shall be suitably strengthened about the minor axis for sliding movement of the base plate of ESP due to thermal movement.			
5.02.07	ESP Control Building i. Salient Features ESP Control Building can either be structural steel superstructure or RCC framed structure with RCC floors at ground floor level and upper levels. The RCC floors at upper levels shall support the Switchgears, cable galleries and Control Room. The RCC floors at upper levels shall be cast in situ RCC slabs. For steel framed building the RCC floors shall be supported on profiled metal deck sheet and structural steel beams and roof of the building shall comprise of minimum 40mm thick RCC slab supported on profiled metal deck sheet and structural steel beams. The rainwater down comers shall be as per specification and shall be suitably concealed. The external Transformer Yard of the building shall comprise the transformer foundations and cable slit below ground level.			
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5.02.08	The building shall have Lift structure with lift pit below ground level and staircase at each gable end of the building. ii. Design Concept The Design of ESP Control Building shall be based on provisions of IS 800 for Structural Steel & IS 456 for RCC works. iii. Architectural Features This building shall be completely covered with Light Weight Autoclaved aerated concrete blocks on all four sides except for the portion in front of the external Transformer Yard and toilet and pantry block. Provision for glazed/ fire proof doors & windows shall be included. Minimum 345mm thick brick wall shall be provided for the external brick wall facing the adjacent transformer yard and the brick wall height shall be 600mm above the highest point of the transformer. Inside the building, AHU rooms, UAF Room& Battery rooms shall have brick masonry of one brick thickness. The internal walls of air-conditioned area shall be finished with 2 hour fire rated Aluminum Composite Panel Cladding. Entire transformer yard, which shall be adjacent to the building, shall be provided with metal fencing with gates. The building shall accommodate cable vault, toilet, staircase, switchgear rooms, control rooms and AHU room. An auxiliary transformer yard with fencing and gate shall be provided adjoining to the building. Control room and VFD room shall be air-conditioned and shall have false ceiling. Windows& Ventilators all shall be provided with Aluminium sections. All doors, windows in air conditioned area shall be provided with hermetically sealed toughened glass glazing in Aluminium frame work Steel doors and Fire proof doors shall be provided as per requirements. Internal columns in Control Room shall be encased with Aluminium Composite Panel cladding. Minimum 2 Nos. of stairs and 2 Nos. of Toilets shall be provided as per requirement. Cut-outs and opening shall be provided in floors and walls as per requirements. External finish shall be of Aluminum Composite Panel Cladding except Transformer area where premium smooth Acrylic Paint shall be provided. Pipe & Cable Galleries i. Salient Features The Pipe- Cable Gallery shall be Structural Steel Superstructure with Steel Truss (Lattice Girder) having a general span of 15.0m/20.0m. The steel truss shall be supported on 2 legged/ 4 legged trestles the arrangement of which shall be developed by the Bidder. Trestles for pipe and cable galleries shall also be of structural steel. The width of the Gallery shall vary depending on the functional requirement. A walkway of minimum width 600mm shall be provided along the Cable Trays supporting floor of the gallery. The walkway shall comprise 40mm thick MS grating and 1.0m high handrail made of 32NB MS pipes. For pipe cable galleries carrying ash pipes, galvanized MS grating shall be provided over entire width of the gallery. Plan bracings shall be provided at all chord levels of the cable gallery truss. Minimum gusset plate thickness shall be 8mm for all connections. The level of the bottom chord (bottom of steel) of the gallery shall be at least 3.0m above the finished paving level in general. However, at all road/rail crossings, the level of bottom of steel of the gallery shall be at least 8.0m from the top of road surface and 8.5 m from top of rail track. Before and after the road/rail crossings, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8 m) up to the pipe/cable racks/trestles.		
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	The Caged structural steel ladder shall be provided at an interval of 200m for access to the Pipe-Cable Gallery Walkway. At the inter-connection of Pipe/Cable gallery with Plant buildings, Pipe/Cable gallery shall be terminated at a maximum distance of 1.50m from the building. The foundation of the Pipe/Cable Trestle shall be constructed at a distance of 4.0M from center line of the plant building. Cantilever of 2.50m shall be taken from pipe-cable gallery/ trestle structure. The foundation for Pipe-Cable gallery trestles shall be open foundation or pile foundation depending upon bearing capacity requirements. For specification regarding open and pile foundations, clause. 7.00.00 is to be referred. The grade of concrete for RCC footing/pilecaps & pedestals shall be M25. The structural trestles shall not be supported on paving RCC slab. ii. Design Concept The pipe-cable structure shall be designed as a 3-dimensional space frame for all the relevant load cases mentioned in the design criteria chapter. The gallery being an unclad building, wind load shall be evaluated based on the projected frontal area of the structural members and cable tray depth. The end portals shall be designed as rigid frames hinged (pinned support) at the base plate level (on top of the trestle column). Deflection of end portal due to wind shall be evaluated at the portal column-rafter joint. The gallery vertical truss shall be designed as simply supported girders on trestles and detailing of end portals shall be done accordingly. Suitable expansion gap shall be provided in the gallery structure by providing twin two-legged trestles at the expansion gap. The expansion gap shall be provided at an interval of 100 to 120m. Expansion gap shall also be provided at location where changes in plan dimensions (gallery width) take place abruptly.			
5.02.09	Main Power House (i) Salient Features: Main Power House shall consist of the Turbine bay, adjacent Deaerator Bay, electrical bay & common control room building (CCR Building) (as stipulated elsewhere in this specification). The turbo – generator (TG) foundation, boiler feed pumps foundations and shall be located inside the power house and their foundation system shall be as per design concept of machine foundation. All other equipment foundations (including Heaters & Deaerators) shall be supported on RCC floors with structural steel beams. The RCC floors shall comprise RCC slab over profiled metal deck sheets (to be used as permanent shuttering but not to be considered for design of RCC slab as composite slab). Shear anchor studs shall be provided through metal deck at regular interval on all top flange / flange plate of structural beams. However, steel gratings, chequered plate flooring as well as precast RCC covers shall be provided as per the functional requirements. All RCC pits & trenches below ground floor slab (including Condensate Extraction Pump (CEP) pit) shall be covered with minimum 40 mm thick MS grating supported on structural steel beams. The RCC pits shall also be provided with a sump at the corner for dewatering with submersible pumps. Staircases & ladders shall be provided for access to these pits. Electrically Operated Travelling (EOT) cranes shall be placed in the turbine bay with the gantry girders (supporting crane wheel loads) supported on structural steel brackets on A & B row columns). Walkway with chequered plate shall be provided at crane girder level at both 'A' row & 'B' row side with caged ladder access from the operating floor. All main columns & beams of Main Power House shall be of structural steel girder (open web or solid web) with base plate level of columns 1.20m below ground floor slab level in			
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	general except for other pit areas where structural steel column shall be extended below upto a depth lower than the pit top surface such that the column base plate & stiffeners are concealed below the pit raft level are concealed below the pit raft level. Auxiliary columns in main power house shall be either of structural steel construction. The roof system in turbine bay shall comprise a structural steel girder (open web or solid web) for the entire bay width. The roof slab shall consist of 40mm thick (min. above the crest of metal deck sheet) RCC slab supported on profiled metal deck sheet. The metal deck sheet shall be supported on structural steel purlins. The purlins shall be in turn be supported on turbine bay roof girder top chord at regular interval. Additional waterproofing shall be provided above the roof RCC slab as per details mentioned elsewhere in this specification. 1 in 100 slope shall be provided for the turbine bay roof sloping downwards towards the A-row (towards transformer yard). Minimum 150mm dia. galvanized mild steel pipes shall be used at A-row & C-row as Rainwater Down comers. Staircases in main power house shall be of structural steel. Treads of each staircase shall be 40mmthick MS grating and handrail/ hand post shall be 32mmNB circular hollow sections unless specified otherwise in architectural section of the specification. All staircases in turbine Bay and Deaerator Bay shall be enclosed with minimum 230 thick brick masonry wall with fireproof doors at all floor landing levels. The parapet wall shall be of minimum 1m height and shall be provided all the around roof of main plant building. All edges of openings shall have edge protection angles (minimum ISA 75x75x6) and handrails with hand posts (Hand post spacing 1m maximum). ii. Design Concept: Main Power House shall be designed as moment resisting sway frame in the transverse direction and braced in the longitudinal direction. However, due to functional requirement, vertical bracings to the column in CCR Building not to be provided at (& above) the operating floor level and CCR Building frames shall be designed as moment resisting frames in both transverse and longitudinal directions. All beam column moment connections shall be designed for adequate ductility. The building shall have connectivity with walkways from Boiler through sliding bearing only. The connectivity with cable gallery shall be as specified in Pipe & cable gallery section of this chapter. Floor level acceleration spectra shall be generated during seismic analysis for design of pipe supports / equipment located at the elevated floors. Adequate number of thermal expansion gap (minimum 2.00m) between adjacent structural frames at expansion joint and minimum 50mm between RCC slabs at expansion joint) shall be provided between the units and Common Control Building. In the RCC floor/ roof slabs, the spacing of shear anchor studs on structural beams shall be minimum of the spacing required for i) Restraining the compression flanges of beams and ii) Transfer of the horizontal shear at floor/roof to the supporting beams. The roof girder in Turbine Bay shall be provided with a camber to take care of deflection due to dead weight. The Main columns in A, B & C rows of Main Power House Building shall be built-up I sections. Rolled sections/ I sections with additional flange plates shall not be acceptable for main columns & auxiliary columns. The roof girder (open web or solid web) to column connection shall be bolted connection using high strength bolts (grade 8.8/ IS 1367). The roof girder of Turbine Hall shall be adequately braced in plan using Tie level and rafter level bracings. The longitudinal bracing shall comprise a pair of members connected to the column flanges and detailing shall be adequate to restrain the entire column cross-section. Minimum gusset plate thickness for bracings shall be 12mm. Common Control Room at operating floor shall have minimum 60% free space for		
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	movement, control room to be free of any auxiliary/stub columns other than the C-row central column with minimum depth as possible For all other design methodology, refer to Design Criteria specified elsewhere in this specification. iii. Architectural Features This building shall be of Structural Steel Framed structure and shall be completely covered with external cladding and RCC roof. The external vertical face (herein stated as 'A' row) of main power house facing (& adjacent to) the transformer yard and also the two gable ends shall be completely covered with vertical cladding comprising 3.0m high brick wall (on ground floor slab) and single skin profiled vertical metal sheet for the remaining height except for the vertical segment between operating floor & gantry girder bracket level where double skin vertical metal sheet shall be provided. In case of routing of bus-duct is done outside the A-row (part/full), there shall be a continuous cladding of metal sheeting covering steel structure supporting the bus duct to match the entire A-row elevation. The metal cladding shall be designed to suit the aesthetics of the entire main plant building. In front of the power transformers, RCC fire barrier wall shall be provided as per functional requirement in lieu of brick wall at A-row. The above mentioned RCC wall shall be attached with single skin metal sheet on external face. The 'A' row & Gable End columns projecting inside the turbine hall shall be concealed with single skin profiled metal sheet from operating floor level to crane girder bracket top level. The external vertical face (herein stated as 'C' row) facing (& adjacent to) the Boiler area shall be completely covered upto the Deaerator floor level with vertical cladding comprising 3.0m high brick wall on ground floor followed by either single skin metal sheeting with runners or brick wall sandwiched with single skin metal sheeting on external face (for all floors requiring 2 hours of fire rating e.g. cable spreader room, ventilation/ air washer room, AHU Rooms and air conditioned areas) The internal vertical interface plane between Turbine bay & Deaerator bay (herein stated as 'B' row) shall have brick masonry Wall from RCC roof slab level of turbine bay (AB bay) upto specified floor level below such that Turbine bay & Part of Deaerator bay below the Deaerator supporting floor level is completely covered on all sides. Glazing for A Row & gable end shall be reflective 6mm thick clear toughened glass with Aluminium frame. Hermetically sealed double glazing shall be provided between air conditioned & non air conditioned areas. Internal glazed partition inside CCR/CER/Offsite Control Room and B-Row at operating floor level shall be of fire resistant glass having 2 (Two) hour fire rating and with suitable frame. Light weight aerated concrete panels with Single Skin Metal Panel cladding shall be provided in exterior of UPS Battery room area and Control Equipment Room area. All internal side of Aerated concrete panel and columns in air-conditioned areas other than CCR in MPH shall be encased with Aluminium Composite panel cladding from inside. Inside the main power house building, brick masonry wall (and fire proof doors) shall be provided for switchgear rooms, cable spreader rooms, MCC rooms, AHU rooms, Air Washer room & Oil rooms and all other rooms where fire protection is envisaged. Cut-outs and opening shall be provided in floors and walls as per functional requirement. All door, windows in air conditioned area and all windows glazing shall be provided with Aluminium frame work Steel door and Fire Proof doors shall be provided as per requirements. Stairs in BC Bay and on A-Row shall be provided as per functional requirement and as		
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per National Building Code and Factories Act.

All stairs in BC Bay lift lobby Area shall be in RCC. Stainless steel railing shall be provided at TG floor level for all cut-outs/ openings, walkways, cut-outs at lower level that are visible from TG floor level and stairs near lift lobby. M.S. railing shall be provided for all other locations. All peripheral edges of floor cut-outs / openings at T.G floor level and covered with gratings/ chequered plates, expansion joints along T.G deck, structural expansion joints shall be covered with minimum 2mm thick stainless steel plate of grade SS 316.

For each unit minimum one no. gent's toilet with adequate facilities including drinking water space and janitor's space shall be provided at each level of power house building, in addition one no ladies toilet shall be provided in each unit at 0.00M and mezzanine floor level and CCR level. A separate ladies and gent's toilet and pantry shall be provided for CCR approachable from CCR / CER / Offsite Control Rooms.

B Row portion in TG Hall fronting Control Room & CER and glazed partitions in CER/ CCR/Offsite Control room shall be of **30 mm thick** Hermetically sealed double glass of Fire resistant of min 14mm thick clear, toughened, interlayered 120 minute fire rated for both integrity & radiation control and 6 mm thick toughened tinted glass with **10 mm** gap and with suitable fire resistant frame of 1.6 mm thick powder coated steel sheet. The partitions shall be up to false ceiling level and wall above up to the soffit of floor slab above control room and shall be finished with Aluminum Composite panels cladding and shall also have FRP mural of theme matching to local art and Culture.

Glass partition between AC areas in CCR/CER and other areas in associated with CCR/ CER shall be single Fire Resistant glass in line with technical specs as per fire zoning requirement. It shall be single toughned glass minimum 10 mm thick if not within fire zone.

In CCR, EIC Room, Conference Room, Programmer's Room and Visitors Gallery etc. a theme based coordinated false ceiling shall be provided with latest state of art design.

In CCR, EIC Room, Conference Room, Programmer's Room and Visitor's Gallery etc., vitrified flooring shall be designed with theme and color coordination in line with the designed false ceiling.

Mullion-less glass wall with motorized curtain shall be provided in between the control room and the Visitor's gallery.

The fire resistant glass partition in between CER/PADO room & control room (control room left hand side wall) and shift in-charge room/Conference room & control room (control room right hand side wall) shall have motorized blinds (with provision of remote control from Unit in-charge desk) with central metallic panel column having NTPC signature icon.

The rest of the walls including LVS wall shall have coordinated design keeping in mind the overall theme of the control room using metallic panels with calcium silicate boards.

The control room gates shall have biometric physical security feature with double layer of sliding doors with air lock lobby.

Control room interiors shall be designed and executed by M/s EVANS / M/s Pyrotech or equivalent vendor who are specialized in control room interior design.

Control room/ Control Equipment Room / Offsite Control Rooms, entire area, False Ceiling shall have Cat Walk Way above for service/ maintenance.

Main power house building shall be provided with passenger lift in BC way as specified elsewhere in technical specification.

Adequate partitioning as per functional requirement above false ceiling in control Room & CER shall be provided for Inert Gas zoning.

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	Internal steel columns in Air Conditioned Area of Main Power House Building (CER, UPS charger room, SWAS room, etc.) shall be encased with Aluminium Composite Paneling up to false ceiling. Functionally the very heart of Power House Building is its Control Rooms. Special attention shall be given for conceptualization of interior design of the Control Rooms. Control rooms design shall be both functional and ergonomic for ensuring reliable and error free operation of the plant. Control room shall have metallic panels with calcium silicate boards cladded video wall housing large video screens and a separate visitor viewing gallery. A walk through view of the control rooms shall be submitted along with bill of quantity to illustrate the design scheme. Metal Panel Cladding shall be composed of Different Colour shades to match with the surroundings. External finish of Masonry wall shall be premium acrylic smooth exterior paint with silicon additives finish. Air Conditioned Office for 25 persons (Including 5 cabins for Senior persons) with Pantry, Toilet block(Ladies and gents toilet separately), conference room for 25 persons, shall be provided in MPH building in addition to other facilities specified . This area shall have access to natural light on three sides minimum. It shall have air lock lobby at entrance with auto sliding doors. Minimum area of office area shall be 350 sq.m. This area shall be positioned over the CR with good aesthetic view and noise reduction and dust isolation.		
5.02.10	Not Used		
5.02.11	CPU CIVIL WORKS		
5.02.11.01	Design Concepts for Buildings/ Shed		
	i. All Buildings shall have RCC framed structure with cast-in-situ RCC roof slabs with brick cladding. ii. Equipment/facilities with shed shall have structural steel superstructure with permanently colour coated metal sheeting at roof and side open. However, kerb wall shall be provided all around the plinth/ floor area above the Finished Floor Level (FFL). For other buildings brick wall cladding on exterior face shall be provided. iii. Unless specified, the wall cladding for buildings shall be with minimum one brick thick on exterior face. However, brick wall for buildings adjacent to transformers shall be minimum 345mm thick.		
5.02.11.01.01	Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.		
5.02.11.01.02	The load and load combinations and design criteria shall be as specified elsewhere in the specification.		
5.02.11.01.03	All liquid retaining structures shall be designed for following load conditions. Underground structures: a. Water filled inside up to design level and no earth outside. b. Earth pressure with surcharge of 2.0 T/m² and ground water table up to FGL outside and no water inside. c. Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure.		
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- d. The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table.
- For design of over - ground liquid retaining structures appropriate load cases shall be considered.
- 5.02.11.01.04 All liquid retaining and conveying structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2).
- In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.
- Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.
- Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.
- Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.
- The minimum grade of concrete for all RCC structures shall be M30. The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456(2000) and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to severe exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.
- 5.02.11.01.05 Factor of safety against overturning and sliding
- The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.
- 5.02.11.01.06 For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.
- Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.
- Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:
- | Sl. No. | Structural Element | Main Reinforcement | Distribution Reinforcement / Stirrups/ ties/ Anchor Bars |
|---------|--------------------|--------------------|--|
| a) | Foundation | 12 mm | 12 mm |
| b) | Beams | 12 mm | 8 mm |
| c) | Columns | 12 mm | 8mm |
- Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.
- Suitable shrinkage reinforcement shall be provided at top face of foundations. Minimum shrinkage reinforcement shall be 10 mm dia. @ 200mm c / c.

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5.02.11.01.07	Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area. Minimum tensile Reinforcement in each direction for all foundation slabs / rafts shall be 0.2% of cross sectional area. Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm. Minimum thickness of all other elements of RCC liquid retaining / conveying structures (except effluent drains, launders and aerator waste slab) shall be 200mm. Effluent drains (depth more than 500mm), aerator waste slab and launders shall have minimum element thickness of 150mm.		
5.02.11.01.08	All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter rods or 6 mm flats. Edge protection angles shall be provided as specified elsewhere.		
5.02.11.01.09	All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.		
5.02.11.01.10	2.0m wide walkway with M25 grade concrete paving over an under bed specified elsewhere shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL Reinforcement of the RCC paving shall consist of minimum 8mm diameter bars @ 200 mm c / c in both directions at the centre of the slab.		
5.02.11.02	Coating on RCC water retaining structures (other than drinking water) Epoxy phenolic coating shall be applied on (i) internal surfaces of the RCC water retaining structures and (ii) external surfaces of RCC Neutralisation-pit which is in contact with earth, as per details specified below: - All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% $\pm 2\%$) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free. - Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.		
5.02.11.03	Coating on RCC water retaining structures (drinking water) Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free.		
5.02.11.04	Architectural Concepts and Finishing Schedule Architectural concepts and finishing schedule shall be as specified elsewhere in architectural specification.		
5.02.11.05	Acid / Alkali Resistant Treatment: Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick Acid Resistant (A.R.) bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable pilasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.		
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5.02.11.06	The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R. bricks layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 1.0M high with above treatment shall also be provided if applicable in case of walls nearby. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum Solution Preparation tank: 5mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks. Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns. Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns. Guarantee The Contractor shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Contractor shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.			
	Foundation of Over Ground Steel Circular Water Storage Tanks			
	General Requirements			
	The tank foundation shall be as per IS 803 and as specified in relevant clause of foundation chapter.			
	Sub Grade Preparation			
	The surface of natural soil shall be thoroughly compacted by rolling or other means, as directed by Engineer, to obtain 95% of max. laboratory dry density for the soil, as per IS:2720 (Part-VII).			
	Anti Corrosive Layer			
	Anti-corrosive layer shall consist of screened coarse sand, mixed with 80/100 bitumen or equivalent 8% to 10% by volume.			
	Bitumen shall be heated to a temperature 175 ⁰ C to 190 ⁰ C, with 3% kerosene, if required. Sand shall be thoroughly mixed with it in a mixing drum to obtain uniform mixture and shall be laid over the compacted surface, laid in line, grade and levels and as directed by the Engineer. Bitumen shall not be heated beyond the temperature limits given above.			
	The premix carpet shall be laid in two layers of 3 cm and 2 cm respectively. After compacting and laying the first layer of 3cm, a tack coat of hot bitumen at the rate of 1 Kg. per Sq.m. shall			
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5.02.11.07	be uniformly applied to the surface, by means of Sprayer and the Second layer of 2cm thick shall be laid, tamped and compacted to the satisfaction of the Engineer. Sand shall be spread on the final surface at the rate of 0.5 Cu. m per 100Sq.m. Premix Materials Sand Sand shall be clean, dry, coarse, hard angular, free from coatings of clay, dust and mix of vegetable and organic matters and shall conform to IS 383 (Grade -III). Stone Chippings Stone chippings shall be hard black trap or granite or locally available stone and shall conform to IS 383. The grading shall be of normally 12mm down size and 6mm down size, in the ratio of 3:2 respectively. Bitumen Bitumen required for the work shall be 80/100 grade or its equivalent quality. Laying Areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen shall be uniformly applied by Sprayers. The applied Binder shall be evenly brushed. The Binder bitumen 80/100 shall be heated to the temperature of about 190^o C with 3% kerosene, if required and mixed with stone chippings of size, as mentioned above, at the rate of 400 KG, with Six (6) Cu. M. of stone chips, for 100 Sq.M. of surface. The total mixed quantity, as mentioned above, is the quantity required for the total 50mm thick for 100 Sq. m. of area. Mixing shall continue until the aggregate is well coated.		
5.03.00	CHIMNEY		
5.03.01	Salient Features Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. There shall be one flue (liner) for each unit. The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.		
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5.03.02	The flue duct outside the chimney shall be suitably connected to the vertical flue liner inside the chimney as per EPRI Wet Stack Design Guidelines.-Expansion Joint shall be provided at the interface between the flue liner and the absorber outlet duct as per design. The expansion joint in the flue liner shall comprise of non-metallic material suitable for wet stack operations, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. If required as per design or as per the recommendation of expansion joint manufacturer, the space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Design of expansion joint shall comply EPRI guidelines to avoid contact of condensate with expansion joint material and to ensure drainage of condensate. Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be upto the platform just below roof platform and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects. Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance. The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments. Design Concept Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. Imposed loading for design of all chimney components shall not be less than 5 kN/ Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.		
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5.03.03	Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Wind Shield The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998. The wind shield shall be analysed for cases with and without flue liner loads. Forces/stresses in the wind shield due to eccentricity effects of local loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. Seismic response of the chimney shall be computed by the response spectrum method. Dynamic modulus of Elasticity shall be considered for calculating natural frequencies of the chimney. At least, the first five modes of vibrations shall be used for this analysis. The across wind analysis of the chimney shall be carried out as per the provisions of IS 4998. Across wind loads shall be combined with co-existing along wind loads. The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm. The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm. There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings. There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level. The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height up to the top level of flue duct opening. Shell thickness between any two 10m reference levels shall not vary more than 150mm. The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm. Grade of concrete for chimney shell, and other super structure shall be minimum M30. Only OPC cement shall be used for Chimney shell and other super structure. The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located upto distance of 20 times diameter at 2/3rd height of subject chimney in the area or in the future expansion stage of the project, as envisaged by the owner at the time testing, shall be determined along with the other topographical features of the local area through model test.			
	5.03.04	Flue Liners		
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5.03.05	The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification. For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification. Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels. The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.			
	Internal Platforms The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.			
	Internal Staircase The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.			
	Foundation The chimney foundation shall be designed as per limit state method as per IS 4998 for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/piles for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 30.			
	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner) The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/°C at a mean temperature of 100°C. The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation			
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5.03.09	shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer. Chimney Painting (i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification. (ii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. (iii) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. (iv) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iii) above in alternate bands of 'signal red' and 'bright white' colours.			
5.03.10	Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual.			
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5.04.00	RAW WATER RESERVOIR			
5.04.01	Scope The scope of work for Raw water reservoir generally involves design, preparation of general arrangement drawings, construction drawings, supply of labour, materials and construction of all civil and structural works like site clearance, site leveling & grading, excavation, filling, construction of earthen embankment, providing sand filters, sand chimney, sand blanket in embankment, cut-off trench, mechanical compaction, slope protection, HDPE lining, PCC lining, non woven geotextile, Inlet and Outlet Structures, RCC spillways, supplying & laying of MS pipes and associated Civil Works, road works, construction of drains along the reservoir boundary etc. and other ancillary works associated with the completion of reservoir as per directions of the Engineer. Disposal of surplus excavated material in NTPC Land outside plant boundary(including dressing the top surface) and compacting the same by mechanical means in layers(not exceeding 300mm thickness, higher layer thickness upto 500mm in case of compaction using special type of equipment such as vibratory roller etc.) to minimum 85% Standard Proctor Denisty at optimum moisture content in case of soil and/ or to 85% of original volume in case of boulders , clearing grass and vegetation, levelling is in bidder's scope.			
5.04.02	General Requirements Raw water reservoir shall have gross usable capacity as indicated in the tender drawing.			
5.04.03	Design Requirement Sizing of the reservoir shall be such so as to utilize the maximum allocated area for the reservoir as per the layout drawing of the plant and as directed by the Owner. Bottom 500 mm (minimum) depth of water shall be treated as dead storage for settlement of any silt etc. The dead storage shall be over and above the total required capacity of the reservoir. 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 1500mm. Earthen embankment shall be designed as an earthen dam as per IS: 12169 with internal drainage system i.e. sand chimney and sand blanket of 500mm (min.) thickness shall be provided inside the embankment. Slope stability of embankment shall be analyzed as per IS: 7894. However, the minimum slope of embankment shall be 1V:2.5H with a berm of 3.0m at every 6.0m interval. The founding level of embankment shall be at least 300mm below natural ground level. The top soil shall be stripped to a minimum depth of 300mm. However, the stripping depth, if required, shall be increased to the required level as per actual conditions to totally remove all vegetations, organic matters, roots, soft spots, etc. The whole area of reservoir bed shall be graded & leveled by cutting and filling. Wherever filling is required at the bed of the reservoir, area shall be stripped first and then embankment filling shall be done in layers of 300mm compacted thickness and compacted to minimum 90% of maximum dry density (Standard Proctor) by mechanical means at optimum moisture content. Minimum top width of embankment shall be 6.0m with provision of single lane WBM road including black topping all around on top of embankment. WBM road shall be constructed in accordance with IRC: 19 (latest edition). On downstream slope of the embankment, rip-rap shall be provided from toe up to or higher level than the HFL. Turfing shall be provided from embankment top to rip-rap/HFL level. Rock-toe with toe drain shall be provided at the toe (bottom) of the embankment all around the reservoir. Toe drain shall be of adequate capacity to be constructed in RCC grade M30. An approach ramp of minimum 6m width and min. 1V:8H slope shall be provided for access to the top of reservoir embankment along with single lane WBM road including black topping. The side slope of ramp embankment shall be minimum 1V:2.5H and shall be provided with rip-rap/turfing (as required) on side slopes.			
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5.04.04	In order to arrest the seepage/percolation losses through reservoir bed/embankment, 1mm thick high density polyethylene (HDPE) liner shall be provided at entire bed and upstream side slopes. HDPE liner shall be laid on the prepared soil bed which is free from any sharp objects, roots or any other organic materials. HDPE liner shall be anchored in PCC filled trench at the edge of top of embankment. HDPE liner shall be protected by providing non woven geotextile and 75 thick PCC lining. Suitable underdrainage system consisting of Pressure Relief Valves (PRV) shall be provided below the HDPE liner in the reservoir bed to counter uplift forces on HDPE liner occurring when the reservoir is empty and ground water table in the vicinity is above the reservoir bed level. PRVs shall conform to IS 4558. Earthen Embankment Material for Filling Material to be used for embankment filling shall be of approved quality excavated from inside the reservoir/plant area or brought from borrow area arranged by the Contractor. Material used for embankment filling shall not be organic soils, peat, cohesionless soil, sand dust, expansive soils and chemically aggressive soils. They shall be clean and free from shingle, salts, organic roots and sod, lumps, concrete or any other foreign substances. Fill shall be placed in horizontal layers not exceeding 300 mm compacted thicknesses. Compaction shall be done to achieve minimum 95% standard Proctor density by mechanical means. 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 (+/-) 20mm of the specified level. When the borrow area is located contiguous to the embankment alignment then it must be ensured that the borrow area shall not be opened within a distance of 5 times the height of embankment contiguous to the heel or the toe of the embankment or 25 metre whichever is more. The required approach roads and haul roads shall be constructed and maintained by the Bidder. The Bidder shall divert the existing roads, nallah/drain if any which are in the Raw Water Reservoir area at his own cost before the start of work. Frequency of sampling and testing including the methods for conducting the tests are as given in Table-1. The testing frequencies set forth are desirable minimum and 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. Following Acceptance Criteria shall be followed: - All individual samples collected and tested should pass without any deviation when only one set of sample is tested. - For re-test of any sample, two additional samples shall be collected and tested, and both should pass without any deviation. - Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.		
5.04.05	DELETED		
5.04.06	Graded Coarse Aggregate Filters		
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	Graded coarse aggregate shall be used in filters below rip-rap and rock-toe as per IS 8237. The coarse aggregate material shall consist of durable well graded broken rock of hard stone. The materials shall range in the size from 10mm to 75mm and shall satisfy the filter criteria. The rock material used in the aggregate filters shall satisfy the following condition: a) Specific gravity shall not be less than 2.50. (As per IS 1122) b) Sulphate soundness less than 10% loss of weight after 5 (Five) cycles (As per IS 1126) c) Aggregate Impact value shall not exceed 30% (As per IS 2386) d) Water absorption shall not exceed 2.5% (As per IS 2386) a) In slake durability test (as per IS 10050), the percentage retained after two ten (10) minutes cycles shall be more than 85%.			
5.04.07	DELETED			
5.04.08	HDPE Liner The proposed lining system consisting of High Density Polyethylene (HDPE) membrane shall form the water-tight barrier to prevent seepage/leakage. Bidder shall examine in detail the prevailing conditions and provide a liner system to meet the above requirement. The specification as outlined hereunder shall be treated as bare minimum. However, bidder shall offer the system to meet the site specific requirements and shall provide complete details in the offer. In case bidder deems it necessary to provide additional measures over and above what has been specified, he may do so at the quoted rate against the schedule of item. Bidder shall guarantee the satisfactory performance of the proposed liner system for a period of five years from the end of defect liability period. REQUIREMENT OF HDPE MATERIAL The High Density Polyethylene (HDPE) Liner shall be manufactured out of polyethylene resin. The resin composition and production shall meet the intended purpose as specified above. The natural polyethylene resin without the carbon black shall meet density of 0.932 g/cc or higher and melt index less than 1.0 g/10min. The test methods shall conform to ASTM D 1505 or ASTM D792 or equivalent for density test and ASTM D1238, condition E or equivalent for Melt Index test. The HDPE liner shall not be less than 6.0 M in width. Carbon Black shall be included in the resin to render it ultra-violet resistant. The Carbon Black content shall be between 2-3 percent as per ASTM D 1603. The surface of liner shall not have striations, roughness, pinholes or bubbles. The liner may be smooth. The liner sheet thickness shall be 1.0MM (40 Mil) with sheet density not less than 0.94 g/cu.cm. The Melt Flow Index shall be less than 1.0 g/10min. The method for testing melt flow index shall be as per ASTM D 1238 or equivalent. The Tensile stress at yield shall not be less than 17.0 N/mm and the yield strain not less than 12%. The strain at break shall not be less than 700%. The Tear Strength as per ASTM D 1004 or equivalent shall not be less than 130 N. The Puncture Resistance as per ASTM D 4833 (or equivalent) shall not be less than 390 N. For all other properties & test methods specified elsewhere in this specifications shall conform to GRI test method GM13 (Latest revision). Any sealants used shall be of type as per the recommendations of the HDPE manufacturer compatible with the intended use. However, before the use, Owner's approval shall be obtained.			
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	INSTALLATION AND LAYING OF LINING SYSTEM The HDPE Liner sheet (Geo-membrane rolls) shall be brought to site by trailer/truck or by any suitable transport without damaging the geo-membrane. The geo-membrane rolls shall be stored in such a way that they are protected from puncture, dirt, grease, moisture and heat. In case any material gets damaged, it shall be segregated and stored separately for replacement. All the geo-membrane rolls shall be stored on a prepared smooth surface. The HDPE Liner works shall be executed at site by the supplier of HDPE liner only. Subgrade (reservoir bed) shall be rolled and compacted and made flat and smooth. The top layer of reservoir bed subgrade shall be compacted with 2 passes of 8 to 10 flat footed roller over rock and soil surface. Any weak and soft spots, if present shall be removed and replaced with compacted fill. All subgrade surface where lining shall be placed should be smooth, free of all foreign and organic matter, sharp objects. Standing water or excess moisture shall not be allowed. For the purpose of anchoring the geo-membrane, 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 geo-membranes. Geo-membrane shall be laid using a spreader bar assembly attached to a loader bucket or any other method as approved by the Engineer. While laying the geo-membrane precaution shall be taken to avoid any damage to the lining system. Equipment or tools shall not damage the geo-membrane during handling, transportation and laying. Personnel working on the liners shall not smoke or wear shoes that may damage the geo-membrane. The method of unrolling the panels should be such that it should not cause scratches or crimps in the geo-membrane. While unrolling due care shall be taken to ensure that the subgrade is not damaged. In order to prevent uplift by wind, adequate loading by sand bags or similar items that will not damage the geo-membrane shall be placed over the geo-membrane. Continuous loading along the edges of the geo-membrane panels shall be provided in order to minimize the risk of wind flow under the panels. Geo-membrane shall not be laid when ambient temperature is above 50°C. Placement of geo-membrane 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 geo-membrane shall not be taken up. Deployment of geo-membrane shall immediately followed by field seaming operation. The field seaming shall be as per manufacturer's recommended process. The field operation shall either be hot shoe fusion type or extraction welding type. Any other process may be acceptable subject to approval of the Owner. On embankment slopes and other slopes, in general, seams shall be oriented in the general direction of maximum slopes. In other words, the seams shall orient down and not across the slope. In corners and other geometric forms, the number of field seams shall be minimized. At the base, T-seam shall not be closer than 1.5m from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and fishmouths. If a fishmouth or wrinkle is found, it shall be relieved and cap stripped. All geo-membrane panels shall have a finished overlap of 100mm (minimum) in case of hot wedge welding and 75mm (minimum) for extrusion welding. Unless approved by the Engineer-in-Charge, cleaning solvents shall not be used. Bidder shall provide all equipment as approved by the Owner. The equipment shall consist of, but not limited to, hot-wedge 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 Tensiometer for performing shear and peel tests. In order to verify that seam conditions are acceptable, field test on seams shall be conducted. Test seams shall be carried out at the outset of each seaming period and at least once every four hours for each seaming instruments and personnel deployed that day. All test seams shall		
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	be made in contact with the subgrade. All welding rods used for extrusion welding shall have the same properties as the resin used in the geo-membrane. The length of test seam sample shall be 3.0 meter in case of hot wedge welding and 1.0 meter in case of extrusion welding. At least five test specimens shall be cut from each end of the test seam. A tensiometer shall be used to test five specimens for shear and five specimens for peel. Each specimen shall be at least 25mm wide with a 100 mm plus width of the seam as grip separation, the seam shall be centered between the clamps. The rate of grip separation shall be 50mm per minute. Average of five specimens test results shall be considered for seam strength properties, four out of five specimens shall pass seam acceptance criteria. Shear and peel test shall result in film Tearing Bond (FTB), as defined in NSF std. 54 or equivalent, which is a failure in ductile mode of one of the bonded area. In case a test seam fails to meet the field seam requirements of the specification, the apparatus for seaming and / or seamer shall not be used until the deficiencies are corrected and a successful test seam results. All fields seams are over their 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. Vacuum Box Testing (VBT) VBT shall be carried out by bidder as per the procedure outlined hereunder. A vacuum box assembly consisting of a rigid housing with a transparent window and having a soft rubber gasket attached to be bottom, porthole or valve assembly and a vacuum gauge shall be used. A soapy solution in plastic bucket with a mop shall be made available. The excess sheet overlap, if any, shall be properly trimmed away. Then a strip or geo-membrane of length 300 mm shall be wetted by the length of box with the soapy solution. The box shall be place over the wetted area and compressed. Create a vacuum of 0.2kg/sw.cm to 0.35 kg/sq.cm. Care shall be taken to ensure that a leak proof seal is created. Vacuum shall be maintained for sufficient time. For a period of approximately 15 seconds, examine the geo-membrane through the viewing window for presence of any animated soap bubbles. In case no animated bubbles appears after 15 seconds, close the vacuum valve and open the bleed valve. Thereafter, move the box over the next area adjoining the tested area with a minimum 75 mm overlap. Repeat the process as described above. In case animated soap bubbles appear all such areas shall be marked, repaired and then retested successfully. In locations where seams cannot be non-destructively tested, the seam shall be spark tested according to the manufacturer's recommendations and directions of the Engineer. Air Pressure testing (APT) APT shall be applicable for all double fusion seams, only. Bidder shall furnish all required equipment. An air pump equipped with pressure gauge capable of generating and sustaining a pressure between 1.7 kg/sq.cm and 2.1 kg/sq.cm. The pressure gauge shall be equipped with a sharp hollow needle. The Bidder shall seal one end of the seam to be tested. Then insert needle or any other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld. Then energize the air pump to verify the unobstructed passage of air through the channel. Seal the other end of the channel. Then energize the air pump to about 2.1 kg/sq.cm. Close the valve and allow 2 minutes for the injected air to come to equilibrium in the channel and keep the pressure approximately for 5 minutes. In case loss of pressure exceeds 0.28 kg/sq.cm or even pressure does not stabilize, then locate faulty area. The area to be repaired and then retested successfully. In case the test is successful, the air channel should be deflated. Destructive seam testing shall be carried out as per the recommendations of the manufacturer. One destructive test shall be carried out for every 150 meter length of seam or as directed by the Engineer. Holes in the geo-membrane resulting from obtaining the seam samples shall be		
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	immediately patched and vacuum tested. The sample shall be 300mm wide and 1.0 meter long with the seam centered lengthwise. The sample shall be cut into three equal length pieces. One piece to be given to the Engineer and the other shall be with bidder for testing. Bidder shall test ten 25mm wide specimens, five specimens for shear strength and give for peel strength. To be acceptable, four out of five specimens must pass. The Owner may send seam samples, at his own discretion, to a laboratory for testing. In case the sample fails the destructive test, then the Bidder shall cap strip the seam between the failed locations. If the test fails, then process is repeated. Over the length of seam failure, the Bidder shall either cut out the old seam, then reposition the panel and re-seam or add a cap strip. Bidder shall thoroughly inspect all seams and non-seams areas of the geo-membrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Surface of the geo-membrane shall be cleaned at the time of inspection by the Bidder. Each suspect location in seam and non-seam areas shall be further non-destructively tested in presence of Engineer, if so desired. Each location that fails the non-destructive e testing shall be marked and repaired by the Bidder. The defective seams shall be cap stripped or replaced. Small holes shall be repaired by extrusion welding. If the holes are larger than 6mm, if should be patched to the satisfaction of the Engineer. All tears shall be repaired by patch work, where the tear is on a slope or an area susceptible to stress and has a sharp end; the same shall be properly rounded before patching. Blisters, large cuts and undispersed raw materials shall be repaired by patches; Patches shall be done by extrusion welding. The weld area shall be ground not more than 10 minutes prior to welding. It shall be ensured that no more than 10% of the thickness is removed by grinding. Welding shall commence immediately after grinding and must overlap the previous seam by at least 50mm. Re-seaming over an existing seam shall be carried out, if permitted, only after regrinding. Generally, welding shall restart by grinding the existing seam and re-welding a new seam. Patches shall be round or oval in shape, made of the same geo-membrane, and extend a minimum of 150mm beyond the defective areas. Each repair shall be non-destructively tested to the satisfaction of the Engineer-in-Charge. Repairs that pass the non-destructive tests shall be considered as an acceptable repair. In case the tests fails, the repair shall be repeated and retested until passing test results are obtained. The bidder shall keep daily reports and details of all non-destructive and destructive testing. The report/ documentation shall clearly identify all seams that initially failed the test and include all evidence/ certification from the Engineer that these seams were satisfactorily repaired and successfully retested. All anchor trenches shall be casted by the bidder. Anchor trench material shall be plain cement concrete. It shall be suitably placed to the size as specified in the drawings without damaging geo-membrane. If damage occurs, it shall be repaired immediately. For attachments to concrete, stainless steel concrete anchors and epoxy anchors, stainless steel nuts and washers along with stainless steel slotted flat bars (6mm thick) shall be provided at no extra cost to the owner. Bidder shall also provide closed cell neoprene gaskets and associated adhesive with no extra cost to the owner. Bidders shall make their own assessment of the requirements and include all cost in the quoted price of geo-membrane (HDPE Liner). Wherever pipe penetrations are to be sealed, the geo-membrane shall be formed around the pipes with stainless steel clamps, closed cell neoprene gaskets, etc shall be provided all around the pipe to make it leak proof. The details of the seal generally follow the manufacturer's recommendations subject to the owner's approval. No separate payment shall be made for all pipe penetration sealing works. The bidder shall make his own assessment of the total work and provide for the same in the unit rate quoted for geo-membrane (HDPE Liner). All quality control measures shall be deployed by the bidder. All tests are required to be carried out at Bidder's own cost during the production of materials as well as during laying operation.		
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All resins for use in geo-membrane shall conform to the requirements. Each lot shall be sampled with following tests conforming to manufactures specifications.

1. Density : ASTM D 1505
2. Melt Index : ASTM D 1238

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

1. Carbon Black content : ASTM D 1603

Manufacturer's quality Assurance Testing shall conform to the provisions as stipulated here. Full width samples shall be taken as tokens from the end of each roll. The HDPE liner that is to be supplied, quality control testing shall meet following frequency.

Test	Description	Method	Frequency
1.	Thickness	ASTM D 5199	Every roll
2.	Tensile properties	ASTM D 638	Every 5000 Sq.m.
	a. Tensile strength at yield.		
	b. Tensile strength at Break		
	c. Elongation at Yield.		
	d. Elongation at Break.		
3.	Tear resistance	ASTM D 1004	Every 5000 Sq.m.
4.	Puncture Resistance	ASTM D 4833	Every 5000 Sq.m.
5.	Carbon Black Content	ASTM D 1603	Every 5000 Sq.m.
6.	Dimensional Stability	ASTM D 1204	Every 5000 Sq.m.
7.	Carbon Black Dispersion	ASTM D 5596	Every 5000 Sq.m.
8.	Density	ASTM D 1505/D792	Every 5000 Sq.m
9.	Melt Index	ASTM D 1238	Every 5000 Sq.m.
10.	Oxidative Induction Time	ASTM D 3895	Every 5000 Sq.m.
11.	Low Temperature Brittleness	ASTM S 746	One per resin lot
12.	Environmental Stress resistance	ASTM D 1693	Every 5000 Sq.m.
13.	High Pressure Oxidative Induction Time	ASTM D 5885	Every 5000 Sq. m.
14.	Oven Aging at 85 Deg C – High Pressure OIT (min. ave.)- % retained after 90 days – ASTM D 5885 - Every 15000 Sq. m. and each formulation		
15.	UV Resistance – High Pressure OIT (min. ave.)- % retained after 1600 hrs – ASTM D 5885 - Every 15000 Sq. m. and each formulation		
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.			
1.	Thickness/diameter as per ASTM D751	:	ASTM D 751
2.	Density as per ASTM D 1505	:	ASTM D 1505
3.	Melt Index as per ASTM D 1238	:	ASTM D 1238
4.	Carbon black content as per ASTM D 1603	:	ASTM D 1603

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5.04.09	All the reference to ASTM codes shall be tested as the base requirement. Other International codes of practices, which are equivalent to the above ASTM, shall also be acceptable to the owner subject to prior approval. Results of all the tests shall be furnished to the owner for his review. Owner or his authorized representative reserve the right to inspect the testing facilities and witness the tests as and when desired. Owner or his authorized representative reserve the right to retest some or all the parameters of HDPE liner at NTPC identified 3rd party testing laboratory anytime during the execution of contract. Sample shall be selected from site randomly jointly by NTPC and contractor. Cost of all testing shall be borne by the contractor. In case the sample does not meet the requirement of Technical Specifications, then owner reserve the rights to reject the HDPE liner lot from which the sample is selected. Precautions to be taken for HDPE liner laying: 1. After the construction of reservoir embankment, the slopes shall be dressed properly and shall be free from any gravel or sharp rock pieces. The slopes & bed of reservoir shall be free from any gravel or sharp rock pieces which can puncture the HDPE liner. 2. After the bed preparation, HDPE liner roll shall be unrolled one at a time. The liner shall be adequately loaded with the sand bags and shall be immediately welded with the adjacent liner roll. 3. Once the welding of previous liner rolls is completed then only the next roll shall be unrolled. 4. The loading of HDPE liner shall be continuous at the edges and in a dense grid of 1mX1m at over the liner area. 5. Liner shall not be left open without adequate loading and it shall be pressed properly (in order to take out air pockets which causes undulation) before welding. 6. Anchoring of HDPE liner at reservoir top shall be done as per the construction drawing. 7. Non-Woven geotextile & over that 75 thick PCC M20 layer shall also be placed over HDPE liner to get finished surface. 8. In the reservoir bed, 300mm thick layer of specified soil shall be provided in rocky surface. Bed shall not consist of gravels and sharp rock pieces. 9. The welding of HDPE liner rolls shall be carried out simultaneously. Large number of rolls should not be left un-welded to avoid tearing off of liner. PCC Lining 75mm thick Plain Cement Concrete of grade M-20 (design mix) shall be provided over non-woven geotextile laid over HDPE liner at all levels on the inner surface of reservoir embankment (upstream side slope) and reservoir bed with graded stone chips (12.5 mm nominal size). Synthetic Polyester triangular fibre of length 12mm, effective diameter 10-40 microns and specific gravity of 1.34 to 1.40 shall be mixed in Plain Cement Concrete of grade by using 125gms of synthetic Polyester triangular fibre for 50 Kg cement used as per directions of Engineer. Placing After the slope & bed of reservoir has been dressed to line and HDPE liner has been provided over the compacted earth/soil, the entire upstream slope surface & bed shall then be covered with non woven geotextile followed by placing of 75 thick PCC lining. The PCC lining shall be		
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5.04.10	free from impurities like particles of stone, lime and other foreign materials visible to the naked eye on the surface and shall be of uniform texture. On completion of PCC lining, the surface presented by the lining shall be even throughout, free from irregularities. Non-Woven Geotextile This specification covers the technical requirements for the Manufacturing and Installation of the nonwoven geotextile. All materials meet or exceed the requirements of this specification, and all work will be performed in accordance with the procedures provided in these specifications. Submittals A. Prior to material delivery to project site, the contractor shall provide the engineer with a written certification or manufacturers quality control data which displays that the geotextile meets or exceeds minimum average roll values (MARV) specified herein. B. The contractor shall submit, if required by the engineer, manufacturer’s quality control manual for the geotextile to be delivered to the site. Geotextile A. Geotextile shall be Needle punched Non-woven type. B. The geotextile shall be manufactured from prime quality virgin polymer. C. Geotextile shall be with U-V (Ultra-violet) treatment suitable for a temperature range from 0 Deg. C to 50 Deg. C so that the strength and the life of the same is not affected due to exposure to ultraviolet D. Geotextile shall meet or exceed all material properties as given below. E. In addition to the above, geotextile shall have good resistance to chemicals and to biological degradation <table><tr><td>1. Material for Geotextile filter</td><td>100% Polypropylene</td></tr><tr><td>2. Mass per unit area</td><td>250 g/sq.m (ISO 9864)</td></tr><tr><td>3.Thickness in mm</td><td>2.2 (min.) (ISO 9863)</td></tr><tr><td>4. Tensile strength</td><td>19 kN/m (ISO 10319)</td></tr><tr><td>5. Elongation at break</td><td>80/35(md/cd)(ISO 10319)</td></tr><tr><td>6. Puncture strength</td><td>2900 N (ISO 12236)</td></tr><tr><td>7. Effective opening size</td><td>0.09mm (ISO 12956)</td></tr><tr><td>8. Horizontal water flow 20kPa</td><td>13 l/m.h (ISO 11058)</td></tr><tr><td>Horizontal water flow 200kPa</td><td>3.0 l/m.h (ISO 11058)</td></tr><tr><td>9. Vertical water flow 50mm head</td><td>72.0 l/sqm.h (ISO 11058)</td></tr><tr><td>10. Width to be supplied</td><td>minimum 3.5 m</td></tr></table> MANUFACTURE All rolls of the geotextile shall be identified with permanent marking on the roll or packaging, with the manufacturers name, product identification, roll number and roll dimensions. TRANSPORT A. Transportation of the geotextile shall be the responsibility of the contractor. B. During shipment, the geotextile shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, or other damaging or deleterious conditions.			1. Material for Geotextile filter	100% Polypropylene	2. Mass per unit area	250 g/sq.m (ISO 9864)	3.Thickness in mm	2.2 (min.) (ISO 9863)	4. Tensile strength	19 kN/m (ISO 10319)	5. Elongation at break	80/35(md/cd)(ISO 10319)	6. Puncture strength	2900 N (ISO 12236)	7. Effective opening size	0.09mm (ISO 12956)	8. Horizontal water flow 20kPa	13 l/m.h (ISO 11058)	Horizontal water flow 200kPa	3.0 l/m.h (ISO 11058)	9. Vertical water flow 50mm head	72.0 l/sqm.h (ISO 11058)	10. Width to be supplied	minimum 3.5 m
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	C. Upon delivery at the job site, the contractor shall ensure that the geotextile rolls are handled and stored in accordance with the manufacturer's instructions as to prevent damage. INSTALLATION A The geotextile shall be handled in such a manner as to ensure that it is not damaged in any way. Any damage to the geotextile to the extent that it is no longer usable as determined by these specifications or by the engineer, the contractor shall replace the geotextile at his own cost. B The geotextile shall be rolled down the slope in such a manner as to continuously keep the geotextile in tension by self-weight. The geotextile shall be securely anchored in an anchor trench where applicable, or by other approved or specified methods. C. In the presence of wind, all geotextiles shall be weighted by sandbags or approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material. D. The contractor shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. Any damage to such material occur due to the fault of the contractor, the contractor shall repair the damaged materials at his own cost and to the satisfaction of the engineer. E. During placement of the geotextile, care shall be taken not to entrap soil, stones or excessive moisture that could hamper subsequent seaming of the geotextile as judged by the engineer. F. The geotextile shall not be exposed to precipitation prior to being installed and shall not be exposed to direct Sun light for more than 15 days after installation. G. The geotextile shall be seamed using heat seaming or stitching methods as recommended by the manufacturer and approved by the engineer. Sewn seams shall be made using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams shall be continuous. Seams shall be oriented down slopes perpendicular to grading contours unless otherwise specified. For heat seaming, fusion welding techniques recommended by the manufacturer shall be used. H. The contractor shall not use heavy equipment to traffic above the geotextile without approved protection. I. The geotextile shall be covered (as per drawings) as soon as possible after installation and approval. Installed geotextile shall not be left exposed for more than 15 days. J. Material overlying the geotextile shall be carefully placed to avoid wrinkling or damage to the geotextile.			
5.04.11	Spillways/Over Flow Structures Bidder shall suitably design and construct spillways/over flow structures to prevent overtopping of the embankment. The discharge from the spillways/overflow structures shall flow to the nearest nallah or drains with capacity to accommodate it.			
5.04.12	Inlet /Outlet Structures Suitable outlet pipes of mild steel (MS) as per IS: 3589 shall be provided. The adequate nos. of outlet pipes (as per design requirement) of suitable diameter and minimum 500mm thick RCC encasement with concrete Grade M20 as per IS 456. Pipes shall be laid as per IS 783. Inlet structure shall be suitably designed & constructed. Inlet pipes shall be of MS as per IS: 3589 and laying shall be done as per IS 783. The number and diameter of pipes shall be suitably designed to meet the capacity requirement. A minimum 500mm thick RCC			
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5.04.13	encasement with concrete Grade M20 as per IS: 456 within the embankment shall be provided. To dissipate the turbulence and energy of the falling water suitable energy dissipation devices/system shall be provided. Rip-Rap Rip-rap shall be hand placed on the slopes of the embankment as per IS: 8237 - "Code of practice for Protection of slope for reservoir embankments". The thickness shall be 300mm and shall be measured normal to slope of the embankment. The rock materials used for rip-rap shall satisfy the quality requirements specified in IS code.		
5.04.14	Rock Toe The rock material used for the rock toe shall satisfy the quality requirements. Rock toe shall be formed with rock material consisting of sound, durable and well graded broken rock obtained from approved quarries and shall be of approved quality. The materials shall range in size from 10 to 45 cm. All brush, roots or other perishable materials shall be removed from rock-fill during spreading and disposal off. Contamination of the rock with finer materials from any other zones shall be avoided. Accumulations of soil caused by contamination shall be removed. Rock materials shall not be dumped directly but shall be hand placed in layers.		
5.04.15	D/S Slope Protection Works – Turfing The D/S slope of embankment including berms, if any, shall be turf sodded from top of embankment to rip-rap level. Turfing shall consist of at least 5 cm thick grass turf sods of approved variety obtained from the tank beds or river margins for use in this work. The sod shall include a mat of roots and earth at least 5cm thick. Sod containing an excessive amount of obnoxious weed growth shall be excluded. The block of sod shall be laid on the slope in close contact and then tampered firmly in place so as to fill and close the joints between blocks.		
5.04.16	Diversions of Surface & Under Ground Water The whole of the works shall be carried out in the dry condition. Water from any source shall be diverted or pumped as required, clear of the works. Bidder shall make all necessary arrangement whatsoever required for keeping the work area dried by diverting and pumping of water, and also provision and operation of all temporary works including pumps, motors, fuel, piping and for the formation of any sumps, drainage channels, flumes, coffer dams and other protective works.		
5.04.17	Rainfall Run-Off As part of the work may have to be carried out in wet season, Bidders programme and methods must be capable of dealing with run-off from rainfall on the adjacent catchment area. The associated flow in the nallahs etc. shall be diverted clear of the works by an approved system of bunds and channels. Bidder shall supply, install and operate his own temporary pumping installation.		
5.04.18	Prevention of Pollution Arrangement shall be made by the Bidder to prevent pollution of the water in any streams, springs, nallahs and lakes. Arrangements for sprinkling of water in the construction and borrow area to prevent any dust blowing also shall be done by the Bidder. Bidder shall be solely responsible and liable for all damage caused by any pollution that may take place during the execution of the works, and he shall make arrangements, as the Engineer may approve, for preventing pollution but, notwithstanding such approval, the entire responsibility for any pollution shall rest with the Bidder		
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Table-1
Frequency of sampling and testing

S.No.	Nature of test/Characteristics	Method of test	No. of samples & frequency of test	Remarks
1	Suitability of fill material		One in every 2000 cum for each type and each source of fill materials subject to a minimum of two samples	Test for soil and sand
	a) Grain size analysis	IS: 2720 (Part-IV)		
	b) Liquid limit and Plastic limit	IS: 2720 (Part-V)		
	c) Shrinkage limit	IS: 2720 (Part-VI)	One in every 5000 cum for each type and each source of fill material	Test for soil The frequency of test can be increased depending on type of soil
	d) Free swell Index	IS: 2720 (Part-XL)		
	e) Chemical Analysis	IS: 2720	One in every 5000 cum for each type and each source of fill material	Test for soil and sand
	i) organic matter	Part-XXIL		
	ii) calcium carbonate	Part-XXIII		
	iii) Ph	Part-XXVI		
	iv) total soluble sulphate	Part-XXVII		
2.	Standard proctor Test	IS: 2720 (Part-VII)	One in every 2000 cum for each type and each source of fill material	Test for soil for determining optimum moisture content, dry density etc
3.	Moisture content for fill before compaction	IS: 2720 (Part-II)	One in every 2000 cum for each type and each source of fill material	Test for soil
4.	Degree of compaction of fill			
	a) Dry density by core cutter method or dry density in place for sand displacement method	IS: 2720 (Part-XXIX)	For area filling, one for every 1000 sqm area for each compacted layer	Test for soil
	b) Relative density (density Index)	IS: 2720 (Part-XIV)	For area filling, one for every 1000 sqm area for each	Test for soil

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			compacted layer	
	c) Dry Density for proctor needle penetration	Standard practice	Random checks to be carried out for each compacted layer in addition to tests mentioned under IV(a) above	Test for soil
5.05.00	ASH HANDLING SYSTEM			
5.05.01	The civil works for Ash handling system shall comprise of bottom ash and fly ash handling systems, which includes Ash slurry pump house and their related sumps/tanks, Ash water pump house, Bottom Ash (BA) slurry transportation pump pit and their related sumps/tanks Slurry trench (In case of SCC system), Transport/instrument Air Compressor house, Conveying air compressor house, Switchgear /Control/RIO rooms, HCSD Pump house, AHP Control room building, Ash classifier, Ash silo, supporting structures and foundations for Bottom ash hopper, Buffer hoppers, dewatering bins, bottom ash overflow tank, Settling tanks and Surge tanks, Seal water tank, Bagging plant Complex, Silo Utility Building complex including development of silo area (i.e. paving, fencing/boundary-wall, access roads, office block and watchman cabin), miscellaneous equipment foundations, trenches, pipe racks, pedestals/thrust blocks for HCSD pipe supports (inside the plant boundary) including bridges/ culverts for road/rail/drain/nallah as required. For the ballast-less rail track under silo area complex a 4.0m wide area (2.0 m either side of centre line of railway track) shall be left unpaved along the rail track in complete silo area complex same shall be constructed by railway siding agency. RCC peripheral drains, crossing rail track shall be covered with permanent RCC slab (minimum 150 mm thk.) & construction of these RCC drains such that it will not create any hindrance in construction of rail track. Top of paving level in balance silo area complex shall be governed by the top level of rail track in silo area complex. Steel gates of minimum 6.0m width for entry & exit of railway wagons in silo area complex shall be provided in boundary wall/ fencing of silo area complex. For the hindrance free movement of railway rack on the rail track under Silo following shall be provided however necessary approval shall be taken from the railway authority by successful bidder. *Horizontal clearance: A minimum clearance of 3.5m shall be maintained between centre line of the Railway track to face of the crossing structure. *Vertical clearance: A minimum vertical clearance of 8.5m shall be maintained between Rail top level and bottom of structure.			
5.05.02	Transport air compressor houses, Conveying air compressor houses, Ash slurry Pump House, HCSD Pump house shall have steel shed building with side sheeting and Silo utility building, shall have RCC framed structure, with RCC columns and profiled metal deck sheet roofing (filled with RCC) supported on steel purlins & truss / girders. Other buildings like MCC /switchgear rooms, control room, etc. shall have RCC framed structure with cast-in-situ RCC roof slabs. Bagging plant Complex building shall be closed steel shed. All RCC buildings shall have brick cladding. Crane girders or monorails shall be provided as per requirement and the same shall be of structural steel construction.			
5.05.03	The documents and drawings as listed below are to be submitted for the approval of the Employer unless specified otherwise. The list given below is not exhaustive but indicative only.			
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	a) Project design intent document giving the basis of design, which shall cover all the design philosophy aspects, parameters, assumptions, references, loading cases, load combinations, analysis and design of all buildings, structures, facilities etc. shall be furnished for approval, before commencement of detailed engineering. b) Structural analysis, design calculations and drawings of substructures and super structures for all buildings/structures, facilities like pump houses/shed, compressor houses, sumps / tanks, channels, pipe support structures, culverts/ bridges, pedestals, thrust blocks transformer yards, etc. shall be submitted for approval of the owner. c) The design and drawings for the equipment and their supporting structures like bottom ash hopper, buffer hopper/collector tanks, surge tank/settling tank, silos/bins, etc. associated with Ash Handling System, shall be submitted to the Owner for information only. However, the structural design criteria and basis of design as mentioned at (a) above, for these structures also shall be approved by the Owner. d) Top of RCC pedestal of foundation for bottom ash hopper, fly ash silo, other columns etc. shall be 300 mm above paving level or surrounding finished ground level (FGL).			
5.05.04	DELETED			
5.05.05	The Silo utility building complex shall be fenced with chain linked fencing, if placed inside the plant boundary and shall be confined with boundary wall if placed outside plant boundary. Gates shall be provided for rails, truck movement and transformers. The boundary wall shall be of one brick thick of height 2.4 m with a 600 mm high galvanized concertina at top, such that total height is 3.0 m above formation level. The fencing shall be PVC coated G.I. Chain link of minimum 4 mm thickness (including PVC coating) of mesh size 75mm x 75 mm and of height 2.4 m above toe wall. The toe wall shall be 1 brick thick, minimum 200 mm high above paving/formation level and 300 mm below paving/formation level on 75 mm thick PCC (1:4:8) bedding. Entire area in the silo area complex shall be paved and have a peripheral RCC drain of adequate capacity & slopes covered with perforated precast RCC slabs of minimum 150 mm thickness with provision of openable galvanized steel grating covers of 1.0 m at every 4 m interval. The complex shall be provided with a sump for collection of ash water. In addition to the outer confinement, additional fencing with gates should be provided for all transformers in the complex. A watchman cabin with a minimum area of 5 Sq.m shall also be provided in this area.			
5.05.06	Pipe supports shall be provided for ash slurry pipes—HCSD—pipes, dry fly ash(FA) pipes including RCC thrust blocks and any other supports required to complete the system. Over-ground pipes shall be supported on RCC pedestals except for FA pipes which shall be on elevated steel trestles. Unless noted otherwise, the top of concrete pedestals shall be minimum 500 mm above surrounding ground level/paving level. Pipes shall be suitably anchored with RCC pedestals to resist lateral and vertical movements as per system requirement. Conveyor Galleries, Trestles, Trasfer points shall be provided for Dry Bottom ash system			
5.05.07	DELETED			
5.05.08	Where the pipes are crossing the road through RCC box culverts, the culvert top generally, shall not be not more than 100 mm above the road top and a hump with slope of 1:35 shall be provided on the road. All other road crossings inside the plant area can be either underground or overhead road crossings with necessary headroom clearance. For any boundary wall crossings, pipe shall be laid through casing pipe / RCC culvert. After laying the pipe, the boundary wall shall be restored. For other water body crossings, such as local Nallah / canal, local water bodies, local drains etc. suitable structural arrangement with 800 mm wide walkway shall be provided. Minimum clearance of the bottom of pipeline for all such locations shall be 1.50 M above the High flood level (HFL). Bidder to take all statutory clearance from concerned authorities for crossing his pipe/trestles over road / rail / culverts / nallah etc. at his own cost and initiative, without any commercial implication to the owner. For any other additional works,			
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5.05.09	bidder have to make their own assessment too of the quantity/ number of culverts, existing pipe pedestal crossings, nallah crossings etc., based on their site visit before quoting. All ash handling system pipe crossings with Railway Lines including MGR lines shall be laid by method accepted by concerned railway authorities for existing rail lines & by cast in situ RCC box culvert for future envisaged rail lines. The railway track crossings are to be designed in accordance with railway Standard/RDSO guidelines and all necessary approvals from the concerned Railway authorities shall be obtained by the Bidder, without any financial implications to the owner.		
5.05.10	DELETED		
5.05.11	All liquid retaining structure shall be designed by working stress method as per IS 3370 (Part-1&2):2009. The thickness of base slab in liquid retaining/ carrying structures shall be minimum 150mm. Minimum grade of concrete for liquid retaining structures like Sumps/tanks/drain sumps etc shall be M-30.		
5.05.12	For liquid retaining structures, the minimum reinforcement in each direction shall not be less than 0.24% of the gross cross-sectional area.		
5.05.13	All liquid retaining structures shall be tested for leak proofness with full water level in accordance with clause no.12 of IS 3370(Part 1):2009 and IS 6494.		
5.05.14	All pump houses and other substructures shall be checked for stability as per the following guidelines: - Stability of structure against sliding during construction as well as operating conditions for various combinations of applied characteristic loads. In case where dead load provides the restoring moment, only 0.9 times the characteristic dead load shall be considered. Factor of safety against sliding shall not be less than 1.4 under most adverse combination of applied characteristic loads. - Stability of structure as a whole against overturning. It shall be ensured that the resisting moment shall be not less than the F.O.S. times the maximum overturning moment. Factor of safety against overturning shall not be less than 1.2 due to characteristic dead load and shall not be less than 1.4 due to characteristic imposed load. - Stability of structure against uplift due to the ground water table at finished ground levels during construction and after construction stages. Minimum factor of safety of 1.2 against uplift shall be ensured considering 0.9 times dead weight, empty condition inside and ignoring the superimposed loadings. Inclined wedge action shall be limited to 15 degree with vertical plane. Provision of pressure relief valve / flap valves etc. shall not be permitted to counter the uplift. Also FOS against uplift, to be taken as 1.0 considering the dead weight of structure and soil resting on side projections, if any, in the vertical plane. Inclined wedge action of soil shall not be considered in this case.		
5.05.15	Architectural Features of Ash Handling System Buildings - Building shall have Aluminium and Steel doors/ windows/ rolling shutters / ventilators. - Safety norms shall be followed as applicable. The buildings shall be provided for Pump houses, Switch Gear Room, Control Room etc. as per ash handling system requirements. - External finish shall be of premium acrylic smooth exterior paint with silicon additives. - All the air conditioned rooms shall be provided with hermetically sealed double glazing in windows and false ceiling. - Encased staircase shall be provided for double storeyed buildings and cage ladder shall be provided for roof access in single storeyed building. - Each building shall have one toilet block with drinking water facility.		
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5.06.00	FGD SYSTEM		
5.06.01	The civil works for FGD system shall comprise of civil, structural and architectural works below and above ground level of FGD control room building, slurry re-circulating pumps & oxidation blowers building, tank foundations, absorber tower foundation, MCC building, gypsum dewatering building, transformer foundation, equipment foundations, pipe & cable gallery/trestles, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD system specified elsewhere in this specification. Bidder may also refer terminal points & exclusions in this regard.		
5.06.02	Buildings for FGD System FGD System may comprise of various buildings based on the functional requirement viz. MCC/Control room building, Gypsum dewatering building, re-circulating pumps & oxidation blowers building, Gypsum storage shed etc.		
5.06.02.01	Control building, M. C. C. Buildings These shall be steel/RCC framed building with RCC roof and floor. For steel framed building roof/floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations. All air - conditioned areas, shall be provided with false ceiling system (details specified elsewhere) with under deck insulation.		
5.06.02.02	Not Used		
5.06.02.03	Gypsum Dewatering Building This shall be steel framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification		
5.06.03	Booster Fan foundations: Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round. ii) Design Concept: a) For the foundations of Fans etc. detailed static and dynamic analysis shall be done. b) Wherever block foundation is adopted by the bidder for FAN foundations, suitable provisions to be ensured by the bidder in their General Arrangement and design to prevent transmission of vibration from these machine foundations to other nearby structures / foundations.		
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	The bidder or his consultant should have adequate prior experience in design of machine foundations and the machines should be in successful operation for at least one year prior to the date of submission of bid.		
5.06.04	Pipe and cable gallery/ trestles shall be as per details given in clause no. 5.02.08.		
5.06.05	RCC Floors, Paving & Grade Slab details Passages shall be provided inside the FGD area connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area, storage area with 50 mm thick metallic hardener topping. Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. However, corridors below pipe/cable trestle gallery where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil. All facility/buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand. An area of minimum 7.5m width all around the tank foundations and other facilities/buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings. Wherever multiple FGD facilities are located in a cluster in the areas proposed for FGD, the entire extent of the cluster shall be provided with area paving maintaining minimum 7.5 m width around the facility buildings. Paving shall be extended up to nearest road for easy access to FGD facilities. Any functional requirement of paving for FGD facility not specifically mentioned in this document is also in scope of bidder. GRADE SLAB OF BUILDINGS AT GROUND FLOOR In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, gypsum storage shed stone soling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided. Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.		
5.06.08	Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be of concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.		
5.07.00	SEWERAGE SYSTEM:		
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5.08.00	Complete sewerage system including Sewage Treatment Plant for facilities within the plant is in bidder's scope. Bidder shall provide 'De-centralized Sewage Treatment' units. The capacity of the Decentralized Sewage Treatment units should be as per the design requirements, subject to minimum combined capacity of 75 Cum/day. Design of Sewage treatment plant shall be as per CPHEEO manual. Primary, Secondary and Tertiary treatment to be provided. Treated sewage water shall be used for horticulture purpose as per quality requirement of CPHEEO manual. Cement concrete pipes of class NP-3 as per IS 458 shall be used below ground level for sewage disposal in all areas other than main plant area. However, for pressure pipes and in main plant areas, and under roads spun Cast Iron pipes conforming to IS 1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS 4111. Sewage pump stations shall be provided as per IS 4111. Bidder shall have to provide complete arrangement for sewage disposal up to the sewage treatment plant including pumping facilities.		
	Plant Storm Water Drainage System Complete storm water drainage system of Plant area is in bidder's scope. Storm water drain shall be designed taking into account the finished ground levels of the plant & surrounding area, drainage pattern, intensity of rainfall, etc. These values shall be based on minimum rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The inside drain dimension at any point should not be less than 0.45m (height) x 0.75m (breadth). Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of the double lane roads and single lane roads. The drains shall be provided on one side of the patrol roads along boundary wall. These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings. Layout of drain shall be as per layout given in tender drawing "Layout of drain". Complete drainage upto outfall point to be completed to avoid flooding in the respective area.		
5.09.00	TRANSFORMER FOUNDATION Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Solid RCC block foundation shall be provided for the main transformer block. Alternatively, transformer shall be supported on a RCC foundation comprising of common raft for rail supporting walls up to rail-cum-road along with pedestals for jacking pad, roller lock etc. Tie beams connecting roller lock pedestals at rail level shall also be provided. Common raft/solid RCC block shall be supported on soil or pile based on requirement specified elsewhere in the specification.		
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5.10.00	Oil soak pit / oil water separation pit for transformer shall be provided as envisaged elsewhere in the specification. The oil soak pit shall be provided for each transformer and shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store one-third (1/3) of the oil volume of transformer/reactor considering only 40% of the volume as available voids between gravel filling. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. Oil soak pits sump of individual transformers shall be connected to common oil retention /oil water separation pit through hume pipes and manholes. Separate common oil retention pit/oil water separation pit shall be provided for a group of transformers in transformer yard area of each generation unit of plant. The Oil-water Separation pit shall be designed for an effective capacity of complete oil of one transformer having highest volume of oil along with 10 minutes of firewater. For calculating effective capacity of oil-water separation pit, effective depth excluding 200 mm freeboard below invert level of inlet pipe shall be considered. Plan area and depth of oil-water separation pit shall be decided based on above consideration. Oil-water Separation pit shall be provided with five separate chambers interconnected by pipes. First chamber shall be for collecting oil-water mix from transformers' soak pits in case of fire. After entering into first chamber, oil being the lighter in density floats above the water. The water from lower elevation flows in to subsequent chambers interconnected through galvanized MS pipes. The accumulated oil in the first chamber to be pumped out for subsequent usage or disposal. Water collected in the last chamber to be pumped out for subsequent disposal after treatment. Invert level of inlet Hume pipes (of NP-3 grade and adequate capacity), carrying oil and water from transformers soak pits, shall be designed for gravity flow. Freeboard of 200 mm shall be provided below the invert level of inlet pipes. Invert levels of interconnecting pipes of subsequent chambers shall be decided accordingly. Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/reactor foundations. RCC Firewall shall also be provided between the transformers wherever required. 300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for firefighting system shall be provided up to top of gravel filling. However, the supply and erection of Pylon supports with anchor fasteners for HVW spray system are not under the scope of this package. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.			
	Roads All roads shall be of rigid pavements unless otherwise specified. Rigid pavements shall be constructed with Geopolymer concrete. Concrete road/pavement or rigid pavement, mentioned in specification, shall mean road /pavement constructed with Geopolymer Concrete. All concrete roads shall be unreinforced jointed plain concrete pavement having dowels in transverse joints and tie bars at longitudinal joints. A 40mm bitumen mastic wearing course over concrete pavement shall be provided with industrial bitumen of grade 85/25 conforming to IS : 702, prepared by using mastic cooker and laid to required level and slope, including providing antiskid surface with bitumen fine grained hard stone chipping of approved size at the rate of 0.005 precoated cum per 10 sqm and at approximate spacing of 10 cm centre to centre in both directions, pressed into surface protruding 1 mm to 4 mm over mastic surface, including cleaning the surface, removal of debris etc. all complete. (Considering bitumen using 10.2% as per MORTH specification). This 40mm bitumen mastic wearing course shall be laid after completion of construction activities i.e at the time of handover. All the road shall again be repaired/made good as per IRC : SP :83 after completion of construction activities i.e at the time of handover.			
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5.10.00.01	All service and utility lines like fire water line, sewerage line, electric cables line etc. crossing the road shall be taken through NP3 class RCC Hume pipe. Hume pipe shall be laid before road work so that the road shall not be damaged. Construction of road work shall be as per priorities given in Tender drawing 'Layout of Road Drawing'. For road to be constructed with Geopolymer Concrete: The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab. The road construction including its shoulders, base, sub base and concrete pavement shall be as per MORTH. The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Laying /placing of Concrete DLC and PQC manually with hand-guided means or by semi-mechanized methods may be permitted around BTG area provided acceptance criteria as per MORT&H specification is achieved. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete pavement shall be provided with 125 micron polythene sheet below it. Concrete pavement shall also be provided with contraction and expansion joint with MS dowel bars and as per Ministry of Road Transport and Highways (MORTH) specification. The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level. All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed. Unless otherwise specified, all roads (excluding access roads to all buildings / facilities / structures, patrol road along boundary wall and road inside the switchyard) shall be double lane roads.			
5.10.00.02	Geo-polymer concrete road shall be constructed over soil sub-grade/embankment. Road section shall comprise of Granular Sub base over soil sub-grade, Dry Lean Concrete of M10 Grade (DLC) base and Pavement Quality Concrete of M35 grade (PQC) top layer. Thickness of different layers of pavement section shall be as per design. However, minimum thickness shall be 150 mm for DLC and 250 mm for PQC. Provisions of Clause 5.10.00.01 in respect of design, construction and other requirement shall also be applicable for Geopolymer concrete road. In addition, specific information pertaining to geopolymer concrete is provided in Chapter D-1-8.			
5.10.01	Double Lane Roads The double lane roads shall be (12 metre wide) with 7.5 metre wide concrete pavement and 2.25 metre wide raised shoulders on both sides of the roads as given in tender drawing "Details of road" .			
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5.10.02	Single Lane Roads All access roads to all buildings / facilities / structures, road approaches / connections, access roads to liquid fuel storage areas and other equipment areas where access is necessary from inspection, operation and maintenance point of view and all roads inside the switchyard shall be single lane roads as given in tender drawing "Details of road".		
5.10.03	PATROL ROADS All patrol roads along the boundary wall shall be single lane roads with 3.75 metre wide concrete pavement and 1 metre wide shoulders on one side of the road. as given in tender drawing "Details of road".		
5.10.04	Intermediate Road The intermediate lane roads shall be (8 meter wide) with 5.5 meter wide concrete pavement and 1.25 meter wide raised shoulders on both sides of the road as given in tender drawing Details of Road. *Concrete roads anywhere mentioned in specification shall be read as Geo-polymer concrete road.		
5.11.00	DELETED		
5.12.00	Fuel Oil Handling system The civil works are to be provided for following fuel oil handling system areas as mentioned below: - Fuel Oil pressurizing pump house. - Foundation and dyke wall and all associated works for LDO tanks. - Pedestals and foundations to support the interconnecting piping between LDO tanks to the pressurizing pumps as well as piping from tanker unloading area to the Unloading pump house and further on to the LDO tank. - Oil water separator pit.		
5.12.01	Fuel Oil Pressurising Pump House Salient Features: This building shall be a single storeyed framed superstructure with RCC columns, structural steel roof truss (with rafter and tie level plan bracings), purlins and roof slab. The roof slab shall comprise minimum 40 mm thick (above the crest of metal deck sheet) RCC slab supported on profiled metal deck sheet connected through shear anchor studs. Waterproofing of Roof slab shall be done as per architectural specifications. The building shall be completely covered with 230mm thick brick wall with provisions for fire proof doors, windows, rolling shutters. The basement RCC slab and RCC wall shall be designed as for uplift and external surcharge load as per the design criteria specified elsewhere. All pump foundations shall be designed for both static and dynamic loading. The building shall have separate enclosures for the control room and the switchgear room. All rainwater down comers shall be concealed with brick wall. The minimum floor area of this building shall be as per the equipment layout plan of the bidder/ EPC contractor. Design Concept: The grade of concrete shall be M 25 for all columns, beams, footing and slabs. The building shall be designed as per IS: 456, IS 800, IS 1893, IS 13920 (for ductility detailing).		
5.12.02	Fuel Oil Storage Tank Foundations The Fuel Oil Storage Tank foundations shall be either RCC raft or RCC Ring Beam system with compacted infill. The RCC raft /RCC ring beam shall be supported on virgin soil or pile foundation depending on the load bearing capacity of the soil. The tank bottom base plate shall		
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	be supported on flexible compacted fill comprising 75mm thick Bitumen aggregate mix on top and compacted sand/ soil fill below, compacted in layers of 200mm to minimum 85% relative density as per IS:2720. The bitumen-aggregate mix shall consist of compact crushed stone, screenings, fine gravel, clean coarse sand(river sand) mixed in hot asphalt (8 to 10 percent by volume) and rolled or compacted. In the GA & detailing of foundation RCC ring wall/ beam it should be ensured that no bearing stress from tank superstructure is transmitted to the concrete surface. The top of flexible compact fill and top of RCC Circular wall shall be atleast 325mm above the surrounding ground surface for effective drainage. The finished tank grade (Top surface of flexible compact fill) shall be crowned from its outer periphery to its centre at a slope of 1 in 100. The Tank foundations shall be inside a RCC dyke wall enclosure. The entire area outside the tank foundations and within the surrounding RCC dyke walls shall be paved with concrete. The thickness of concrete paving shall be minimum 100mm.The single layer reinforcement in paving slab shall be min 10 Tor@200c/c. The area paving RCC slab shall be supported on 230mm thick Rubble soling with the internal voids filled with coarse sand. The height of the RCC dyke wall shall be evaluated based on the depth of Oil spillage for full oil volume of one storage Tank in addition to a free board of 300mm. Structural steel cross over ladder shall be provided (min 2 numbers) for each RCC wall dyke enclosure. Operating platforms wherever required as per functional requirement shall be provided.				
5.12.03	DELETED				
5.12.04	DELETED				
5.12.04	Oil Water Separator Pit The Oil-Water Separator RCC structure (pit) shall be designed as an underground structure. The sizing of the separator shall be based on the total surface run-off from the Fuel Oil Handling area and Hydraulic design for the oil separation. Surcharge load and ground water table up to ground surface shall be considered in addition to other functional loads for structural design of RCC wall for the separator pit. Drainage trenches with proper bed slopes towards the oil-water separator pit shall be provided around the tank foundation. The entire area outside tank foundation shall have slope towards the drain trenches Foundation for trestles and pedestal foundations, for supporting the pipes, shall be provided wherever required, at appropriate spacing. At pipe bends, necessary thrust resisting arrangement shall be provided. The entire fuel Oil Handling area shall be fenced all round with minimum 1.50m high metal fencing with provision for gates at key locations. Seismic design shall be carried out for the Fuel Oil Storage Tank foundation, Fuel Oil Unloading Pump House & the Oil water separator.				
5.12.06	Architectural Features of Fuel Oil Handling Buildings Spaces for Pump Rooms, MCC Rooms, Control Rooms etc. shall be provided as per functional requirement. One Toilet block with drinking water facility shall be provided in each building. External finishing shall be of Premium Acrylic Smooth Paint with Silicone additives over suitable primer of water proof cement.				
5.13.00	AREA PAVING RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted				
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5.13.01	thickness for normal duty paving and 400mm compacted thickness for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm diameter bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm diameter bars @ 200 mm c / c in both directions at the centre of the slab. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. Passages shall be provided inside the main plant block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the complete Mill bunker building and handling areas for PA/FD/ID fans with 50 mm thick metallic hardener topping. Ground floor area in the boiler shall be provided with normal duty paving and shall be finished with 50 mm thick metallic hardener topping. Ground floor area in the ESP envelope shall be provided with normal duty paving with neat cement punning. Wherever paving is envisaged to be provided, RCC paving shall be provided. However, corridors below trestle where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil. All other areas inside the Main plant block shall be provided with normal duty paving without metallic hardener topping. Suitable open RCC drains shall be provided to dispose off storm water drain. Separate open RCC drains shall be provided to dispose off floor wash and plant effluents into RCC sump pits. Separate RCC sump pits shall be provided for different types of effluents. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. All drains/pits shall be provided with Heavy duty electro forged GI grating cover. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from main plant block. For the purpose of area paving, Main plant block is defined as the entire area enclosed between peripheral roads encompassing the Transformer yard area, Main Plant Building area, Boiler area, ESP area, Chimney area & FGD area. Ground Floor Slab of Buildings		
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5.13.02	In all buildings including main plant building, the ground floor slab shall consist of minimum 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm diameter bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at passages, unloading & maintenance bays, stone soling of minimum 400mm thick and minimum 10mm diameter bars @ 200 mm c/c at top and bottom in both directions shall be provided. Further, top surface of ground floor slabs shall be finished with 50mm thick metallic hardener topping. Civil Works for Fire Detection & Protection System in Ground Floor/ Paving Fire water pipes shall be provided with either RCC trench/buried underground/on pedestal. Fire water trenches shall be open RCC type trench with removable RCC cover. RCC valve pit alongside trenches and RCC fire trenches crossing drains shall also be provided as per requirement. Interlocking concrete block paving shall be provided over the buried fire water pipes as specified elsewhere in the specification. At road/ drain crossings, NP3 class hume pipe encased in RCC shall be provided as per requirement at a depth of minimum 1m from FGL for routing of fire water pipes. In case of rail crossings, NP4 class hume pipe encased in RCC shall be used instead of NP3 class hume pipe. Each of the outdoor deluge valve and accessories shall be provided with housing comprising of Brick wall and RCC roof.		
5.14.00	DELETED		
5.15.00	DELETED		
5.16.00	DELETED		
5.17.00	Induced Draft Cooling Towers		
5.17.00.01	The civil , structural and architectural works for cooling towers are related mainly to following areas, but not limited to: Cooling Tower Basin The basin of the cooling tower for collection of cold water shall be made of Reinforced Cement Concrete (RCC M - 30 grade as per IS: 456). The floor of the basin shall be sloped to minimum 1 in 80 towards the sludge drains. The required slope shall be achieved by screed concrete of grade M-15 as per IS:456 having minimum thickness at edge as 25 mm. Drainage arrangement of basin shall be as specified elsewhere in the Technical Specifications. If the cooling tower basin and sludge sump is below ground level, FRP hand railing shall be provided all around the cooling tower basin and sludge sump pit. The bottom 500 mm of hand railing shall also have FRP/PVC wire mesh with opening size of 50mm grid to avoid ingress of leaves, vegetation, and debris into the basin. The basin shall be tested for water tightness as per IS:3370. Bottom of the lowest level beam shall be at least at free board level. In case, the beams are provided into the water, the same shall be designed for un-cracked section as per IS:3370. The outlet channel shall be covered on top with removable precast concrete slabs for about 5m length from cooling tower basin and the entire length of cold water outlet channel shall be provided with 32 NB (Medium) G.I pipes. Hot water duct around cooling towers, if placed below ground shall be encased with min. 500mm thick PCC (M20 grade).		
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	a) Foundation of Cooling Tower The foundation of the Cooling Tower shall be as detailed out elsewhere in the specifications. b) Super Structure of Cooling Tower (applicable in case of RCC cooling tower) Columns, beams and other structures like tie beams, slabs etc. shall be of reinforced cement concrete of grade M-30 (minimum) as per IS : 456. Uniform concrete grade shall be used for the entire cast-in-situ reinforced concrete superstructure. The fan deck slab shall be properly sloped so that rain water does not accumulate over the deck slab. The slope shall be 1 : 120 (min.). The slope shall be provided with screed concrete of grade M-15 (minimum) as per IS : 456.. Fan Deck slab and all other over ground platforms shall be provided with FRP handrailing. Suitable arrangement for drainage of rain water to be provided. However, there is no specific requirement of Rain Water down comers. c) Cells, Distribution System and Stack (applicable in case of RCC cooling tower) Cooling tower cells shall consist of RCC columns, beams and walls. The spacing of columns shall be minimum 4000 mm c/c. Inclined bracings shall not be provided between the columns. Hot water distribution channel shall also be of RCC. Cell division partition walls shall be of precast solid concrete blocks with provision of pilasters for walls, if required. The peripheral wall shall be Cast-in-Situ RCC wall and shall have two layers of reinforcement on either faces in both directions with minimum dia of reinforcement bars as 8 mm and maximum spacing as 150 mm c/c. Minimum thickness of Cast-in-Situ RCC peripheral walls shall be 200 mm. Hot water channel shall be covered with suitably designed precast / cast - in - situ concrete slab. Wherever flow control valves are located over hot water basin, these shall be placed over precast concrete covers / concrete slab and designed for specified load. The minimum thickness of RCC fan stack shall be 150 mm. The fanstack shall have two layers of reinforcement on either faces in both directions with minimum dia of reinforcement bars as 8mm and maximum spacing as 200mm c/c. d) Stairs RCC staircase for approach to fan deck for each cooling tower shall be provided. The stairs shall have 1000 mm clear width and FRP hand railing. The riser shall be maximum 175 mm & treads 250 mm (minimum). Edge protection angle (min 35X35X6, made of aluminum) shall be provided to the treads with the lugs. e) Steel Structures All mild steel parts of structures used in cooling towers shall be hot dip galvanized or seal spray zinc coated as per BS:5493 (for a very long period of maintenance of more than 20 years). The minimum coating for galvanization shall be 610 gm/sq.m and shall comply with relevant IS Codes. Galvanizing shall be checked and tested in accordance with IS: 2629. All welding shall be done before galvanizing. Any site joints required to be carried out after galvanizing shall be either flanged or screwed joints. Nails, nuts, bolts and all components coming in direct contact with water shall be of stainless steel of SS 316. f) Water proofing of structures and construction joints For water proofing of underground structures including basin slab and hot water distribution channel, water proofing cum plasticizer compound shall be mixed with the concrete. In addition Chemical injection treatment shall be provided for the construction joints of all underground structures.		
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	g) Expansion Joints PVC sealing strips shall be used for all expansion joints where water is retained. The minimum thickness of PVC sealing strip will be 6 mm (minimum) and minimum width 225 mm. The expansion joint shall be as per IS: 3370. At expansion joints, joints filler material with sealing compound on both sides shall be provided throughout the length of the joint. h) Grade of concrete All RCC associated with induced draught cooling towers including switchgear and control room, unless specified otherwise, shall be design mix (controlled) concrete of grade M 30 of IS: 456. Water - cement ratio shall not exceed 0.45. Minimum 75 mm thick PCC of grade M-7.5 as per IS: 456 shall be provided as mud mat below foundation unless specified otherwise. The PCC shall extend 75 mm beyond the outer edge of structural concrete. For water retaining structure minimum 100 mm thick PCC of grade M-10 as per IS:456 shall be provided as mud mat below the bottom slab / raft. The PCC shall extend 100 mm beyond the outer edge of the structural concrete. i) Form-Work Plywood Form-work shall be used for basin, basin walls, outlet channel and super structures. j) Doors (applicable in case of RCC cooling tower) FRP door shall be provided in each fan stack at fan deck level. Door height & width as per requirement for equipment movement (clear) shall be provided. However, door size shall be minimum 2100 mm high (clear) & 1200 mm wide (clear). Door shall have locking facility. k) Coating All concrete surfaces in direct contact with water/ water spray/moist air shall be applied with Moisture Compatible Corrosion Resistant Coating System or its equivalent as specified in Annexure-G. All concrete surfaces subject to water/ water spray/moist air upto and including Fan Deck slab level including basin slab, inner faces of peripheral walls, all faces of cell partition wall, all faces of columns, all faces of beams (both cast in situ and precast), bottom surface of fan deck slab for counter flow tower and both surface of fandeck slab for cross flow tower, inner face of fanstack, all faces of hot water basin (for cross flow tower), etc as applicable shall receive the said coating after cleaning and drying of the concrete surface. The detailed specification of the coating system on concrete surfaces is given in Annexure-G. External surfaces of Cooling tower peripheral walls and fanstack shall be painted with two or more coats of waterproof cement paint of approved shade, make and color. l) Paving Paving shall be provided for a minimum clear width of 5.0 m from the outer face of the HW pipes all around the cooling tower basin. Paving shall also be provided in between the hot water pipes and space available between HW pipes and CT basin wall spray catcher. The minimum total width of paving around CT basin shall be atleast 8.5 m from outer edge of the spray catcher or basin wall. Paving shall consist of reinforced concrete base slab laid over 75 mm thick PCC of grade M-10 as per IS:456 sub-base and 200 mm thick stone soling. The sub-base shall be laid on the compacted and suitably prepared sub-grade. The degree of compaction of sub-grade shall be as specified elsewhere in the specification. The thickness of the RCC base slab of grade M - 25 shall be suitably designed considering a superimposed load intensity of 5T /		
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	Sq.m. However the minimum thickness of base slab shall be not less than 150 mm having double layered reinforcement in both directions both top and bottom. The maximum spacing of the reinforcement bars shall be 150mm c/c and minimum dia of reinforcement bars shall be 8mm. RCC peripheral drain of minimum cross sectional dimensions 300mm X 300mm to dispose storm water shall be provided around area paving and shall be connected to nearest Owner's storm water drain. RCC paving all around cooling towers shall be connected to the existing road so as to provide approach to both cooling towers and switchgear & control room building as indicated in tender drawing. The clear width of this approach road shall be 5.5M and top of approach road shall be 350 mm above FGL. m) Walkways Permanent walkways at least 1000mm clear width shall be provided at hot water distribution level and at drift eliminator level for counter flow type cooling towers. The clear working height available above these walkways shall be at least 2.0 meters. The walkway and its supporting structure shall be of RCC M - 30 grade. Suitable RCC guards rails 300 mm high shall also be provided on both sides of these walkways. Over the guard rails FRP hand railing shall be provided. The vertical post of handrail shall be 700 mm high and at an interval of 1500mm c/c. There shall be two levels of horizontal pipes for hand railing spaced equally in vertical plane. Permanent walkways at least 1000 mm clear width shall also be provided for access to fan and around gear box with FRP gratings of clear opening size not more than 50 MM x 50 mm and grating thickness of 50 mm on RCC supports at fan deck Level.			
05.17.00.02	Design Criteria R.C.C. Structures (a) The design of all liquid retaining/conveying structures like of cooling tower like C.W. basin, sump, hot water distribution channel/basin, sludge drain and pits shall be designed by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2) : 2009. These structures shall be designed for following conditions :- 1. Water filled inside upto the designed level and no earth outside. 2. Earth pressure plus 2.0 T / M² surcharge (Vertical direction) plus ground water table at Finished Graded ground Level (FGL) outside and no water inside. (b) The design of all structures other than liquid retaining/conveying structures of cooling tower above CW basin slab such as columns, beams, fins, walkways, slabs, cladding/partition wall, fan stack, precast beams etc. as applicable shall be carried out by limit state method as outlined in Clause 4.4 of IS: 3370 (Part 2): 2009. Further, for limiting the crack width, the stress for the reinforcement steel shall be limited to 130 MPa (on all faces) as per clause 4.4.3.1 of IS: 3370 (Part 2): 2009 using the partial safety factor for serviceability condition as per clause 4.4.1.3. Wherever, the foundation raft of cooling tower is same as CW basin slab, the foundation shall be designed by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2): 2009 (all faces). However, if the cooling tower foundation is not the same as the CW basin slab and a separate foundation for the cooling tower is provided below the CW basin slab due to founding level requirements, the basin slab shall be designed as a structural slab resting on grid of beams taking support from columns or as a flat slab taking support from columns. Arrangement with providing walls between the columns and the periphery to support the structural basin slab is not permitted. The CW basin slab (both faces, including beams at CW basin slab level) shall be designed as structural			
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	slab by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2): 2009 and the structures below CW basin slab shall be designed as per IS:456 (2000). However, the size of the column below CW basin slab upto foundation shall be maintained same as the size of the columns just above CW basin slab. (c) The design of staircase, switchgear building, control room/RIO room, transformer and trestle foundation, storm water drain shall be as per IS: 456 (2000). (d) The Cold Water basin shall be checked against uplift for basin empty condition with ground water table at FGL. Stability against uplift shall be ensured both for construction & operating stage with no water inside. The provision of flap valve / pressure release valves is not permitted. The factor of safety against uplift shall be as per IS: 3370. (e) Fan deck shall also be designed for rolling loads due to movement of equipment during Installation / maintenance operation. Minimum Clear cover for all RCC structures/elements of cooling towers to meet durability requirements shall conform to severe exposure condition as per IS: 456 (2000). Fan Supporting Structures (applicable in case of RCC cooling tower) Static Analysis & Design The following load conditions and load combinations shall be considered for the design of the Fan supporting structures. (a) Machine Load (b) Load case (a) + unbalance load for the balance of the fan corresponding to G16 as per ISO 1940-1: 2003 (c) Load case (a) + unbalance load corresponding to one blade failure load condition. The strength design of the Fan supporting structure shall be done for worst loading combinations as stated above. Dynamic Analysis (a) Free vibration analysis A free vibration analysis of the fan supporting structure including the intermediate supporting structure for motor, gear box and pillow block (if applicable) shall be carried out to calculate the natural frequency of the fan supporting structure and its fundamental natural frequency shall be at least + 20% away from the operating speed of the fan and motor. (b) Forced vibration analysis Forced response analysis shall be carried out on the fan supporting structure including the intermediate structure supporting the motor, gear box and pillow block to calculate the vibration amplitudes for the following unbalance condition: - 1. For unbalance load corresponding to G16 as per ISO 1940-1: 2003 2. For unbalance load corresponding to one blade failure condition. The amplitude derived shall be within the permissible values as specified by the fan manufacturer or IS: 2974 (Part - IV), whichever is more stringent. Mid Bearing Supporting Structure The intermediate supporting structure for motor, gear box and pillow block if provided shall be so arranged that it does not cause any torsional moments on the beams / pedestals on which the intermediate support rests. The intermediate supporting structure shall be		
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	orthogonal to the grid of beams on which it rests. The motor shall be supported on a base frame. The concrete block supporting the fan/gear reducer shall be connected to immediate lower level of beam column junctions by means of at least four diagonal columns. Fan Stack The fan stack shall be made of RCC with minimum 150 mm thickness. With reinforcement provided on both faces in either direction. Design of the fan stack shall be made on the basis of relevant stipulations of IS : 11504 for Natural Draught Cooling Towers. The fanstack shall have two layers of reinforcement on either surfaces in both directions with minimum dia of reinforcement bars as 10mm and maximum spacing as 150mm c/c. Steel Structure These structures shall be designed, fabricated and erected as per IS: 800 (latest revision). All mild steel parts or structural steel works used in the cooling towers shall be hot dip - galvanised as per IS: 4759 with 610gm/sq.m. coating or seal spray zinc coated as per BS:5493 (for a very long period of maintenance of more than 20 years). Nails and all components coming in direct contact with water shall be of stainless steel of SS 316 or equivalent. For all steel structures, other than hot water pipes, sludge pipes and hot water distribution pipes, which are outside cooling tower painting shall be as specified in corrosion protection clause. However, for painting of hot water pipes, sludge pipes and hot water distribution pipes, relevant clause for painting specified elsewhere in the technical specification shall be referred. The minimum cement content as specified in subsequent clauses of this specification shall be applicable for all structures of cooling towers. Test for water tightness The water tightness of C.W. basin, outlet channel, CW channel and all other water retaining structures shall be tested for water tightness as per the provisions of IS : 3370.			
5.17.00.03	Stoplog gates and Trash racks for Cooling Tower Stoplog gate and trash rack/screen shall be provided in the outlet channel of each cooling tower. The design criteria and material specification for Stoplog gates and Trash racks shall be as specified for Circulating Water Pump House.			
5.18.00	CW SYSTEM, RAW WATER SYSTEM CIVIL WORKS			
5.18.01	Circulating Water Pump House (CWPH), Raw Water Pump House (RWPH)			
5.18.01.01	A circulating water pump house (CWPH) for housing circulating water pumps and Raw water pump house (RWPH) for housing raw water pumps shall be provided. Separate bays shall be provided for each pump by providing intermediate dividing piers of RCC between the pumps. a) The pump houses shall be provided with minimum two sets of stop-logs for each opening sizes along with electrically operated hoisting arrangements. Steel embedments required for stop-logs shall be provided for all the bays. b) All bays of pump houses shall be provided with a removable trash rack including electrically operated hoisting arrangements and cleaning arrangements. Moreover, one spare trash rack for each opening sizes shall			
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	also be supplied. Steel embedments required for trash-racks shall be provided for all the bays. c) Stop-logs, trash-racks and hoists shall be supplied in accordance with the specifications covered elsewhere. d) The steel structure shall be provided to carry EOT crane of the CW and Raw Water pump houses. The over ground portion of Raw Water Pump House and CWPH including maintenance bay shall be framed structure of structural steel work with permanently colour coated metal sheeting at roof and side open. However 4m high steel sheet side cladding shall be provided at the top under the roof for protection against rain. At the ground level, brick cladding of 0.9m height above the finished floor level, plastered on both sides shall be provided for all pump houses. e) The pump house including its forebay shall be of RCC with M-30 grade of concrete conforming to IS 456. The CWPH pump house shall be structurally separated from forebay by providing an expansion joint. The pump house shall be provided with separate maintenance bay f) For Raw Water Pump House (RWPH), connection shall be provided to meet the flow requirement with all necessary arrangement & precautions. Further, associated structure for & including supply of valves/gates are also to be provided for isolation of the connection.			
5.18.01.02	Each pump house shall be provided with a separate maintenance bay for maintenance of various equipment. Length of maintenance bay shall be adequate for one pump maintenance or minimum dimension indicated in the tender drawing, whichever is higher. Hand-rail with 32 NB (medium) pipes shall be provided around the operating floor on the forebay side in the stoplog and trash rack area.			
5.18.01.03	Sump model study for CWPH Sump model study for circulating water pump house shall be carried out as specified elsewhere in the specification.			
5.18.01.04	Design requirement for CWPH, RWPH Design of substructure shall be divided into two parts, namely, (a) Stability analysis, and (b) Structural analysis and design. For the design of substructure, a surcharge load of 2.0 T / Sq.m shall be assumed at the finished ground level for nearby vehicular movement. (a) Stability Analysis The Pump House sub structure shall be analyzed and designed for following load combinations: - 1. Under Operation Stages Maximum load from super structure + equipment load + load from sub structure + no water in the pump chambers + earth pressure at rest from outside with surcharge and maximum ground water pressure. 2. Condition (1) + earthquake/ wind 3. Under Construction Stages No load from super structure and deck slab, load from sub structure with no water in the pump chambers, pump units not installed, earth pressure at rest from sides with surcharge and maximum ground water pressure.			
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	4. Condition (3) + earthquake Following stability checks will be made for the above load combinations: i) Check for overturning Factor of safety against overturning, i.e, the ratio of stabilizing moment to overturning moment shall be as per IS: 456. For the above condition, uplift due to maximum Ground water table (GWT) acting on the base slab and side pressures on the walls due to earth and ground water shall be considered as destabilizing forces. In order to have no tension condition at tip of the base slab, resultant of all the forces acting on the pump house under different conditions of loading as listed above shall fall within middle one third of the base width provided. Maximum compressive stress at other end of the base slab shall be within the safe bearing capacity of soil / rock. Under earthquake condition, resultant of all the forces including earthquake force shall fall within middle three fourth of the base width provided. An increase of 25% shall be allowed in the safe bearing capacity of soil when earthquake forces are considered. ii) Check for Sliding Factor of safety against sliding under static condition, i.e. ratio of horizontal frictional resistance to horizontal sliding force shall be as per IS:456. For this condition, earth pressure at rest and the maximum GWT pressure from sides shall be taken as de - stabilizing forces. Keys shall be provided, if found necessary, to increase the factor of safety against sliding. To ensure an adequate factor of safety under earthquake condition, the factor of safety against sliding shall not be less than 1.2. iii) Check for Uplift Right from construction to operating stage, minimum factor of safety against uplift due to ground water shall be 1.2. Installation of pressure release valves shall not be permitted in the base slab (raft) of the pump houses to counter the uplift due to ground water. (b) Structural Analysis 1) Base Slab Base slab of the pump houses shall be designed as a raft foundation supported at locations of piers. Following load cases shall be considered: i. Maximum water level in the sumps with maximum GWT. ii. No water in the sumps and maximum GWT. iii. Alternate bays of sumps filled with water with maximum GWT. iv. Same as in (iii) above but with minimum water level. 2) Intermediate Piers Intermediate piers shall be designed by working stress method as per IS: 456 (latest), with limiting crack width of 0.2mm for the worst combination of maximum water pressure on one side and no water in the adjacent sump. These shall be designed as RC walls fixed at base and supported (hinged) at top by the deck slab. Since a breast wall may be provided for stop logs and back wall is provided connecting all the piers at the rear end, additional restraints for the pier due to breast walls and back wall may also be accounted for. Intermediate piers are also to be checked for the combined action of direct load due to		
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	superstructure and bending due to water pressure from one side. 3) End Piers Design of end piers will be similar to the intermediate piers. The end piers shall be designed for the following conditions: I. Soil pressure + maximum GWT + surcharge of 2 Ton / Sq.m. at FGL from outside or design surcharge load at floor level with no water in the sumps. II. Only maximum water level in the sump. End piers shall be designed by working stress method as per IS: 456 (latest), with limited crack width of 0.2mm on water face and the outside, i.e., earth side shall be designed as cracked section as per IS : 456. Since end piers are fixed at base and supported (hinged) at top by deck slab, there will be negligible yielding of the wall at top. This will give rise to earth pressure at rest and therefore an earth pressure at rest, $K_0 = (1 - \sin \phi)$ is considered where ϕ =angle of internal friction of soil. End piers shall also be checked for the combined action of direct load due to super structure and bending due to earth pressure with surcharge and ground water pressure. 4) Back Wall Back walls shall be designed as fixed at bottom of the base slab and on two vertical sides by the piers and supported at top by the deck slab. Since back walls are also of the unyielding type, earth pressure at rest, K_0, shall be considered for design. Back walls shall be designed by working stress method as per IS: 456, with crack width limited to 0.2 mm on water face and as cracked section on outer face as cracked section as per IS : 456. Following load combinations shall be considered: i. Soil pressure + maximum GWT + surcharge of 2 T / sq.m. at FGL from outside with no water inside the sump. ii. Only maximum water level inside the sump. 5) Operating Floor Slab Operating floor slab or deck slab shall be designed for loads of the pumps and other equipment, which may be placed on it. A live load of 1.5 ton / Sq.m. shall be considered on the deck slab. The deck / slab shall have monolithic construction with the piers and shall be designed as a continuous RC slab supported on piers. Design of bottom face shall be by working stress method as per IS: 456, with crack width limited to be 0.2 mm. Floor slab of maintenance bay may be designed as slabs on grade. A live load of 3 T / Sq. m. may be considered for the maintenance bay floor slab. Dynamic analysis shall be carried out to ensure proper separation of natural frequency of the structure and pump operating frequency C.W. Ducts CW ducts shall be concrete encased steel lined ducts. The concrete encasement shall be of minimum 500mm thick with square shape outside. Generally, M20 grade PCC encasement shall be provided. At locations of duct crossing road, rail in transformer yard or any other facility, RCC encasement of grade M25 shall be provided. Minimum two layers of reinforcement (On both faces) of 12 mm diameter bars @ 200 mm c/c shall be provided for RCC encasement of CW Duct. Top of CW duct encasement shall be minimum 1.5 m below finished ground level. The minimum thickness of steel pipes shall be as follows including corrosion tolerance of 2 mm:			
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5.18.01.06	a. For pipes above 1800 mm upto and including 2300 mm dia. - 12 mm b. For pipes above 2300 mm upto and including 3200 mm dia. - 14 mm c. For pipes above 3200 mm upto and including 3750 mm dia. - 16 mm d. For pipes above 3750 mm upto and including 4000 mm dia. - 20 mm However, for ducts running below rail line in transformer yard/road, minimum thickness of CW liner shall be 20 mm. Suitable tap-offs shall be provided in the duct to connect CW blow down, ACW tapping etc. Based on the transient analysis, sufficient number of stub connection shall be provided in the duct to fix air release valves. All duct installation & jointing shall be strictly in accordance with the stipulation given elsewhere in the specification for structural steel work. All the joints of liners shall be butt welded joints. The circular deformation of liner shall be less than 1% of diameter of liner while handling, transportation, erection & construction. If required, temporary bracings may be provided, during handling, transportation & concreting to reduce the deformation. The completed duct shall be tested for water tightness, for the pressure equal to twice the working pressure or 1.5 times the design pressure whichever is higher and shall be generally water tight to Engineer's satisfaction. The testing pressure shall be held for minimum period of 30 minutes without any signs of leakage or failure of weld. Any in flow / leakage of water from the duct shall be sealed / repaired at Contractor's cost. However, tests in part of length of duct may be permitted with prior approval only. Wherever required anchor / thrust blocks shall be provided with RCC M25 grade concrete. Suitable RCC chambers shall be provided with precast covers to install flow measurement devices and valves in the duct. Manholes of minimum 1000mm clear opening shall be provided in each CW duct at a spacing of 200M (approx.) to facilitate maintenance / dewatering of CW ducts. At least one manhole shall be provided at the deepest point for both intake & discharge duct. Following shall be considered for design of C.W. ducts: - Maximum design water pressure - Surge or water hammer pressure of 5.0 Kg / Sq.cm. - Expected vacuum conditions as arrived from transient analysis - Soil overburden - Surcharge Pressure of 2T/Sq.m - The effect of concrete encasement shall not be considered in the design of CW duct Painting as per Cl. 6.04.03 shall be carried out on machined faces, flanges and external exposed surfaces of CW ducts. For external surfaces of CW ducts encased in concrete, painting shall be as specified in Cl. 6.04.02(a). CW Channel		
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	The channel shall be of RCC section with vertical wall projecting minimum 300mm above finished ground level. Hand rails with 32 NB (medium) pipe shall be provided on both walls of the channel where height of channel wall is less than 1200 mm above finished ground level. The channel shall be designed to carry the required discharge with minimum water level in cooling tower basin and considering minimum value of rugosity coefficient (n) of 0.018 for concrete surface. However, the maximum velocity in CW channel shall be restricted to 1.8m/sec. The channel shall be designed by working stress method with crack width limited to 0.2 mm on water face and as cracked section on outer face as per IS: 456 considering (i) no water inside the channel, with earth pressure of soil upto FGL, ground water table upto FGL and surcharge load of 2.0 ton / Sq.m from outside, and (ii) with water inside the channel upto maximum level in the forebay / channel and no earth pressure, ground water pressure and surcharge load from outside. Right from construction to operating stage, minimum factor of safety against uplift due to ground water shall be 1.2. The channel shall be checked against uplift due to 50% of the total water head considering ground water table upto FGL. In addition pressure relief valves with under drainage arrangement in the channel shall be provided to prevent uplift of the channel as per relevant IS Codes. Minimum wall thickness shall be 250 mm. Forebay Structure Forebay consists of retaining wall and forebay slab. The walls shall be analysed as a retaining wall for stability against overturning and sliding, similar to end piers of the pump house. Pressure relief valves and under drainage arrangements shall be provided below the forebay slab to prevent uplift of the forebay slab. Size and spacing of pressure relief valves shall be designed by the Bidder to take care of the uplift due to ground water table. However, centre to centre spacing of PRV shall not exceed 5000mm. The forebay slab shall be designed against uplift due to 50% of the total water head considering ground water table upto FGL. The forebay slab shall be minimum 250 mm thick. The forebay slab shall be structurally separated from the retaining walls and water stops shall be provided at the junction of slab and retaining wall. Minimum thickness of retaining wall at top shall be 250 mm. Hand rails with 32NB (medium) pipe shall be provided on both walls of the forebay.		
5.18.01.07	DELETED.		
5.18.01.08	Stop-logs and Trash Racks for CWPB, RWPB		
5.18.01.08.01	Stop-log gates Clear size of the stop logs shall be equal to the clear opening size of water inlet opening below breast wall. Number of segments of the stop log shall be decided to match the capacity of the electrically operated monorail hoist provided to handle it. Structural design of stop log shall conform to IS: 5620 and IS: 4622. Maximum water level for designing the stop logs shall be taken as maximum water level of the forebay. Top and bottom unit of stop log gates shall be designed for their respective water head, whereas the remaining interchangeable units shall be designed for the water head corresponding to the lower most interchangeable unit. The stop logs shall be operated under balanced water head and they are not to be designed for operating under flowing water. Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log. These stop logs are used only during maintenance / inspection of pumps. The stop logs shall be operated by means of an electrically operated hoist. Suitable lifting beam shall be provided to operate the stop logs.		
5.18.01.08.02	Trash Racks Bar screen trash rack is to be provided at inlet of the sump of the pump house in order to prevent ingress of timber & other floating particles which could damage the Pumps.		
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Each bay of pump sump shall be provided with Type - 1 trash rack (removable section rack), conforming to IS: 11388. Centre to centre spacing of trash rack bars shall be 100mm (max). The trash racks shall be provided with number of interchangeable segments, to facilitate easier handling by means of a lifting beam and electrically operated hoist. Trash rack bars shall be designed for a differential water head of 2.0m. and other structural members shall be designed for a differential water head of 1.0m. Minimum thickness of trash rack bars shall be 10mm. Suitable size of horizontal members and end members shall be provided as per design requirements, for efficient operation of trash rack.

All trash racks should be capable of being lowered in the associated stop log groove to enable drawal of clean water while a particular trash rack is raised for cleaning purpose.

Suitable arrangement for storing all the stop logs and stand by trash rack shall be provided by the Bidder, to keep them in good working condition.

5.18.01.08.03 **Lifting Beams**

Separate lifting beams (automatic) shall be designed & fabricated with guide shoes, hooks, links and counter weights etc. complete for automatic operation to engage and disengage the stop logs and trash racks in the required position.

5.18.01.08.04 **Leakage Tests of Stop logs**

Leakage tests shall be carried out with the stop logs lowered onto the sill. Before observation for leakage, the stop log shall be raised and lowered about one meter several times in order to dislodge any debris that might have lodged in the side and bottom seals, The leakage shall then be measured and it should not be more than 5 litres / minute / meter of length of seal under maximum head.

5.18.01.08.05 **Material Specifications of Stop logs & Trash racks**

All material used in the fabrication of stop log or trash rack shall be of high grade, free from defects and imperfections and shall be of the highest standard commercial quality suitable for the intended use. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the Bidder, if asked for by the Employer.

5.18.01.08.06 **Materials for the various components of Stop logs**

Sl. No.	Component Parts	Recommended materials	Reference
1.	Stop log Leaf	Structural steel	IS 2062
2.	Stop log Frames, 1 st stage embedded parts and structural steel members	Structural steel	IS 2062
3.	2nd stage embedment	Stainless steel	SS316L or IS:1570 (part-5)
4.	Wheels (the hardness of wheel track surface shall be kept 50 points higher than that of wheel tread)	Cast steel	IS : 1030
5.	Wheel axles, wheel track	Corrosion resistant steel.	IS 1570
6.	Seals	Rubber	IS 11855

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5.18.01.08.07	SI. No.	Component Parts	Recommended materials	Reference
	7.	Bearings	SKF or equivalent	04Cr19Ni
	8.	Seal seats	Stainless steel	SS316L or IS 1570 (part-5)
	9.	Lifting pin	Stainless steel	SS316L or IS 1570 (part-5)
	10.	Guide	Corrosion resistant steel	IS 6603
	11.	Guide shoe	Structural steel	IS 2062
	Materials for various components of Trash Rack:			
	SI. No.	Component Parts	Recommended	Reference Materials
	1.	Trash rack and 1st stage embedded parts	Structural steel	IS 2062
	2.	2nd stage embedment	Stainless steel	SS 316L or IS 1570 (Part-5)
	3.	Slide Block	Structural steel with bronze padding	IS 2062 & IS 305
	4.	Track base	Stainless steel	SS 316L or IS 1570 (Part-5)
5.	Track	Stainless steel	SS 316L or IS 1570 (Part-5)	
6.	Guides	Corrosion resistant steel.	IS 6603	
5.18.01.08.08	Painting Specification for Structural Steel parts for Stoplog Gates and Trash Racks			
	(i) All structural steel surfaces shall be cleaned by shot blasting.			
	(ii) All MS structural parts shall be galvanised to minimum coating of Sealed Zinc spray (250 Micron) as per BS 5493.			
	(iii) Over zinc coating one coat of zinc Phosphate Epoxy primer having minimum 30 micron DFT and three coats of coal tar Epoxy paint having minimum 75 micron DFT / coat shall be provided. Total DFT of epoxy paint including primer shall be minimum 250 microns.			
5.18.01.09	CONSTRUCTION REQUIREMENT AND ACCESS TO WORK AREAS			
	Contractor shall notify to the Engineer before start of work well in advance about the method of construction for crossing road, pipeline, cable, railway, canals, utility lines and other existing obstacles.			
	Contractor shall not commence work on such crossings before having obtained approval from the authorities and land owners concerned to the satisfaction of the Engineer. The work at crossings shall meet at all times requirements and conditions of the permit issued by the authorities concerned. In the absence of any specific requirements by authorities, Bidder shall comply with Engineers' instructions.			
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5.18.01.10	Where the work areas come within the area of influence of high voltage electrical installations, contractor shall propose and provide adequate safety measures for all personnel working. He shall obtain necessary permission/permit from the concern authority. No work is allowed in such areas without Engineer's prior approval. Switch Gear / Control Room/ Remote IO room for CWPB, RWPB and MUWPB It shall be single storied building, framed RCC structure with beams, columns, floor and roof. It shall have non-load bearing brick wall cladding. It shall house the switch gear and MCC of respective Pump house & associated cable trenches. The architectural features shall be as specified elsewhere in the specification. Bio Toilet shall be opted for make up water facility area outside the plant boundary. Specifications of same shall be as mentioned elsewhere in technical specifications.		
5.18.02.00	DELETED		
5.19.00	WATER TREATMENT PLANT-DM Plant, PT Plant, ETP and CW Chemical Treatment Civil Works, CSSP etc		
5.19.01.00	Design Concepts for Buildings/ Shed - All buildings shall have framed super structure. - Equipment/facilities with shed shall have structural steel superstructure with permanently colour coated metal sheeting at roof and side open. However, kerb wall shall be provided all around the plinth/ floor area above the Finished Floor Level (FFL). For other buildings brick wall cladding on exterior face shall be provided. - Unless specified, the wall cladding for buildings shall be with minimum one brick thick on exterior face. However, brick wall for buildings adjacent to transformers shall be minimum 345mm thick.		
5.19.01.02	Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.		
5.19.01.03	The load and load combinations and design criteria shall be as specified elsewhere in the specification.		
5.19.01.04	All liquid retaining structures shall be designed for following load conditions. Underground structures: - Water filled inside up to design level and no earth outside. - Earth pressure with surcharge of 2.0 T/m² and ground water table up to FGL outside and no water inside. - Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure. - The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table. For design of over - ground liquid retaining structures appropriate load cases shall be considered.		
5.19.01.05	All liquid retaining and conveying structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2):2009.		
5.19.01.06	In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the		
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5.19.01.07	horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.			
5.19.01.08	Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand of approved quality shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.			
5.19.01.09	Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.			
5.19.01.10	Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.			
5.19.01.11	The minimum grade of concrete for all RCC structures associated with DM plant, PT plant, ETP and CW chemical treatment and CSSP shall be of grade M30. The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456(2000) and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to moderate exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.			
5.19.01.12	Factor of safety against overturning and sliding			
5.19.01.13	The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.			
5.19.01.14	For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.			
5.19.01.15	Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.			
5.19.01.16	Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:			
5.19.01.17	Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars
5.19.01.18	a)	Foundation	12 mm	12 mm
5.19.01.19	b)	Beams	12 mm	8 mm
5.19.01.20	c)	Columns	12 mm	8mm
5.19.01.21	Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.			
5.19.01.22	Suitable shrinkage reinforcement shall be provided at top face of foundations. Minimum shrinkage reinforcement shall be 10 mm dia. @ 200mm c / c.			
5.19.01.23	Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area distributed equally over top and bottom faces.			
5.19.01.24	Minimum tensile Reinforcement in each direction for all foundation slabs / rafts shall be 0.2% of cross sectional area.			
5.19.01.25	Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.			
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5.19.01.20	Minimum thickness of all elements of RCC liquid retaining / conveying structures (except effluent drains, launders and aerator waste slab) shall be 200mm. Effluent drains (depth more than 500mm), aerator waste slab and launders shall have minimum element thickness of 150mm.			
5.19.01.21	All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter. Edge protection angles shall be provided as specified elsewhere.			
5.19.01.22	All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.			
5.19.01.23	2.0m wide walkway with concrete paving shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL.			
5.19.02.00	Architectural Concepts and Finishing Schedule Architectural concepts and finishing schedule shall be as specified elsewhere in architectural specification.			
5.19.02.01	Acid / Alkali Resistant Treatment: Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable pilasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification. The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.bricks layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 1.0M high with above treatment shall also be provided if applicable in case of walls nearby. Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing. Alum solution preparation tank: The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum Solution Preparation tank: 5mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.			
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	Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns. Lime tank: Two coats of bitumen paint conforming to IS : 9862, with total DFT 150 microns. Guarantee The Contractor shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Contractor shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.		
5.19.02.02	DM Tank Foundation		
5.19.02.02.01	General Requirements		
	The tank foundation shall be as per IS:803 and as specified in relevent clause of foundation chapter.		
5.19.02.02.02	Sub Grade Preparation		
	The surface of natural soil shall be thoroughly compacted by rolling or other means, as directed by Engineer, to obtain 95% of max. laboratory dry density for the soil, as per IS:2720 (Part-VII).		
5.19.02.02.03	Anti Corrosive Layer		
	Anti-corrosive layer shall consist of dscreened coarse sand, mixed with 80/100 bitumen or equivalent 8% to 10% by volume.		
	Bitumen shall be heated to a temperature 175 ⁰ C to 190 ⁰ C, with 3% kerosene, if required. Sand shall be thoroughly mixed with it in a mixing drum to obtain uniform mixture and shall be laid over the compacted surface, laid in line, grade and levels and as directed by the Engineer. Bitumen shall not be heated beyond the temperature limits given above.		
	The premix carpet shall be laid in two layers of 3 cm and 2 cm respectively. After compacting and laying the first layer of 3cm, a tack coat of hot bitumen at the rate of 1 Kg. per Sq.m. shall be uniformly applied to the surface, by means of Sprayer and the Second layer of 2cm thick shall be laid, tamped and compacted to the satisfaction of the Engineer.		
	Sand shall be spread on the final surface at the rate of 0.5 Cu. m per 100Sq.m.		
5.19.02.02.04	Premix Materials		
	Sand		
	Sand shall be clean, dry, coarse, hard angular, free from coatings of clay, dust and mix of vegetable and organic matters and shall conform to IS 383 (Grade -III).		
	Stone Chippings		
	Stone chippings shall be hard black trap or granite or approved locally available stone and shall conform to IS 383. The grading shall be of normally 12mm down size and 6mm down size, in the ratio of 3:2 respectively.		
	Bitumen		
	Bitumen required for the work shall be 80/100 grade or its equivalent quality.		
	Laying		
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	Areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen shall be uniformly applied by Sprayers. The applied Binder shall be evenly brushed. The Binder bitumen 80/100 shall be heated to the temperature of about 190⁰ C with 3% kerosene, if required and mixed with stone chippings of size, as mentioned above, at the rate of 400 KG, with Six (6) Cu. M. of stone chips, for 100 Sq.M. of surface. The total mixed quantity, as mentioned above, is the quantity required for the total 50mm thick for 100 Sq. m. of area. Mixing shall continue until the aggregate is well coated.			
5.20.00	Switchyard Civil Works			
5.20.01	Civil works for switchyard includes:			
	a. Towers, girders, lightning masts and equipment supporting structures including proto type assembly etc., b. Foundations and supporting pedestals for towers, lightning masts, equipment supporting structures etc., c. Control room/Auxiliary building as required for switchyard, foundation for AC Kiosks etc. d. Foundations for transformers and reactors including oil pit, stone filling, laying and fixing of rails for movement of Transformers / reactors, rail track, jacking pad and fire walls as required, arrangement for cabling etc. all complete e. Earthing mat, single lane roads and R.C.C. drains in switchyard area including road/drain/trench crossings etc., f. All necessary embedments, inserts, supporting structures & supporting members as required etc. g. Cable trenches in switchyard and inside Control room/Auxiliary building including civil works for panel fixing etc.			
5.20.02	Design Criteria			
5.20.02.01	Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to IS 2062 and duly galvanized conforming to IS: 2629 and IS 4759. All joints shall be bolted connections. All bolts for connections shall be of 16mm dia conforming to IS 12427 and of property class 5.6 as per IS 1367 (Part 3). Nuts shall conform to IS 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS 5624 and property class shall be 4.6 as per IS 1367 (Part-3). Butt splice shall be used for splicing the main members and splice shall be located away from the node point. IS 802 “Code of practice for use of structural steel in overhead transmission line towers” shall be followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all outgoing and incoming feeders, the conductor span shall be taken as 200m for design purpose. The analysis of towers and gantries shall be carried out with combined model of critical configurations of towers and gantries using any established structural analysis software like STAAD Pro. etc.			
5.20.02.02	Switchyard structures shall be designed for the worst combination following loads: 1) Dead loads (load of wires/conductors, insulator, electrical equipment and structural members), 2) Live loads, 3) Wind loads			
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	a. Switchyard gantries, towers, equipment supporting structures and lightning mast shall be designed as per IS 802. The wind load calculations shall be made as per IS: 802 except the parameters basic wind speed (V_b) and terrain category as stipulated in "Criteria for wind resistant design of structures and equipment". b. All other structures shall be designed as per IS 456 / IS 800. The wind load calculations to be made as per IS: 875 shall be with the parameters as stipulated in "Criteria for wind resistant design of structures and equipment". 4) Seismic loads, 5) Loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane), 6) Loads due to unbalanced tension in conductor/wire, 7) Torsional load due to unbalanced vertical and horizontal forces, 8) Erection loads, 9) Short circuit forces including snap in case of bundled conductors, etc. Note: i. The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space. ii. Short Circuit forces and Wind pressure shall be considered to act together for design of switchyard structures iii. Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately. iv. The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries. v. The distance between terminal and dead end gantry shall be taken as 200 meters.		
5.20.02.03	Factor of safety: The factor of safety for the design of members shall be considered as 2.0 for normal condition and broken wire condition, 1.5 for combined short circuit and broken wire condition. Foundation shall be designed for a factor of safety of 2.2 for normal and broken wire condition and 1.65 for combined short circuit and broken wire condition.		
5.20.02.04	Design consideration for switchyard equipment support: The supporting structure for B.P.I., LA, CVT & Isolator equipment's shall be comprised of GI (ERW) pipe of grade YST:210 or of higher grade conforming to IS: 1161 & shall be designed as per IS 806 "Code of Practice for use of steel tubes in general building construction". Minimum diameter of the pipe type support for 765kV structure shall be 300NB, 400kV structure shall be 250NB, for 220kV & 132kV structures shall be 200NB and that for 66kV & 33kV shall be 150 NB. The supporting structure for CT, CSE & Wave Trap equipment shall be comprised of lattice structural steel conforming to IS 2062 and shall be designed as per IS: 802. Common raft foundation shall be provided for each pole of isolator.		
5.20.02.05	Special design consideration for lightning Mast:		
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	Diagonal wind condition shall be considered for lightning masts. Diagonal wind shall be taken as 1.2 times the wind calculated on Longitudinal/Transverse side. Lightning mast shall be provided with minimum two nos. of platforms as per requirement and an\ ladder for climbing purpose shall be provided up to platform at top level. Top of platform shall have grating, railing and toe guard plates. The minimum width of platform shall be 900mm. Live load of 300kg/m2 above platforms shall be considered for design of Lightning Mast.			
5.20.02.06	Design Criteria for structures not covered under Cl. 5.20.02.01 to Cl. 5.20.02.05 The Switchyard Control Room building shall have RCC framed super structure with one brick thick wall cladding on exterior face. The Control room building shall consist of rooms/facilities/ equipment/ monorail as per system requirement. An open space of one meter width (minimum) shall be provided on the periphery of the panel rows and equipment to allow easy operator movement and access for maintenance purposes. The design of RCC structures shall generally be carried out using limit state method of design as per IS 456. The minimum grade of concrete shall be of RCC M25 as per IS 456.			
5.20.03	The architectural features including roof water proofing, rain water down comers and RCC parapet walls etc. shall be as specified elsewhere in the specifications.			
5.20.04	The fabrication and erection of the switchyard works shall be carried out generally in accordance with IS 802 and IS 800. All materials shall be completely shop fabricated and galvanised.			
5.20.05	All structural steel members including stub members, bolts, nuts, spring washers, etc., shall be hot dip galvanised after fabrication. Minimum section thickness should not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m2 and foundation bolts shall have heavier zinc coating at least 0.80 kg/m2.			
5.20.06	Cable Trenches Cable trenches shall be provided for routing of cables as required and shall be of adequate size. The trenches located within switchyard shall project at least 300 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected to sump pits. The precast covers shall not be more than 300mm in width and shall not be more than 65 kg. Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:250 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided in the edges of RCC cable trenches and any other place where breakage of corners of concrete is expected. All cable trenches shall be provided with suitable insert plates for fixing support angles of cable trays. All internal cable trenches shall have minimum 6mm thick (o/p) chequered plate covers while external cable trenches shall have pre - cast RCC covers. However, the portion of the cable trench behind and sides of control panel / MCC shall be provided with suitable chequered plate covers as directed by the Engineer. Cable trenches inside switchyard, having depth more than 500mm, shall have wall thickness of minimum 150mm with two layer reinforcement.			
5.20.07	PCC Layer & Gravel Filling: PCC Layer and Gravel filling shall be provided as specified elsewhere in the specifications. Before laying of PCC layer, the subgrade shall be properly compacted and the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity. The anti-weed - soil sterilization details such as manufacturer's name, their specification, test certificate, etc. shall be furnished for Owner's approval. Any modification if required in the proposed anti-weed treatment chemical shall have to be done by the contractor at no extra cost to the Owner. The contractor shall be required to furnish a performance guarantee of three years for the anti-weed treatment. This guarantee shall be commenced from the date of completion of work or date of handing over, whichever is later. Stone/gravel shall be chemically inert, hard, strong durable against weathering, of limited porosity and free from deleterious materials. It shall be properly graded and shall meet the requirements of IS: 383.			
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5.20.08	Transformer/reactor foundations Foundations of transformers/reactors shall be designed for seismic and wind loads in addition to other applicable loads. Solid RCC block foundation shall be provided for the main transformer/reactor block. Alternatively, transformer shall be supported on a RCC foundation comprising of common raft for rail supporting walls up to rail-cum-road along with pedestals for jacking pad, roller lock etc. Tie beams connecting roller lock pedestals at rail level shall also be provided. Common raft/solid RCC block shall be supported on soil or pile based on requirement specified elsewhere in the specification. Oil soak pit / oil water separation pit for transformer/reactor shall be provided as envisaged elsewhere in the specification. The oil soak pit shall be provided for each transformer and shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store one-third (1/3) of the oil volume of transformer/reactor considering only 40% of the volume as available voids between gravel filling. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. The Oil-water Separation pit shall be designed for an effective capacity of complete oil of one transformer having highest volume of oil along with 10 minutes of firewater. For calculating effective capacity of oil-water separation pit, effective depth excluding 200 mm freeboard below invert level of inlet pipe shall be considered. Plan area and depth of oil-water separation pit shall be decided based on above consideration. Oil-water Separation pit shall be provided with five separate chambers interconnected by pipes. First chamber shall be for collecting oil-water mix from transformers' soak pits in case of fire. After entering into first chamber, oil being the lighter in density floats above the water. The water from lower elevation flows in to subsequent chambers interconnected through galvanized MS pipes. The accumulated oil in the first chamber to be pumped out for subsequent usage or disposal. Water collected in the last chamber to be pumped out for subsequent disposal after treatment. Invert level of inlet Hume pipes (of NP-3 grade and adequate capacity), carrying oil and water from transformers soak pits, shall be designed for gravity flow. Freeboard of 200 mm shall be provided below the invert level of inlet pipes. Invert levels of interconnecting pipes of subsequent chambers shall be decided accordingly. Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/reactor foundations. RCC Firewall shall also be provided between the transformers wherever required. 300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of Stone filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.			
5.20.09	The switchyard roads, drains, fencing and gate shall be as specified elsewhere in the specification.			
5.21.00	FIRE WATER PUMP HOUSE, FIRE WATER BOOSTER PUMP HOUSE& FOAM SYSTEM Salient Features: The scope of the Bidder shall be design and construction of Civil, Structural, Architectural, Water Supply, Plumbing and Sanitary Works of Fire Water Pump House, Fire Water Booster Pump House and Foam system including supply of all materials. The fire water Pump House shall be single storeyed and single bay RCC superstructure provision for a structural steel monorail. MCC /switchgear rooms, control room etc. shall have RCC framed structure with cast-in-situ RCC roof slabs with brick cladding. The building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and exhaust fans. The Fire Water Booster Pump House shall be structural Steel Shed superstructure with provision for a structural steel monorail. Control room shall have RCC framed structure with			
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	cast-in-situ RCC roof slabs with brick cladding. . The shed and building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and exhaust fans. Steel shed with roof covering with provision for a structural steel monorail shall be provided for foam system including associated civil works for foam bladder tank foundations, grade slab, pipe pedestals etc. Control room shall have RCC framed structure with cast-in-situ RCC roof slabs with brick cladding. The shed and building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and exhaust fans. Fire water storage tank foundation shall be provided as detailed elsewhere. Fire water pipes shall be provided with either RCC trench or buried underground as per requirement. Tender drawings shall also be referred. Fire water trenches shall be open RCC type trench with removable RCC cover. Interlocking concrete block paving shall be provided over the buried fire water pipes as specified elsewhere in the specification. At road/rail/ drain crossings of fire water pipes, the fire water pipes shall be provided with minimum 200mm thick PCC encasement all around the pipe.			
5.22.00	DELETED			
5.23.00	COAL, BIO MASS & GYPSUM HANDLING SYSTEM			
5.23.01	Track Hopper, Reclaim Hopper, Underground TP's & Tunnel			
	Track Hopper, Underground portion of TP's and Underground Tunnel shall be of RCC. Structural steel Shed shall be provided over Track Hopper. The vertical and inclined portion of coal hopper and beams in reclaim hoppers shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall also be provided at locations wherever tunnel connects with Underground TP's, penthouse etc. width of 600mm water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Reinforcement detailings at the expansion joint shall be done in such a way that there is no obstruction to copper plate installation. Track hopper, machinery hatches shall consist of underground portion, which shall be of RCC, and above ground portion, which shall be of structural steel shed covered with permanently Colour coated profiled steel sheets. The structural arrangement to be adopted for the design and construction of underground portion of track hopper and machinery hatches shall be as shown in tender drawing. It essentially consists of RCC frames spaced at approx. 3.0M centers with RCC wall panels on the sides and RCC raft/ raft and beam arrangement at the bottom, fixed to the frames. The top beam of the RCC frame supports the rail supporting beams and the coal hopper. Minimum thickness of RCC raft at bottom shall be 600 mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top. No columns shall be provided inside the Machinery Hatches. Foundation of all underground structures like underground TP's & tunnels shall be of solid RCC raft. Raft cum beam/sandwich slab arrangement shall not be acceptable.			
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	The vertical and inclined portion of coal hopper, the beams and top of coal tray in the track hopper structure as shown in the tender drawing shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall be provided in track hopper at a maximum distance of 40m unless otherwise shown in the tender 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Detailing of expansion joints and the reinforcement shall be coherent. Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover. Gratings shall be galvanized to grade 610 gm/m². Water proofing / Damp proofing of underground portion of Track Hopper, reclaim hoppers, tunnels, underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments: (A)Chemical injection grouting for inner faces (details as specified elsewhere) (B)Polymer modified cementitious coating on earth side face as per the following : (1.) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2.) 50 mm thick PCC (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick PCC (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. Steel gratings of mesh size 300 mm x 320 mm for track hopper shall be provided. The grating shall be built of min. 200mm x 28mm thick flats in main direction and min. 100mm x 20mm thick in secondary direction. The hopper and gratings shall be designed for movement of front end loader/ bulldozer over them. Bull-dozer weight shall be considered as about 35T. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication. Earth pressure to be considered for design shall be due to earth pressure at rest (K_o) condition only. Earth pressure due to surcharge intensity of Railway Loads (where applicable) or Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. whichever is critical, shall be considered in the design. A minimum safety factor of 1.2 against uplift of wagon tippler/track hopper, transfer points (underground or with basement) and tunnels, due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be 0.9 times only, ground water table at adjoining formation level and soil wedge angle of not more than 15 degrees.		
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5.23.02	Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case. Wherever, slope of tunnel exceeds 10°, RCC steps shall be provided for the entire width of each walkway. Overhead / Ground Conveyor Galleries and Trestles Overhead conveyors for trough belt conveyor shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. The maximum span of overhead gallery shall be limited to 25 meter unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made. Contractor can also use tubular steel sections for roof truss of conveyor galleries only. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall conform to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor. Grade slab with brick toe wall and plinth protection along with drains shall be provided throughout the length of the ground conveyors. Top of pedestal for ground conveyor portals shall be 300mm above FFL. Bottom of the base plate of the columns of the trestles in Main Plant Block Area shall be kept 1.2m below the finished floor level of ground floor of Main Power House. For double stream conveyor gallery, two side and one central walkway of minimum width 800 mm and 1100 mm respectively shall be provided. The minimum width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates (suitably stiffened) and other drainage arrangements as specified elsewhere.			
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	Trough belt conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However, in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center alternatively on both slopes, shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification. Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 90m intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location. For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However, at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.5m above the road crest / rail top shall be provided. For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc. Thus material load per unit length of each moving conveyor shall be $1.6 \times \frac{\text{Rated Capacity of Conveyor system}}{\text{Conveyor Belt Speed}} \times F$ Where, F = 1100/800 for coal, 800/600 for Biomass & 1250/900 for gypsum It should be noted that for structural design, unit weight of lime shall be considered as 1700 kg/cu. m; unit weight of gypsum shall be considered as 1250 kg/cu. m. It should be noted that for structural design, unit weight of coal shall be assumed as 1100 kg/cu. m. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously. Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways. a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with PTFE bearings to allow both rotation & longitudinal movements.		
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	OR b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with PTFE bearings to allow both rotation & longitudinal movements. End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa. 5.23.03For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and underground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Base plates of trestle columns shall be kept 300 mm above the finished ground level. 5.23.04Transfer Houses The over ground portion of all transfer houses shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and RCC floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering without considering any composite action effect of metal deck sheet) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with brick cladding of 0.9 m height, plastered on both sides shall be provided for all transfer houses. Bottom of the base plate of the columns of the transfer houses in Main Plant Block Area shall be kept 1.2m below the finished floor level of ground floor of Main Power House. Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Pre-Fabricated Insulated Metal Sandwich Panel for Roofing shall be laid to specified slope. Composition of Insulated Metal Sandwich Panels shall be as described in relevant section of Technical Specification. Adequate slope shall be provided for quick drainage of rain water. 5.23.05Crusher Houses The crusher house shall be framed structure of structural steel work with permanently colour		
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	coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of RCC comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering without considering any composite action effect of metal deck sheet) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building, cubicles for resting room of operators shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery. The roof of crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Pre-Fabricated Insulated Metal Sandwich Panel for Roofing shall be laid to specified slope. Composition of Insulated Metal Sandwich Panels shall be as described in relevant section of Technical Specification. Adequate slope shall be provided for quick drainage of rain water. Crushers shall be supported on RCC deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This RCC deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification.		
5.23.06	Stacker Reclaimer Foundation		
	Stacker – Reclaimer (S/R) foundation shall be in RCC and shall be designed as RCC framed structures (in longitudinal & transverse direction). Lateral tie beams between two rail supporting elements shall be provided at a regular interval of approx. 3.0 m center. Conveyor short posts shall be supported on RCC beams at grade level. The foundation shall be designed for the most critical combination of loads as furnished by the equipment supplier. RCC retaining wall on both sides of the S/R foundation shall be provided as shown in the Annexure. The portion between the two rails and between rail and retaining wall on both sides shall be paved in concrete as per specification for grade slab of ground level specified elsewhere. However no metallic hardener finish over RCC slabs is to be provided. Drains shall be provided along the rails for drainage of rain / dust suppression / floor washing water. Drains shall be routed on both sides of the foundation along the rail as shown in Tender Drawing. Drains shall be connected to the network drainage system for finally discharge into coal settling tank. RCC drains shall be provided in Coal stockyard area with precast RCC covers.		
5.23.07	Control building, M. C. C. Buildings		
	These shall be steel or RCC framed building with RCC roof and floor. For steel framed building roof/floor comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Shear anchor studs shall be provided through metal		
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	deck at regular interval on all top flange/flange plate of structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Bidder has also the option to supply and construct pre-engineered buildings. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations. All air - conditioned areas, shall be provided with the false ceiling system(details specified elsewhere) with under deck insulation. Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.		
5.23.08	Pump Houses These shall be framed structure of structural steel work with permanently colour coated profiled steel sheet roof, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. Brick wall cladding (1m height above FFL) shall be provided all around the periphery of pump houses		
5.23.09	Pent House These shall be of RCC framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.		
5.23.10	Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with RCC wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above Tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed. Finished floor level of Gypsum storage shed shall be kept at least 500mm above the finished ground level. The building shall be provided with 750 mm wide plinth protection all around as detailed elsewhere in the specification.		
5.23.11	Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (A) Crusher House (Ground Floor) – (Gents Toilet – 1 No for each.) (B) In CHP/LHP/GHP Control Room building – (Gents and Ladies Toilets-1 No. each)		
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	Each Gents toilet shall have brick enclosure, and the following fittings.			
	i)	Wall mounted glazed vitreous china European water closet with low flush having flow rate of 6.0 litres and 3.0 litres of water per flush, dual flush adopters for standard flushing for solid waste and a modified smaller flush for liquid waste flushing valves shall be provided.	1 no.	
	ii)	White glazed vitreous china flat back lipped urinal 390x375x610 mm (approx.) fitted with photovoltaic controls for flushing system and all requisite fittings.	1 no.	
	iii)	Wash Basin 450x550 mm (approx.) mounted over 18 mm thk granite beveled edge counter fitted with photovoltaic control system for water controls, bottle trap with two taps and all requisite items.	1 no.	
	iv)	Mirror 600x900x6mm thk. with beveled edges (Superior sheet glass) mounted with teak wood beading and minimum 12 mm thk. plywood backing.	1 no.	
	v)	C.P. Brass Towel Rod 600 x 20 mm	1 no.	
	vi)	Liquid Soap Container	1 no.	
	vii)	Washing Tap (CP Brass)	1 no.	
	viii)	Overhead Polyethylene water tank (min. 500 litres capacity)	1 no.	
	ix)	Suitable provision for installation of drinking water cooler.	1 no.	
	x)	Space for Janitor room	1 no.	
5.23.12	Ladies toilet shall be similar to gent's toilet as detailed above, except item at s.no. ii and ix (urinal and provision for drinking water cooler). Package type STP shall be to be provided.			
	No other facilities shall be provided below toilet block except toilet. Toilet facilities shall be provided at control room floor level.			
	Staircases			
	All floors of transfer houses/crusher houses and roof/floors of all multistoried MCC/Control room buildings shall be accessible through staircase and mumty of staircase of mcc/control room shall be accessible through cage ladder. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses & MCC/control room (with only ground floor).			
	All stairs of over ground portion of transfer houses & crusher house shall be of steel (minimum 1200 mm wide) and maximum rise should not be more than 180 mm and minimum tread width 275 mm. Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of electro forged steel gratings. Stairs shall be provided with 32 mm dia nominal bore medium duty M. S. pipe hand rail.			
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5.23.13	Handrails (for staircases, around openings, in walkways etc.) shall be of standard weight steel pipe of flush welded constructions, ground smooth using 32 mm nominal bore medium class pipe provided with double rail, top rail about 1.0 metre, minimum above platform level (upto height of 12m the height handrail shall be 1.0 m and above 12m height the height of handrail on staircase landing and around cutouts and openings shall be 1.2 m) and pipe posts spaced not more than 1.5 metres apart. Angle handrail post may be provided when specifically called for in drawings approved by Engineering. Toe guard of size 100mm x 6mm shall be provided along the railing for all steel platforms/landings and RCC staircases. Smooth uniform curves and bends shall be provided at stair returns and also where so ever required. Posts connected to curb plates shall have a neat closure at the bottom and a 6 mm thick plate neatly welded to posts for attachment to curb plate. All necessary fittings including inner dowels at splices, brackets, belts, bends, flanges and chains, where required shall be plugged and welded. A minimum radius of 3 times the pipe diameter shall be provided at all points of direction changes in the handrail. Treads and landing shall be suitable for the prescribed loading. The maximum width of openings in gratings shall not exceed 40 mm. The minimum size of main bars shall be 25 x 6 mm and cross bar shall be 6mm. The usual span of grating will not generally exceed 1.5 meters. Stair case gratings shall be galvanized to grade 610g/m². All gratings shall be electro forged types. Outside stairs to transfer points shall be open type. However, sheeting shall be provided at the top. Stairs of MCC/control room, wagon tippers/track hopper and underground TP's shall be of RCC construction. The minimum width of stairs for MCC/Control room, wagon tippler/Track hopper, reclaim hopper/underground TP's shall be 1200 mm. Maximum rise should not be more than 180 mm and minimum tread with 250 mm. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in Track hopper/wagon tippler/underground TP's. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. External fire escape staircase along with internal staircase shall be provided for crusher house and multi-storied MCC cum control room building. Minimum headroom in all staircases and all levels shall be 2200mm from floor finish level.			
	Trenches All trenches for cables or any other underground facility as detailed out elsewhere shall be of RCC Cable trenches shall be provided with pre - cast RCC covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles. Lifting hooks shall be provided for all pre - cast RCC covers. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. At road crossings & entry locations, RCC trench covers designed for 10 T wheel load at centre shall be provided. Pre - cast covers shall be designed for central point load of 75 Kgs. RCC cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast RCC covers. For cable trenches outside buildings, top level shall be 200 mm above G.L and sand filling shall be overlaid with 50 thk. PCC.			
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5.23.14	Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of RCC trenches supporting pre - cast covers, supported edges of pre - cast cover. Cable gallery/trestles Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8. Glavanised gratings shall be provided for walkways as per approved electrical drawings. Ladders shall be provided for access from ground to cable galleries at maximum 100m intervals.			
5.23.15	WIND BARRIER Wind barrier need to be provided all around the stock pile area. Its foundation and super struicture need to be design considering 100% blockage condition of mesh.			
5.23.16	Biomass Storage Silo The supporting structure for silo shall be of structural steel. Enclosure with side metal cladding is to be provided above biomass Storage Silos for biomass handling equipment. Side metal cladding is also to be provided for outgoing conveyors below biomass storage silos. Stored biomass load shall be treated as dead load for analysis and design of silo supporting structure.			
5.23.17	Drainage & Water Supply Works			
5.23.17.01	Drainage System:- The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the conveyor galleries, transfer points, crusher building, penthouse etc. with water periodically. Minimum 4 nos. down comers shall be provided in each transfer house / crusher house. In case of conveyor galleries, the down comer shall be provided at every trestle location. Drainage of the complete coal stock pile, area around stacker reclaimer rails etc. shall be discharged into the coal slurry settling pond. For all coal Conveyors, each down comer shall lead the water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into coal slurry settling pond. For Crusher House, pent house, transfer house each down comer shall lead the water / coal slurry into the peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry to water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally to the coal slurry settling pond.			
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5.23.18	For Track hopper/Wagon Tippler & transfer houses peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / coal slurry to a local RCC pit (of 2 Cu. M. capacity) near each facility to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge to a coal slurry settling pit. In case of Control rooms and MCC buildings, Pump houses, etc water / coal slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry into contractor's RCC drain, which will lead the discharge finally into coal slurry settling pond. Suitable kick plates/Curb beams shall be provided around the floor openings, stair case landings, in the transfer points, crusher house and other buildings. Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / IRC standards and approval of Railway culverts from concern Railway authorities.			
	Internal and external water supply, drainage etc.:-			
	The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in these specifications.			
	The scope for service water supply and dust control water supply shall be as described elsewhere in these specifications.			
	For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.			
	The scope for drainage of surface water shall include design, layout and construction of drains for and from buildings and drains required for coal stockyard area, drainage up to main coal slurry settling tank including connection with the tank. Drainage system shall be designed for maximum intensity of rainfall as 75 mm/hr and 60 % runoff coefficient. Moreover, the drainage system shall also comply to detail mentioned in project information chapter. All buildings (including transfer houses, crusher house, MCC rooms, pump house etc.) shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth with removable steel gratings all around the periphery. All drains excepting the peripheral drains around the transfer points, crusher house, control / MCC. buildings, pumps house etc., shall be of RCC construction. All open RCC drains shall have removable steel gratings designed for loads as specified under loading clause. Minimum size of main bar of steel grating (Galvanised to 610 gm/m²) shall be 25 mm x 5mm and cross bars 6mm. At all entry or road/rail crossing point's RCC box/pipe culvert shall be provided. The opening size of grating shall not be more than 90 mm x 35 mm. All drains as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. However, drains in coal stockyard area shall have pre cast RCC covers. RCC pre - cast cover weight shall not be more than 65 Kgs. RCC pre-cast covers near entry or at road crossings shall be designed for 10 T wheel load at centre. RCC pre - cast covers shall be designed for central point load of 75 Kgs. The scope for foul water from toilets shall include layout and laying of sewers for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as			
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5.23.19	connections, manholes and inspection chambers within the building and from the building to the terminal point. For rain water down comer and those to be used for conveying water / coal slurry generated from cleaning of walkways/floors, Galvanized MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be provided for MCC buildings, penthouse, control rooms and Galvanized steel ERW pipes (273mm OD, 4mm thk) of steel grade Fe330 conforming to IS: 3589 with welded joints shall be provided for all TP's, Crusher house, and Conveyor galleries. Galvanizing shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 360 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629. All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti-corrosive painting over a coat or primer. For design of building drainage system IS: 1742 shall be followed. For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints. For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing RCC box culvert to be provided. For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch. Roof Details Roof slabs for CHP and GHP buildings shall be minimum 150 mm thick(in case of metal decking thickness shall be measured from crest top) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. 1000 mm high and minimum 100 mm thick RCC parapet wall shall be provided over roofs of all buildings. However, for mummy, 600mm high parapet wall shall be provided. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings. Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet. Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster. Roofs of all M. C. C./control rooms, crusher house and TP(if applicable), penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as mentioned else where in specification.		
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5.23.20	Roof of pump house shall be provided with single skin troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water.			
5.23.20.1	Floors and Grade level details			
5.23.20.2	DELETED			
	The floor slabs shall be minimum 150 mm thick(in case of metal decking thickness shall be measured from creast top) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. The RCC slab shall be designed without considering any composite action effect of metal deck sheet (ie the structural strength of metal deck sheet shall not be considered for RCC slab design). Floors of transfer points shall have cross slope of not flatter than 1: 80, towards the floor washing drainage outlets, for efficient drainage. For ground conveyor & crusher house slope shall be 1:100. Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick o/p or as indicated on drawings. The chequered plate pattern shall be approved by Employer / Engineer. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates to restrict deflection within span/200. Chequered plates shall be fixed by staggered welding of suitable size. Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided. All along the periphery of RCC floors (where no brick masonry walls are provided) 100 mm thick 300 mm high RCC wall and 900 mm high steel hand rails all around over this RCC wall shall be provided. The grade slab shall consists of 230 mm thick rubble soling (63 mm downgraded hard stone aggregate as per IRC specification, watering and compaction to minimum of 90% Standard Proctor density, including filling the interstices of stone aggregates with sand), over well compacted earth, overlaid by 75 mm thick P. C. C. M-7.5 and 100 mm thick RCC of grade M-25 with minimum 8 mm dia bars placed at 200 mm C / C in either direction respectively. There will be minimum 50 mm thick metallic hardener finish over the RCC slab. All buildings (including Wagon Tippler/track hopper and machinery hatches, truck hopper, penthouse, MCC rooms, pump houses, transfer houses and crusher house) and ground conveyors shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-25 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand. An area of 5 m width all round the water tanks near pump house, transfer houses and crusher house, Gypsum storage shed, truck tippler area, lime storage silo shall be paved. This paving will be in addition to plinth protection. The paving construction shall be as per specifications for the grade slab at ground level. However, 50 mm thick metallic hardener finish is not required to be provided in paved area. Paving shall also be provided in HGTU and VGTU area. Heavy duty paving shall be provided inside the building(Gypsum storage shed) if any vehichular movement is envisaged. Finished Floor level of all buildings shall be kept at least 500 mm above the finished grade / formation level.			
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5.23.21	Brickwork and allied masonry works Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be provided at a maximum spacing of 3m and suitably encased with plaster or 1:2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness. 50 mm thick Damp proof course shall be provided at plinth level for all brick wall.			
5.23.22	CONCRETE Refer General Specification.			
5.23.23	De-watering of Deep Excavations For deep underground structures like wagon tippler/track hopper, tunnels and underground transfer houses, requiring open excavation with extensive de - watering, completely dry working conditions during excavation, shuttering, placement of reinforcement, concreting, water proofing of structures, backfilling and any other operation shall be maintained by suitable de - watering method of suitable capacity.			
5.23.24	Galvanising All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising. Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition). The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.			
5.23.25	CHEMICAL INJECTION GROUTING Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete. For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes. After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low			
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5.23.26	pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer. POLYMER MODIFIED CEMENTITIOUS COATING		
5.23.26.1	Materials Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.		
5.23.26.2	Mixing The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.		
5.23.26.3	Properties of Polymer Modified Cementitious Coating It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm. Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.		
5.23.26.4	Application The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed. (a) For Slurry Mix		
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	A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints. The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat. (b) For Brush Topping Mix This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any. The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat. Rate of application of coating shall be established to achieve the required thickness.		
5.23.27	Miscellaneous		
5.23.27.1	Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.		
5.23.27.1	Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.		
5.23.27.1	Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided. Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers. The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground. Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
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5.23.28	SHOTCRETING General Requirements Generally, shotcreting shall be done in accordance with IS : 9012. Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. (a.) Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting. (b.) Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied. (c.) Clear cover to reinforcement mesh shall not be less than 15 mm. Minimum thickness of shotcreting shall be 50 mm for abrasion resistant work and 25 mm for ordinary surface protection work. Material Generally, the materials shall be in accordance with aggregates specification given here under. Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383. Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012. The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer. Application After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting. The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required. A uniform pressure of not less than 3 kg/cm2 at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.			
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5.23.29	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused. As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38°C during placing and curing. VIBRATION ISOLATION SYSTEM These specifications are meant for the design, supply and erection of vibration isolation system for supporting coal crushers. Supporting Arrangement The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an RCC deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building. The part of the structure consisting of the RCC deck, springs and viscous dampers shall hitherto be referred to as "spring supported foundation". The part of the structure, which is below the spring shall hitherto be called "supporting structure". The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the coal crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for atleast five years		
5.24.00	DELETED		
5.25.00	DELETED		
5.26.00	O&M STORE BUILDING Salient Features: The scope of work of the Bidder shall be design & construction of all Civil, Structural and Architectural, water supply, plumbing & sanitary works of the O&M store building including supply of all materials. The Permanent store Building shall comprise the following: a) Heavy Material Storage Hall The Heavy Material storage Hall shall have a Single Bay framed superstructure with RCC/Structural steel columns and structural steel roof truss and purlins supporting pitched roof. The roofing of the Heavy Material store shall be permanently colour coated insulated sandwiched metal sheet. An EOT crane shall be provided with chequered plate walkways		
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	at both ends inside the bay of the Heavy Storage Hall. The capacity of the EOT crane shall be 30MT. The clear height up to the bottom of roof truss of the Heavy material storage hall shall be finalized based on equipment/spare to be handled. b) Light Material Storage Hall The Light Material Storage Hall with 3 tier Rack system shall have a Single Bay framed superstructure with RCC/Structural steel columns and structural steel roof truss and purlins supporting pitched roof. The roofing of light material store shall be permanently colour coated insulated sandwiched metal sheet. The light material store shall be fully covered with external brick wall of 250mm thickness with provision for doors, windows, rolling shutters as per architectural concept. c) General Light Material Storage Hall The GERAL Light Material Store shall be RCC structure with cast in situ RCC beams & slabs. The RCC building shall be two storied and all beam column joints shall be designed and detailed for adequate ductility. d) Office Complex Office complex of this store shall be a single storeyed RCC building. Architectural Features Total Floor area of the Permanent store building shall be 3000sqm. The minimum clear floor area of Heavy material storage hall shall be approximately 20% of the total area of the Permanent store with bay width of 15m Heavy material store shall have column free space for easy movement of materials. The Heavy Material storage hall shall be fully covered with external brick wall of 250mm thickness with provisions for doors, windows, rolling shutters as per architectural concept. The minimum clear floor area of Light Material Storage Hall (with 3 tier storage) shall be approximately 33% of the total floor area of the Permanent Store. The height of the Light Material Storage Hall (with 3 tier rack system) from ground floor slab to bottom of roof truss shall be 10.0m. A part of light material store shall have facility for storing electronic equipment / instruments. This particular area shall be air-conditioned for dust proof environment. The General Light Material Store shall be two storied building, completely covered with 250mm thick brickwork, doors, windows & rolling shutters. The plan of the building shall be rectangular in shape with minimum floor area of approximately 20% of the total floor area of the Permanent Store. The area of the office complex building shall be approximately 17% of the total floor area of the Permanent Store, with clear height of 4.0m. The external Wall shall be 250mm thick brick wall with provisions for doors and windows. The central office shall be provided for management and monitoring the stored materials. Adequate space shall be kept for loading unloading of materials. Office shall space for Supervisor/In-Charge room, general office cum record-documentation area, toilets, pantry, etc. shall be provided as per requirement. All the above mentioned four buildings shall be interconnected by means of a covered passage 5.0m wide. External finish shall be of Premium Acrylic Smooth Paint with Silicone additives.		
5.27.00	DELETED		
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5.28.00	DOZER SHED Architectural Feature This building shall be prefabricated steel framed structure with brick wall up to window sill height & prefabricated insulated double skin metal sheeting cladding above it. Roof of the building shall be prefabricated insulated double skin metal sheeting on steel roof truss. The building shall provide for Dozer shed space, Workshop space, Office Rooms, Stores, Toilet & Pantry as per functional requirement. Minimum size of the dozer shed shall be 500 Sq.m. Metal side cladding shall be composed of different colour shades to match with the other buildings. External finish for brick walls shall be of Premium Acrylic Smooth Paint with Silicone additives		
5.29.00	DELETED		
5.30.00	PARKING 30 nos. of open car parking and 70 nos. of open scooter parking shall be provided in addition to all other parking requirements specified with buildings.		
5.31.00	FQA BUILDING FQA building shall be RCC construction of single or double storey. Total area shall be decided based on the requirements based in QA chapter, however, minimum area shall not be less than 800 Sqm. Apart from space required to accommodate and operate all the equipments mentioned in the equipment list, office space for 5 executives, one meeting room, spectroscopy room, NDT lab, storage room, welding booth, welding simulator area, platforms for instruments/equipments, ladies and gents toilets, space for water cooler and pantry has to be provided as per specifications mentioned elsewhere in the technical specifications.		
5.32.00	DELETED		
5.33.00	Safety Control Room Safety control room shall be a single storyed RCC framed building of minimum area 60sqm to accommodate equipments and personals as mentioned in C&I chapter for 24X7 operation. Additionally, it shall have ladies and gents toilet, space for water cooler and Pantry.		
5.34.00	BIO TOILET Bio-Toilet shall be provided near all the modular worker's sheds/accommodation, the makeup water pump house building, CHP building outside the plant boundary. Besides these areas, any toilet block provided in area far from plant boundary shall be a Bio-toilet. Bio-toilets shall be made for anaerobic bacterial decomposition of human waste. After decomposition and treatment of the human waste, the residual water from Bio-Toilet shall be: colorless, odorless, devoid of any solid particles and shall have pathogen inactivation by 99%. The water thus obtained shall require no further treatment / waste management and shall be used for irrigation purposes. Bio toilet shall have all fixtures that shall include following fixtures besides the requirements stipulated by DRDO standards. a) One number wall mounted colored (excluding premium colors) glazed vitreous China European water closet and flushing valve system, water faucet, toilet paper holder as per IS:2556 or		
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	One number white glazed vitreous China Orissa pan (580 x 440 mm) and flushing valve system, toilet paper holder as per IS:2256 b) One number colour (excluding premium colors) glazed ceramic oval shaped wash basin 450x 550 mm (approx.) mounted over 20mm thick granite beveled edge counter fitted with photo-voltaic control system for water controls, bottle trap as per IS:2556. For common toilets, number of washbasins shall be as per requirement. However, for Pump Houses the same shall be provided without photo voltaic control system for water control. c) For Male Toilets Urinal as per requirements, with all fittings with photovoltaic control flushing system as per IS: 2556. d) One number looking mirror 600 x 900 x 6 mm, edge mounted with teak beading and minimum 12 mm thick plywood backing, one number stainless towel rail 600 x 20 mm, one number liquid soap dispenser Bio toilet/Bio digester shall be comprised of four compartments and a soak pit. The size of the tank shall be as per the number of users. This four-compartment tank shall be constructed underground and shall be made of FRP with required strength as stipulated by DRDO norms. The bio-toilet constructed shall have S-trap and ball valve for ease of operation and maintenance. It shall have all necessary arrangement and fixture for future operation and maintenance as per manufacturer guidelines. In addition to above sample collection provision(tap/alternate arrangement) to be made before reaching of treated effluent to soak pit. This is to ascertain the quality of effluent at all periods of time and this would also help in the seeding requirement of bacteria.		
5.35.00	NON-BIODEGRADABLE BUILDING The Building shall be as per Tender drawing		
5.36.00	WORKER'S ACCOMODATION BUILDINGS Worker's Accommodation shall be provided as per NBC requirement and Local factory act. The Building design shall be as per Tender Drawing. It shall have Brick wall around the Kitchen, Toilet, bathroom and washing area. It shall have Aerated Concrete panel wall with steel structure having sandwich panel roof sheeting.		
5.37.00	OTHER BUILDINGS For all other buildings mentioned in the scope of work but requirement not furnished in this chapter, the Bidder shall develop the details of such buildings based on the functional and statutory requirements.		
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D-1-6	DESIGN CRITERIA	
6.01.01	General The design criteria given herein is applicable for all sub-structure, super-structure works/buildings/ facilities and various other works included in the scope of the Bidder.	
6.01.02	Structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads (static, friction and dynamic), earth pressure & surcharge loads, hydrostatic & hydrodynamic loads, wind loads, seismic loads and temperature loads. In addition, Erection loads, loads and forces developed due to differential settlement shall also be considered.	
6.01.03	i) All the buildings shall have framed super structure. If the superstructure of building is a steel structure, the framed superstructure shall be moment resisting sway frame in the lateral direction and axially braced in the orthogonal direction. For columns having depth of 1000mm & above, the longitudinal bracings shall comprise a pair of members (spaced) with spacing equal to the column depth. Columns having depth less than 1000mm may have bracing in single plane and at the centerline of column. In both the cases (single bracing or pair of bracing) detailing shall be adequate to restrain the entire column cross-section including both the flanges. Only where axial bracing to one vertical plane is to be waived due to functional requirement, columns in that vertical plane may be allowed to undergo biaxial bending. Beam column joints shall be detailed as per seismic resistant joint with adequate ductility. All 2-legged structural steel trestles shall be completely braced in the vertical plane. All 4-legged structural steel trestles shall be completely braced in all four vertical planes. In addition, specified horizontal planes shall be completely braced to provide stiffness against torsional sway. If the superstructure is RCC structure, the superstructure shall be moment resisting sway frame in both orthogonal direction and all the members shall be designed for biaxial bending. Design of RCC structures shall be done as per IS 456. Detailing for ductility shall be followed as per guidelines of IS13920 to be effective against seismic load. Design of liquid retaining structures shall be done as per IS 3370. ii) The Bunker building, transfer towers, conveyor galleries and trestles, crusher house, boiler, ESP Control Building, ESP supporting structures, including inlet and exhaust duct support structures, Compressor House, Pipe cable Gallery shall have structural steel framed super structure. iii) All other buildings may have either RCC or structural steel framework. iv) All buildings having RCC framing shall have masonry cladding of minimum one masonry unit thickness (not less than 225 mm.) on exterior face.	
6.02.00	Loading For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration), Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design.	
6.02.01	Dead loads Dead loads shall include the weight of structure complete with finishes, fixtures and partitions and shall be taken as per IS: 875 (Part-I)	
6.02.02	Imposed loads Imposed loads in different areas shall include live loads, erection, operation and maintenance loads. Equipment loads (which constitute all loads of equipment to be supported on the building frame) are not included in the imposed loads furnished below and shall be considered in	
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	addition to imposed loads. For consideration of imposed loads on structures, IS:875 (Part-2) “Code of practice for design loads (other than earthquake) for buildings and structures” shall be followed. The following minimum imposed loads as indicated for some of the important areas shall however be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered. <table><thead><tr><th>Sl.No.</th><th>Location</th><th>Imposed Loads (T/Sq.m.)</th></tr></thead><tbody><tr><td>A)</td><td>Mill and Bunker Bay</td><td></td></tr><tr><td>i)</td><td>Ground floor</td><td>2.5</td></tr><tr><td>ii)</td><td>Feeder floor</td><td>0.50</td></tr><tr><td>iii)</td><td>Tripper floor</td><td>0.50</td></tr><tr><td>iv)</td><td>Roof</td><td>0.15 (Where no equipment are located) 0.50 (Where equipment are located)</td></tr><tr><td></td><td></td><td>0.075 (For Inaccessible roof)</td></tr><tr><td>B)</td><td>Turbine Building</td><td></td></tr><tr><td>i)</td><td>Ground floor (general)</td><td>2.50</td></tr><tr><td>ii)</td><td>Ground floor (heavy equipment storage area)</td><td>5.00</td></tr><tr><td>iii)</td><td>Mezzanine floor</td><td>1.00</td></tr><tr><td>iv)</td><td>Operating floor</td><td></td></tr><tr><td></td><td>a) Rotor Removal area</td><td>5.00</td></tr><tr><td></td><td>b) Equipment lay-down area</td><td>3.50</td></tr><tr><td></td><td>c) Other areas (corridors, etc.)</td><td>1.50</td></tr><tr><td>v)</td><td>Gratings, chequered floors, walkways, platforms, stairs, etc.,</td><td>0.50</td></tr><tr><td>vi)</td><td>Roof (Where no equipment is located)</td><td>0.15</td></tr><tr><td>C)</td><td>Deaerator and Heater Bay</td><td></td></tr><tr><td>i)</td><td>H.P/L.P. heater floor</td><td>1.00</td></tr><tr><td>ii)</td><td>Deaerator floor</td><td>1.00</td></tr><tr><td>iii)</td><td>Cable gallery (In addition to this, actual cable load</td><td>0.50</td></tr></tbody></table>			Sl.No.	Location	Imposed Loads (T/Sq.m.)	A)	Mill and Bunker Bay		i)	Ground floor	2.5	ii)	Feeder floor	0.50	iii)	Tripper floor	0.50	iv)	Roof	0.15 (Where no equipment are located) 0.50 (Where equipment are located)			0.075 (For Inaccessible roof)	B)	Turbine Building		i)	Ground floor (general)	2.50	ii)	Ground floor (heavy equipment storage area)	5.00	iii)	Mezzanine floor	1.00	iv)	Operating floor			a) Rotor Removal area	5.00		b) Equipment lay-down area	3.50		c) Other areas (corridors, etc.)	1.50	v)	Gratings, chequered floors, walkways, platforms, stairs, etc.,	0.50	vi)	Roof (Where no equipment is located)	0.15	C)	Deaerator and Heater Bay		i)	H.P/L.P. heater floor	1.00	ii)	Deaerator floor	1.00	iii)	Cable gallery (In addition to this, actual cable load	0.50
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	be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.		
	v) Unit weight of bulk materials	a) For structural design i) Lime stone 1700 kg. / Cu. M. ii) Gypsum 1250 kg. / Cu. M. iii) Coal 1100 kg. / Cu. M. iv) Bio mass 800 kg. / Cu. M. For sizing calculation v) Lime stone 1400 kg. / Cu. M. vi) Gypsum 1100 kg. / Cu. M. vii) Coal 800 kg. / Cu. M. viii) Bio mass 600 kg. / Cu. M.	
	E) Boiler/ ESP Support Structures i. Operating Floors1.00 ii. Separator Floor1.00 iii. Elevator Machine Room1.00 iv. Maintenance Platforms1.00 v. Equipment Laydown LoadsAs per Equipment supplier or 1.00 whichever is more. vi. Lift StructureAs per Equipment supplier with 100% impact factor		
	F) Pump Houses Operating floor1.50		
	G) Underground Structures such as Channels, Sumps, Underground Pump House, Tanks, Trenches, Reservoirs, C.W. ducts etc. In addition to earth pressure and ground water pressure, the surcharge load of 2T/sq.m. shall also be considered for design of all underground structures.		
	H) Road Culverts/Bridges and its allied structures including RCC Pipe Crossings and Road Crossing of Trenches. Design for class 'AA' loading (wheeled and tracked both) and checked for class 'A' loading as per IRC Standard.		
	I) Covers for Channels/trenches	0.40 (General) or central point load of 75 kg whichever is higher As per IRC Standard (at road crossings for vehicular traffic)	
	H) Railway Supporting Structures, Rail Culverts	As per Railway 'Bridge Rules'	
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6.02.03	I)	Conveyor Galleries	In addition to the live loads, loads due to cable trays, firefighting / service water pipes shall also be considered @125kg/m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting firefighting pipes/ Service water pipes.
	J)	General (Unless Specified Otherwise)	
	i)	Stairs, Landings and Balconies	0.50
	ii)	Toilets	0.20
	iii)	Chequered plates, grating floors, etc.	0.50
	iv)	RCC floors (General)	0.50
	v)	a) Flat Roofs (where no equipment are located)	0.15
		b) Flat Roofs (where equipment are located)	0.50
		c) Inaccessible roof	0.075
	vi)	Inclined Roofs	As per IS : 875 (Part-II)
	vii)	Dust load on roof	0.050
	viii)	Walkways (General)	0.50
	ix)	Walkways of conveyor galleries, DM & PT	0.30
	x)	Floor of control room of switchyard control building	1.00
	xi)	Cable and pipe trestles	0.40 for walkway and in addition, friction loads as applicable
	xii)	Grating covers/ Precast RCC covers for drain, trench, sump pit in Ground floor/ paving of BTG area	2.50 As per IRC standard (at road crossings for vehicular traffic)
	Notes:		
a) If erection load is higher than the specified imposed loads on any floor or part thereof, then the erection loads are to be considered for the design.			
b) Additional load for cable, piping/ducting, shall be considered as applicable. For any other structures, the loads specified for those structures elsewhere in the specification shall be followed.			
Equipment, piping and associated loads			
Equipment loads shall be considered over and above the imposed loads. Equipment loads			
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6.02.04	shall be considered as given by equipment supplier. Crane load For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.			
6.02.05	Seismic load For design of all structures, the site specific seismic design criteria as attached in Annexure-E shall be followed.			
6.02.06	Wind load For design of all structures, the wind loads shall be taken as per the site specific wind data specified in Annexure–D of this specification.			
6.02.07	Temperature Load For temperature loading, the total temperature variation shall be considered as 2/3 of the 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 ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation. 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.			
6.02.08	Differential Settlement Loads Structures shall be designed considering an additional load on account of differential settlement of 1 in 1000 between any two adjacent columns, subject to a maximum differential settlement of 8 mm in case of foundations resting on soils & 4mm in case of foundations resting on rock/ pile. These differential settlement loads shall be taken into consideration for design of footings & structures of Boiler & Mill Bunker, ESP supporting structure and Main Power House building. Further, in the analysis of differential settlement loads, adjacent columns interconnected with bracings are preferably to be provided with combined footing. In such cases, where rigid combined foundations are provided below braced columns, differential settlement between those columns needs not be considered. Moreover, when rigid raft is provided, the differential settlement amongst the columns supported on the rigid raft need not be considered. However, the differential settlement between the raft and the adjacent column footing of the same structure are to be considered. In the structural analysis for differential loads, following approach may be considered: All the alternate columns in structure shall be applied downward displacement as described above and analyzed at a time. The resultant forces/ reactions shall be considered with reversible effects for design of structures and footings.			
6.02.09	Additional Loads Following Minimum additional Loads shall be considered in the design of Steam generator structures, Mill & bunker buildings, Coal handling Transfer points and Trestles (in BTG island) and ESP structure. (a) Cantilever Loads of not less than 2000 kg/m at a distance of 1200 mm from the external face of the columns, on both sides of the ESP, for Cable trays and Walkways.			
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	(b) Cantilever Loads of not less than 500 kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the Steam Generator, for Cable trays and Walkways. (c) Cantilever Loads of not less than 2000 kg / M at a distance of 2500 mm from the external face of the Mill & Bunker Building columns, CHP transfer point columns/ VGTU columns & conveyor gallery trestles (on one side) for Cable trays and Walkways. (d) Dry Fly Ash Piping Loads. (e) Ash Water Piping Loads. (f) Supply Air and Instrument Air Piping. (g) Service Water Piping (h) Loads associated with Coal Handling Plant equipment			
6.03.00	Civil Design Concepts			
6.03.01	Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.,			
6.03.02	The different load combinations shall be taken as per IS: 875 (Part-5) and other relevant IS Codes. a) Wind and seismic forces shall not be considered to act simultaneously. b) For the design of main plant structures during seismic condition, the deaerator feed water tank shall be considered full upto operating level. However, for other load combinations, deaerator feed water tank in flooded condition shall be considered. c) 'Lifted load' of crane shall not be considered during seismic condition. d) In case two cranes are 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 all through the building length (lifted load near to A/B Row). e) In case two cranes are provided and tandem operation is envisaged then the crane wheel loads shall be taken as both the cranes fully loaded to capacity and travelling side by side al through the building length. f) Permissible stresses for different load combinations shall be taken as per relevant IS and IRS codes. g) For the design of pipe/cable supporting structure, the soil weight shall be considered as backfilled up to grade level for the condition of pipe running full/cables in position. h) Frictional forces between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces. i) Paving in crane corridor shall be designed for the maximum load due to movement of crane. j) In TG bay at crane rail level, chequered plate walkway with handrails shall be provided for entire column sectional depth for full length of the building. Walkway width clearance from the face of the column to the edge of the crane shall be as specified elsewhere in the specification. k) For checking against uplift / tension case, 90% of Dead Loads with no Imposed Loads shall be considered along with other Loads. l) The Structures shall be Designed for most unfavourable Combination of Dead Loads, Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads, Wind / Seismic Loads, Temperature Loads, Ash Loads, and other applicable Loads without exceeding the Permissible Stresses. No reduction in equipment loads, piping loads, ash loads and loads due to other			
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	permanent facilities shall be considered for calculation of seismic weight of the building/structure and for load combinations thereof. m) In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned. n) Where wind load is the main load acting on structure, no increase in stresses is to be considered for design of Structure and Foundation bolts. This includes structures like Transfer Points and Conveyor Trestles. o) In all Load Combinations, differential settlement loads (with reversible effects) are to be considered.			
6.03.03	Design of steel structures shall be done by the working stress method. Design shall be as per provisions of IS:800:1984 and other relevant IS standards. For design of coal bins and loading hopper IS:9178 (part I to III) shall be followed.			
6.03.04	Shop connections will be welded type and all field connections will be bolted. Field permanent bolts wherever provided will be high tensile bolts of property class 8.8(min) as per 1367 for all major connections. However, nominal connections in the field like purlins, stairs, wall beams will be done by means of M.S. black bolts of grade 4.6 conforming to IS-1367. The bolted joints will be designed for friction grip or bearing type. For friction grip type connections, bolts will be tightened to develop the required pretension during their installation. For bolted Connection, IS 4000, IS: 3757, IS: 6623 and IS: 6649 shall be followed. IS 814, IS 816, IS: 1024, IS 4353 and IS: 9595 shall be followed for welding of structures.			
6.03.05	All structures close to railway line shall have clearances conforming to Railway norms.			
6.03.06	For calculation of coal load on moving conveyor, a multiplication factor of 1.6 shall be used to take care of inertia force, casual over burden and impact factor, etc. Thus coal load per unit length of each moving conveyor shall be 1.6 x (rated capacity of conveyor system) Conveyor speed x 1100 800			
6.03.07	a) Conveyor gallery structure and trestles shall be designed considering both conveyors operating simultaneously b) Dynamic analysis of conveyor galleries and conveyor supporting system shall be carried out for spans greater than 25 m. c) All structures close to railway line shall have clearances conforming to Railway norms.			
6.03.08	Coal, Biomass, Limestone and Gypsum handling structures: The loads for all railway load bearing structures e. g. wagon tippler, tunnel, culverts and under ground transfer houses etc. and the analysis and the design of these structures shall be made strictly in accordance with the provisions of Indian Railway Bridge rules (latest edition), and Indian Railway Codes of practice (latest edition) with all amendments up to the date of opening of bids. The axle load for analysis and design shall be considered as “DFC loading (32.5t axle load)” of Heavy mineral loading as per Indian railway standard. Coal heap of 1.2m height shall be considered above hopper top for design of hopper and supporting elements of wagon tippler. The analysis, design and detailed drawing for tunnel, under ground transfer houses, culverts etc. coming directly below the railway track shall be got approved by the contractor from the concerned railway authorities before taking up construction. All necessary payment for the above work shall be made by the bidder to the railway authority. The steel structures shall be designed and fabricated as per ‘code of practice for use of structural steel in general building construction’, IS : 800 and other relevant IS Standards. Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6.			
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	Minimum weld size shall be 6 mm. The steel structures using tubular sections shall be designed and fabricated as per IS:806-“code of practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively. Minimum thickness for rolled/ built up section shall be 6mm. Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports. All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. Peak wind speed method shall be considered for checking the transverse deflection. Longitudinal deflection for all conveyor trestles (along the conveyor direction) shall be Height/500 for peak wind speed. Vertical & horizontal deflection of conveyor gallery shall be restricted to span/500. The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles. For transfer house and crusher houses monorail loads of two floors having highest capacity of monorails shall be considered in addition to other gravity loads along with wind/seismic load. Wind load/seismic load shall be considered along with Running belt tension for the analysis of transfer house and crusher house, however monorail load may not be considered. Stresses for all CHP structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method. The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. Horizontal bracing system shall be provided at floor levels around the openings for plan area greater than 2 sqm. Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement. Contractor can also use tubular steel sections for roof truss of conveyor galleries/cable trestle only. For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of RCC pipes for culverts, latest editions of IS: 458, IS: 783 should be followed. For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level).For all underground structures like wagon tippler/track hopper, tunnels and underground transfer points crack width shall be restricted to 0.2 mm. Design of Hopper walls shall be done for both Static & Dynamic flow condition using Walker's theory.		
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	For foundations of transfer points, crusher house & trestles, pedestals of isolated footings/pile caps shall necessarily be tied with RCC beams. For all RCC buildings, tie beams shall be provided at lintel level. Design of masonry walls shall be made as per IS : 1905. For metal roofing and side cladding, the spacing of purlins/runners shall be such that the deflection of metal sheet used is limited to span/250 under adverse loading condition. Minimum reinforcement (0.12% of total coss sectional area in each direction) shall be provided at the top face of the footing, even if, no reinforcements are required as per design			
6.03.08.01	All liquid retaining structures shall be designed for following load conditions. Underground structures: a. Water filled inside up to design level and no earth outside. b. Earth pressure with surcharge of 2.0 T/m2 and ground water table up to FGL outside and no water inside. c. Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure. d. The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table. For design of over - ground liquid retaining structures appropriate load cases shall be considered.			
6.03.08.02	All liquid retaining structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2).			
6.03.08.03	In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.			
6.03.08.04	Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand of approved quality shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.			
6.03.08.05	Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.			
6.03.08.06	Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.			
6.03.08.07	The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456 and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to moderate exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.			
6.03.08.08	Factor of safety against overturning and sliding The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.			
6.03.08.09	For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.			
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6.03.08.10	Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.			
6.03.08.11	Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:			
	Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars
	a)	Foundation	12 mm	10 mm
	b)	Beams	12 mm	8 mm
	c)	Columns	12 mm	8mm
6.03.08.12	Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.			
6.03.08.13	Buildings shall also comply to IS 4326 requirement-			
6.03.08.14	Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area.			
6.03.08.15	The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However, minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.			
6.03.08.16	Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.			
6.03.08.17	Minimum thickness of all elements of RCC liquid retaining / conveying structures (except effluent drains & launders) shall be 200mm. Effluent drains (depth more than 500mm) and launders shall have minimum element thickness of 150mm.			
6.03.08.18	All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter or 6mm flats. Edge protection angles shall be provided as specified elsewhere.			
6.03.08.19	All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.			
6.03.08.20	2.0m wide walkway with concrete paving shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL.			
6.03.08.21	Design Requirements for Crusher Foundation			
6.03.08.21.2	Dynamic Analysis			
	Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.			
	Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.			
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	Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor. Isolation Efficiency The vibration isolation system shall be designed for about 90 % isolation efficiency. De-coupling A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out. Frequency Criteria The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. The first bending mode frequency of the top deck shall be at least 20 % above the operating speed. Unbalance Forces Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes. I. Balance quality grade G 16 as per IS/ISO:21940-11. II. One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher. III. Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher. Amplitude Criteria The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions. Operating speed of 750 RPM I. 150 microns for an unbalance force arising out of balance quality grade G 16 as per IS/ISO:21940-11-2016. II. 300 microns in case of a one hammer broken condition.			
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6.03.09	III. Amplitudes need not be checked for a three hammer broken condition. Operating speed of 450 RPM I. 200 microns for an imbalance force arising out of balance quality grade G 16 as per IS/ISO:21940-11. II. 400 microns in case of a one hammers broken condition. III. Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the RCC deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vector may be considered while superimposing the modes. Transient Resonance Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition. Strength Criteria The following criteria shall apply for the design of top deck : a) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design. b) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together c) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design. d) Working stress method shall be used for the design of RCC deck. In survival condition, 10 % overstressing may be permitted. e) The RCC top deck shall be at least of M35 grade of concrete as per IS : 456. f) Fatigue need not be considered for the three hammer broken condition. g) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered. Horizontal Deflection criteria			
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	The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td><td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td></tr><tr><td>2.</td><td>For ESP Control Building, Compressor House, and all other steel buildings envisaged in this specification</td><td>Height /325</td></tr><tr><td>3.</td><td>Vertical Metal Sheeting in Cladding</td><td>Span/250</td></tr></table> However, the maximum deflection of Grating / Chequered Plate Shall be limited to 6mm. Note: Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.				Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For ESP Control Building, Compressor House, and all other steel buildings envisaged in this specification	Height /325	3.	Vertical Metal Sheeting in Cladding	Span/250
Sl. No.	Description	Maximum value of														
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)														
2.	For ESP Control Building, Compressor House, and all other steel buildings envisaged in this specification	Height /325														
3.	Vertical Metal Sheeting in Cladding	Span/250														
6.03.10	a)	Dispersion of load in any direction through soil shall be as per IS 8009 (relevant part).														
	b)	Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.														
6.03.11	a)	Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.														
	b)	The allowable deflection for beams directly supporting drive machinery and equipment shall be restricted to span/500 unless specified otherwise in this specification.														
	c)	The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500.														
		For electric overhead cranes :														
		1) upto 50 Tonne capacity : span/750														
		2) over 50 Tonne capacity : span/1000														
	d)	The vertical deflection of beams supporting LP Heater, HP Heater and Deaerator shall be limited to Span/500.														
	e)	The vertical deflection of metal deck sheet for floor shall be limited to span/250.														
	f)	Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.														
6.03.12		Transverse coal pressure on Bunker/Silo/Hopper walls shall be calculated as per IS: 9178. The Coal Bunker/Silo/Hopper shall be designed for the following conditions														
	i)	The Bunker/Silo/Hopper is full up to its full capacity with top surface nearly horizontal.														
	ii)	The Bunker/Silo/Hopper is partially empty with the top surface of coal at an angle of														
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6.03.13	repose of 37 degrees. Design criteria for ash silo 1. The pressure due to ash filling on the side wall and the bottom portion of ash bins/silos shall be taken as the maximum of (a) static pressure determined in accordance with the Jansen's formula multiplied by an impact factor of 1.4 and (b) pressure determined as per Walker's formula for static as well as dynamic conditions. The silo shall be designed for the following conditions: (a) The silo is full up to its full height / capacity (b) The silo is partially empty with top surface of ash, at an angle of repose less than 30 degrees. 2. The following loads are to be considered for design. a) Density of bottom ash to be considered for volume calculation shall be 650 kg./cum. b) Density of bottom ash to be considered for load calculation shall be 1600 kg/cum. c) Density of fly ash to be considered for volume calculation shall be 750 kg/cum. d) Density of fly ash to be considered for load calculation shall be 1600 kg./cum. e) Density of dry fly ash, to be considered for the design of supporting structures for dry fly ash conveying pipes, shall be taken as 1000 kg/cum. The pipe shall be considered full with dry fly ash. 3. Other requirements are as follows: a) Independent supporting structure shall be provided for each silo. b) The joint between the wall and roof of the silo shall be properly sealed by welding or by any other approved means. c) Operating platform covering total plan area wise in silo structure made of grating shall be provided below the hopper outlet. d) The bracing system shall be provided in such a way that the trucks and closed tankers can have a clear passage to approach the underside of the silos for unloading dry ash from the silos. 4. Trestles supporting ash pipes shall be so proportioned that the transverse deflection of trestles due to wind/seismic load shall not exceed trestle height/325. 5. The corrosion allowance for design of Silo, Buffer Hopper, Bottom ash hopper, tanks etc. shall be considered as per IS9178 considering structure exposed to atmosphere. The corrosion allowance shall be provided in addition to the requirement of minimum thickness of steel plate as per IS9178.			
	6.03.14 Coal Bunker (inside Mill Bunker Building) shall be of MS while the hopper shall be of MS with stainless steel (grade SS 304) lining. The minimum thickness of MS plate and SS lining in hopper portion shall be as per the design concept of Mill Bunker Building specified elsewhere in the specification. Pre-formed flexible open ended bellow strap of neoprene is to be provided between top of bunker and bottom of tripper floor to avoid coal dust leakage / escape. The bellow strap shall be of minimum 200 mm wide under un-stretched condition and shall be of minimum 2mm thick. The hopper angle with the horizontal plane be as specified elsewhere in the specification.			
	6.03.15 The live storage capacity of each coal bunker shall be greater of the following: a) Total 10 hours biomass blended coal requirement of the boiler for BMCR duty with			
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	worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere. b) Total 10 hours biomass blended coal requirement of the boiler for BMCR duty with design coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere. c) Total 10 hours biomass blended coal requirement of the boiler for TMCR duty with worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required to be in service for this duty condition as specified elsewhere.			
6.03.16	For all capacity (volume) calculation and structural design (load calculation) unit weight of biomass blended coal shall be assumed as 760 kg/cum. and 1100 kg/cum respectively.			
6.03.16	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification. b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed. c) For reinforcement detailing, IS 5525 and SP 34 shall be followed. d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.			
6.03.17	a) Design of Foundation for Coal Mills and Fans Structural Arrangement of foundations for various machine foundations like TG, TDBFP, MDBFP, Coal Mills and Fans shall be as specified elsewhere in the specification. Analysis for the foundation For the foundations of the all equipment, details static and dynamic analysis shall be done. The static analysis shall include all operating condition, load cases and abnormal loads like short circuit, loss of blades & unbalance and seismic forces as per IS1893. The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. A minimum fatigue factor of 2.0 shall be considered for dynamic forces. The vibration amplitudes shall be calculated at the machine bearing locations and at any other points of interest by a forced response analysis. The unbalance forces used for this analysis shall correspond to the balance quality grade of the machine as per ISO 1940 /IS:11723 or the unbalance forces as provided by the machine manufacturer whichever is higher. It shall be ensured that the calculated amplitudes do not exceed the limits specified by the machine manufacturer and relevant Standards such as ISO 10816/IS:14817. Bidder to consider the acceleration at the top of the deck for the design of supporting / fixing arrangement of machine. Design criteria for steel helical springs and viscous dampers The isolation efficiency for steel helical springs and viscous dampers shall be at least 90%. The ratio of actual spring supported weight to the nominal spring capacity shall not exceed 0.80. At least 5% to 10% of critical damping shall be provided in the form of viscous dampers. Reinforcement Design Working stress method as per IS 456 shall be used for reinforcement design. The design shall be done for the worst load combination. Minimum reinforcement shall be provided as per IS 456 and IS2974 (Part-III), if the calculated reinforcement is less than the minimum. For TG Raft/ Pilecap, minimum percentage of reinforcement at top and bottom faces of foundation shall be same as that stipulated for beam as per IS456. c) Block Foundations:			
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	Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied. Reinforcement design shall be done by working stress method as per IS 456 and IS 2974 (Part-IV). For the foundations supporting minor rotating 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 structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.			
6.03.18	If RCC floor/roof is assumed to act as diaphragm, transmitting lateral loads to braced bays, it shall be provided with shear connectors. The spacing of shear anchor studs on structural beams shall be minimum of the spacing required for i) Restraining the compression flanges of beams and ii) Transfer of the horizontal shear at floor/roof to the supporting beams. However, whenever large / more number of cut-outs are provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab.			
6.03.19	All roads shall be rigid pavements specified elsewhere in this specification. The design traffic load shall be a minimum 4 million cumulative standard axle. The design of concrete pavement shall be carried out as per IRC-58.			
6.03.20	a) No cable/pipe trench is envisaged in the plant area. However, if required, pipe/cable trench can be provided inside the buildings and inside switchyard or some other localised areas. b) All pipes and cable shall generally be routed above ground. c) A minimum clearance (clear headroom) of 8m shall be kept for all over-ground pipe/cable trestles for all road/rail crossings. For other areas, the requirement of trestle height is specified elsewhere in the specifications. All trestles shall be provided with continuous walkway of minimum 600mm width with hand-rails and toe-guards all along the length of the trestle along with approach ladders near roads, passageways, etc. Before and after the road/rail crossings, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8 m) etc., upto the pipe/cable racks/trestles. d) Within AB bay in Main plant area, generally grating shall be provided for Mezzanine floor except for valve room area, cable spreader floor, air washer units, feed water heaters, equipment foundations, miscellaneous skids, etc. where the floor shall be of RCC. Oil equipment room shall also have RCC floor below the grating floor.			
6.03.21	The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.			
6.03.22	Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.			
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	Manual on sewerage and sewage treatment (published by Central Public Health Environment Engineering Organisation, Government of India) shall be followed for design purpose.																								
6.03.22	Foundations for all tanks shall be designed for as per IS: 803.																								
6.03.23	Footings shall be so proportioned to as to minimise the differential settlement.																								
6.03.24	Plinth level of all buildings shall be kept at least 500 mm above the finished grade/formation level.																								
6.03.24	Boiler/ ESP support structures shall be designed for: a. Dead load b. Live/Imposed loads c. Static and dynamic loads of piping, movable equipment and maintenance parts. d. Loads from cable trays and walkways supported on columns. e. Ash water piping supported on the outermost row of boiler columns. f. All ESP hoppers filled up with ash up to the top of the hoppers or the bottom of electrodes (whichever is more) using a bulk density of not less than 1350 kg/cu.m. for the ash, along with additional ash build-up from the end of the third field up to the inlet duct bottom level at a natural repose angle (not less than 30 degree to horizontal in any case). g. Ash load at bottom ash hopper and pent house of the boiler shall be as mentioned in the mechanical chapter of the specifications. h. Seismic and wind loads as specified elsewhere in the specifications. i. Temperature Loads. j. Temperature variations under ESP operating condition. k. The loads listed above indicate the minimum requirements. l. For the Design of ESP Supporting Structures for Seismic, Ash Load in Hoppers filled upto to the top of the Hoppers or bottom of the electrode (whichever is higher) shall be considered as permanent Loads along with other applicable Loads. m. Following Ash density shall be considered for the Design : <table><thead><tr><th>Sl. No.</th><th>Description</th><th>Density (kg/Cu. M.)</th></tr></thead><tbody><tr><td>a)</td><td>Bottom Ash for volume calculations</td><td>650</td></tr><tr><td>b)</td><td>Bottom Ash for Load calculations</td><td>1600</td></tr><tr><td>c)</td><td>Fly Ash for volume calculations (For Boiler)</td><td>750</td></tr><tr><td>d)</td><td>Fly Ash for volume calculations (For ESP)</td><td>650</td></tr><tr><td>e)</td><td>Fly Ash for Load calculations</td><td>1350</td></tr><tr><td>f)</td><td>Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)</td><td>1000</td></tr></tbody></table>				Sl. No.	Description	Density (kg/Cu. M.)	a)	Bottom Ash for volume calculations	650	b)	Bottom Ash for Load calculations	1600	c)	Fly Ash for volume calculations (For Boiler)	750	d)	Fly Ash for volume calculations (For ESP)	650	e)	Fly Ash for Load calculations	1350	f)	Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)	1000
Sl. No.	Description	Density (kg/Cu. M.)																							
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f)	Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)	1000																							
6.03.25	Boiler supporting structures shall be so configured that the temperature of steel does not																								
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	exceed 60 °C unless specified otherwise. Brackets shall be provided on both sides of the outermost row of columns of both the boiler and ESP for supporting cable trays and walkways, at a height not exceeding 10.0 m. The exact levels shall, however, be decided during detailed engineering. Each ESP hopper shall be supported at four corners by providing four columns from the ground.			
6.03.26	The bracings in boiler structure shall be provided such that under no circumstance normal/convenient access to all points in the boiler is blocked or obstructed.			
6.03.27	In design of boiler/ ESP support structures, dynamic piping loads need not be considered acting simultaneously with wind or seismic loads. Increase in permissible stresses shall be allowed in load combinations where dynamic piping loads are considered and shall be as permitted under seismic load conditions.			
6.03.28	Design Criteria for foundations and some other facilities/areas are covered separately in this specification.			
6.03.29	Plinth level of all buildings shall be kept at least 500 mm above the finished grade/formation level. Finished floor level of boiler area paving shall be kept about 200 mm lower than the finished floor level of Main Plant buildings.			
6.03.30	Joints/Connections in steel structures: Steel structures shall be detailed and connection and joints provided as per the provisions of IS 800, IS 816, IS 9595, IS 1367, and IS 9178 and as per following requirements. a) Connection of vertical bracings with connection members and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings. b) Size of fillet weld for flange to web connection for built up section shall be as follows: i) For box section weld size shall be designed for full shear capacity or actual shear whichever is more. Where fillet weld is not possible, full penetration butt weld shall be provided. ii) For built up I section, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated, in drawings) whichever is more. However, weld size shall not be less than 0.5 times the web thickness. Weld shall be double fillet. iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6mm. c) Shear connections shall be designed for 60% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. However, if load is more than above, the connection shall be designed for actual load. d) Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section. e) All butt welds shall be full penetration butt welds. f) The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Engineer. g) Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners. h) Splicing: All work shall be full strength. Field splicing shall be done with web and flange cover plates for full strength. Shop splicing for all sections other than rolled shall be			
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6.03.31	carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plate. Pipe Pedestals, pipe supports and other structures for Ash handling system: - The design of Pipe Pedestal and pipe supports shall be carried out considering Dead load, live load & seismic load / wind load. In addition to above, longitudinal forces equal to product of Co - efficient of friction (between contact surface of pipe and pedestal) with the load coming on each pedestal shall also be considered for the design of pedestal. In bends, suitable thrust block shall be provided to withstand the thrusts transferred from the pipelines. - All RCC pipes carrying water under gravity shall be designed for earth pressure, water and surcharge. Minimum grade of pipe shall be of NP - 2 class or heavier required as per design / specification. - The design and construction of RCC structures shall be carried out as per IS: 456. In general, limit state theory shall be followed for the design of RCC structures, however, working stress method shall be adopted for the design, wherever specifically mentioned in this specification. - Two layers of reinforcement (on inner and outer face) shall be provided for RCC wall sections having thickness 150mm and above.	
6.03.32	Design Criteria of RCC Floors - For Mill Bunker Building, Main Power House, ESP Control Building, Transfer Houses, and other structural steel framed buildings: These buildings being steel framed structure, all RCC floors shall comprise RCC slab supported on troughed, profiled metal deck sheet (to be used as permanent shuttering). The RCC slab shall be minimum 150mm thick above the top surface (crest) of the metal deck sheet. The spacing of structural steel secondary beams shall be based on the bending capacity of the metal deck sheet for self-weight of green concrete and additional construction load of 100 kg/m². The permanent metal deck sheets shall be fixed to the top flange of secondary beams by means of drawn arc welding of headed shear anchor studs directly through the metal sheet. The details of shear anchor studs are specified elsewhere in this specification. The RCC slab shall be designed without considering any composite action effect of metal deck sheet (i.e. the structural strength of metal deck sheet shall not be considered for RCC slab design). - For other RCC buildings. These buildings being complete RCC framed structures, conventional RCC slabs of minimum thickness 150 mm shall be provided. The RCC slabs shall be monolithic with RCC beams and RCC columns	
6.03.33	Design Criteria of RCC roofs For Main Power House, Compressor House, ESP Control Building and Other Steel framed Buildings: The roof system shall comprise minimum 40mm thick RCC slab on top of profiled permanent metal deck sheet. The permanent metal deck sheets shall be fixed to the top flange of secondary beams by means of arc welding of headed shear anchor studs to the purlins directly through the metal sheet. The details of shear anchor studs are specified elsewhere in this specification. Water proofing treatment to roof slab shall be provided as per details specified elsewhere in this specification).	
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6.03.34	The RCC slab shall be designed without considering any composite action effect of metal deck sheet (i.e. the structural strength of metal deck sheet shall not be considered for RCC slab design.			
	b) For Mill Bunker Building, Transfer Houses. Insulated sandwiched metal sheet for roofing shall be provided comprising troughed permanently colour coated sheet at top and plain permanently colour coated sheet at bottom with 50mm thick insulation sandwiched between the two sheets, the details of which are specified elsewhere in this specification. c) Roofing system for Ash Handling Plant Pump Houses and Buildings shall be as specified in relevant clauses d) Other RCC Buildings. Cast-in-Situ RCC slab shall be provided using removable plywood shuttering. Water proofing treatment to roof slab shall be provided as per details specified elsewhere in this specification). Design Criteria for Foundation The founding depth / cut off level of piles shall be decided based on functional requirement. Where structural steel columns are envisaged, the bottom of the base plate shall be kept suitably below the paving level such that the top level of the gusset plate and foundation bolt remain at least 200 mm below the top level of paving except for Boiler Structure, Bunker Building Columns, TP & Trestle Columns, ESP Control Building Columns for which the requirement of levels for bottom of base plates is specified elsewhere in this specification. Further the gusset plate and foundation bolts are to be encased in concrete up to the top of the paving level. For outdoor structural steel columns, about 300 mm height of steel columns above the top of paving level shall be provided with at least 125 mm thick encasement with minimum reinforcement to prevent corrosion of the steel columns from surface water a) OPEN Foundations For foundations, the minimum founding depth and the minimum size of foundation shall be as per foundation system and geotechnical data specified in the foundation chapter include hereafter in this specification. For open foundations, the total permissible settlement shall be as per the criteria furnished under the foundation system specified elsewhere in this specification. The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement both in case of bottom face and also for tension face of foundation shall be same as that stipulated for beam as per IS:456. b) PILE Foundations Minimum centre to centre spacing of the piles shall be as per IS: 2911. Incase single piles are used, these piles are to be interconnected with tie beams along both orthogonal directions perpendicular to each other. Minimum penetration of piles into Pilecap shall be 75 mm and clear cover to the main reinforcement at the bottom face of the pile cap shall be 100 mm. Structural design of pile cap and reinforcement shall conform to IS:2911 and IS:456. However minimum 0.12% of cross section of the pile cap shall be provided on the top face of the pile cap along two orthogonal directions and minimum percentage of reinforcement at bottom face of pile cap shall be same as that stipulated for beam as per IS:456. Detailed requirement of pile foundation have been presented in the foundation chapter specified hereafter in this specification.			
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6.04.00	CORROSION PROTECTION											
6.04.01	General (a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category (as mentioned in Part A IID Civil Works for the project as per ISO 12944). Painting system for steel surfaces embedded in Concrete is given separately. (b) All Painting shall be done as per Technical Specification Painting scheme shall submitted by the Bidder. (c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. Minimum thickness of metal for any structural steel elements shall be not less than 6 mm where steel is fully accessible for cleaning and repainting and where it is feasible to follow design criteria given in ISO 12944 part 3. However, where steel surfaces are inaccessible for cleaning and repainting or where it is not feasible to follow design criteria given in ISO 12944 part 3, corrosion allowance of 1.5 mm shall be kept in thickness (over the design thickness or 6mm, whichever is more). Minimum thickness of tubular/ hollow steel sections conforming to IS 4923 shall be 4.0 mm, provided the ends of such steel sections are effectively sealed unless higher thickness is specified elsewhere for specific structure.											
6.04.02	Painting of Steel Surfaces Embedded In Concrete a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.											
6.04.03	Painting of Steel Surfaces (Other Than Those Embedded In Concrete) <table><tr><th>CORROSSIVITY CATEGORY</th><th>PRIMER COAT</th><th>INTERMEDIATE COAT</th><th>FINAL COAT</th></tr><tr><td>C3</td><td>All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60</td><td>Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application</td><td>Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0</td></tr></table>				CORROSSIVITY CATEGORY	PRIMER COAT	INTERMEDIATE COAT	FINAL COAT	C3	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0
CORROSSIVITY CATEGORY	PRIMER COAT	INTERMEDIATE COAT	FINAL COAT									
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		Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.	of primer coat) by airless spray technique.	ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.
	C5	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 180 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.
Notes:				
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	1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. 2. The most frequent problem associated when top coating Primer is bubbling/pinholes especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. 3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. 4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.			
6.04.04	Coating for Mild Steel parts in contact with Water.			
	a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 g/ Sq.m. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629. b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.			
6.04.05	Gratings			
	All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 gm/sqm.			
6.04.06	Hand Railings and Ladders			
	All Mild steel (MS) handrails and ladders in outdoor locations and in pump valve pits shall be galvanised at the rate of 610 gm/sqm as per IS 4736. All other MS handrails shall be painted as specified in clause 6.04.03 above. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.00.00.			
6.04.07	Sea Worthiness			
	All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti-corrosive Paint before shipment to take care of sea worthiness.			
6.04.08	DELETED			
6.04.09	For reinforced concrete work.			
	i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts. ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,			
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6.04.10	Bidder shall furnish the details of corrosion protection measures. Chequered Plate Chequered Plate shall receive same corrosion protection measures as structural steel unless specified otherwise.			
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D-1-7	FOUNDATION SYSTEM AND GEOTECHNICAL DATE			
7.00.0	Soil Data	refer annexure-A to amendment-1		
	Owner has carried out geotechnical investigation in the proposed area. Available bore logs of the area along with laboratory test results are enclosed at Annexure-C for Bidder's reference. The geotechnical investigation report of proposed area will be made available for the Bidder's study at the Owner's office, if required. Bidder may carry out his own geotechnical investigation at site before bidding for his information at no extra cost and time to owner. Such data collected by bidder is only for the purpose of bidding and it shall not be a part of technical documents related to this package. However, final design shall be based upon the detailed geotechnical investigation, which is to be conducted by successful bidder as per the clause 7.07.00 after placement of award. The Bidder should note that nothing extra whatsoever on account of variation between the foundation system assumed by bidder before bidding and that finalized based on the detailed geotechnical investigation after award, shall be payable. No time extension in the bidding time will be given to bidder for carrying out geotechnical investigation. Bidder may refer topographical survey drawing for variation in existing ground level (EGL) and General layout plan (GLP) for FGL. Onus of correct assessment/ interpretation and understanding of the existing subsoil conditions is on the Bidder.			
7.00.01	Successful bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. Net allowable bearing pressure shall be limited to Table-1 of Clause No 7.02.02. The report shall be submitted for Owner's approval prior to commencement of design of foundation.			
7.00.02	The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation before bidding and after bidding by him or during execution of works, shall be Payable.			
7.00.03	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-7 CIVIL WORKS FOUNDATION SYSTEM	PAGE 1

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.00	d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications. Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals except thrust blocks, channels/drain and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above & i) below) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. h) The water table for design purpose shall be considered at Finished Ground Level. i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. j) Foundation for equipments on ground floor For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications. For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling from Natural Ground Level (NGL) or excavation level of nearby footing whichever is deeper with the load intensity below the equipment limited to 4T/m2. The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications. For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of			
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7.02.02	minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.																																
	Open Foundations																																
	In case open foundations are adopted, following shall be adhered to.																																
	a) The minimum width of foundation shall be 1.0 m.																																
	b) Minimum depth of foundation shall be 1.0m below Ground Level.																																
	c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.																																
	d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.																																
	e) Wherever the intended bearing stratum is weathered rock, but the actual strata encountered during excavation consists of both overburden soil and weathered rock at founding level, under such cases, the overburden upto the weathered rock level including 0.5 m into the weathered rock shall be removed and built up through PCC (1:3:6) upto the designed founding level. Thus, maintaining the same founding level for all the footings of a structure.																																
	f) The last layer of about 300 mm before reaching the founding level shall be excavated carefully by such equipment so that soil / rock at the required level will be left in its natural condition.																																
	g) During detailed engineering, the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-1.																																
Table-1 <table><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing Pressure T/m²</th></tr><tr><th>Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata</th><th>Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata</th><th>Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata</th></tr><tr><th colspan="3">Width upto 6.0m</th></tr><tr><td colspan="4">In case of Soil</td></tr><tr><td>1.0m below NGL</td><td>8</td><td>10</td><td>12</td></tr><tr><td>2.0m below NGL</td><td>10</td><td>13</td><td>15</td></tr><tr><td>3.0m below NGL</td><td>15</td><td>18</td><td>20</td></tr><tr><td>4.0m below NGL</td><td>20</td><td>22</td><td>25</td></tr></table>				Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m ²			Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata	Width upto 6.0m			In case of Soil				1.0m below NGL	8	10	12	2.0m below NGL	10	13	15	3.0m below NGL	15	18	20	4.0m below NGL	20	22	25
Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m ²																																
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-7 CIVIL WORKS FOUNDATION SYSTEM	PAGE 3																													

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7.02.03	<table><tr><td>5.0m and below NGL</td><td>25</td><td>28</td><td>30</td></tr><tr><td>In case of rocky strata</td><td></td><td></td><td></td></tr><tr><td>0.60m Embedment in highly weathered rock</td><td>30</td><td>30</td><td>30</td></tr><tr><td>1.0m Embedment in highly weathered rock</td><td>40</td><td>40</td><td>40</td></tr><tr><td>2.0m and more embedment in highly weathered rock</td><td>50</td><td>50</td><td>50</td></tr></table>				5.0m and below NGL	25	28	30	In case of rocky strata				0.60m Embedment in highly weathered rock	30	30	30	1.0m Embedment in highly weathered rock	40	40	40	2.0m and more embedment in highly weathered rock	50	50	50				
	5.0m and below NGL	25	28	30																								
	In case of rocky strata																											
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	1.0m Embedment in highly weathered rock	40	40	40																								
	2.0m and more embedment in highly weathered rock	50	50	50																								
	For NGL & FGL of the proposed area may be derived from GLP along with topographical survey drawing & borelog data. In case any loose/soft pockets in rocky strata is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8). g) For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:																											
	<table><tr><td>Isolated & Raft (Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil</td><td>25 mm</td></tr><tr><td>Isolated & Strip (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil</td><td>40 mm</td></tr><tr><td>Raft (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil</td><td>75 mm</td></tr><tr><td>Foundations in Weathered rock / rock</td><td>12 mm</td></tr></table>				Isolated & Raft (Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	25 mm	Isolated & Strip (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	40 mm	Raft (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	75 mm	Foundations in Weathered rock / rock	12 mm																
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Foundations in Weathered rock / rock	12 mm																											
Pile Foundations – In case piles are adopted, following shall be adhered to : i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer. If required, temporary or permanent MS liner may be provided for piling. ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be least of the three values i.e. as per approved geotechnical report, as per the values furnished in following table and pile capacity achieved in pile load tests.																												
<table><tr><td>Pile</td><td>Dia. (mm)</td><td>Vertical compression capacity (T)</td></tr><tr><td rowspan="2">Bored cast-in-situ</td><td>600</td><td>140</td></tr><tr><td>760</td><td>250</td></tr></table>				Pile	Dia. (mm)	Vertical compression capacity (T)	Bored cast-in-situ	600	140	760	250																	
Pile	Dia. (mm)	Vertical compression capacity (T)																										
Bored cast-in-situ	600	140																										
	760	250																										
The pile shall be socketed into rocky strata with minimum socket length of 5m into rock. The uplift and lateral load capacity shall be respectively restricted to 35% and 5% of the allowable load capacity in vertical compression. However, the pile capacities to be adopted shall be the least of the estimated design values and that obtained from the initial pile load tests.																												
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	iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval. v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval. vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the pile capacity mentioned in (ii) above. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part). viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter. ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under : i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles and job piles shall be applied by means of Kentledge with concrete blocks / reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package. 7.03.00 Special Requirements 7.03.01 Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly. 7.04.00 Excavation, Filling and Dewatering 7.04.01 For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
7.04.02 7.04.03 7.04.04 7.04.05 7.04.06	back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth. Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum. Backfilling in Main Power House & Boiler Area This clause is applicable in the following areas: a) Main Power House Building foundations including Auxiliary column foundations, TG foundations, BFP foundations, CW pit, CEP Pit. b) Common control room building foundations (between the Main Power House Buildings) c) Boiler foundations including Mill Bunker building foundations, Coal Mill foundations. After construction of foundations for above mentioned buildings/ facilities, excavated earth between the excavation profile and the foundations, wherever backfilling is required, shall be backfilled with sand from founding level till finished ground level in the excavated profile. In case block excavation is carried out for the above mentioned areas, after construction of foundations, whole area shall be backfilled with sand from founding level till finished ground level. Sand used for filling shall be natural sand/manufactured sand, and clean & well graded conforming to IS 383 with grading Zone I to III. Backfilling with sand shall be carried out in layers not exceeding 300 mm compacted thickness and each layer shall be compacted to minimum 80% of relative density. Backfilling in other area Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non cohesive soils. In any case, black cotton soil shall not be used in back filling without providing cushion of 1m of non expansive cohesive soil/moorum around the footings. In case of roads in the area of black cotton soil, minimum 0.4m moorum shall be provided. Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices. Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels. CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level. The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
7.05.00	EXCAVATION IN ROCK			
	Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.			
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).			
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring			
	The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.00	Geotechnical Investigation			
	The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.			
7.07.01.00	Scheme of geotechnical Investigation			
7.07.02.01	Field test shall include but not be limited to the following:			
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	Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.			
7.07.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.			
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.			
7.07.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers. Laboratory Tests on Soil Samples Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel. Laboratory Tests on Rock Samples Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.			
7.07.02.05	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards. On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc. Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.			
7.07.03	Geotechnical investigation work may be got executed by the Contractor through the following suggested agencies			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-7 CIVIL WORKS FOUNDATION SYSTEM	PAGE 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																		
7.08.00	1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad 5. Secon Private Limited, Bangalore 6. Soil Engineering Consultants, New Delhi 7. CEG Test House and Research Centre Private Limited, Jaipur 8. Geomarine Consultants Pvt Ltd., Chennai 9. Soiltech India Private Limited, Pune																						
	Geotechnical Investigation Scheme																						
	a) Boreholes (Minimum)																						
	<table><tr><th>S.No</th><th>Structure</th><th>Spacing/Number of borehole</th><th>Depth of borehole</th><th>Remarks</th></tr><tr><td>1</td><td>Main Plant structures (Transformer Yard, Main power house, Boiler, ESP, Chimney, Mills, Fans etc)</td><td>About 40-50 m along the rows of main power house columns. Minimum 3 boreholes under each Boiler, Mill & Bunker, ESP structure and 3 boreholes under Chimney, Minimum 2 boreholes under each TG, ESP Control Room, TPs. 4 boreholes in Transformer yard</td><td>Depth of boreholes shall be 25 to 35m.</td><td rowspan="3">Depth of boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 50% whichever is</td></tr><tr><td>2</td><td>Switchgear room, control room and transformer foundation</td><td>Minimum 6 no of boreholes</td><td>25 to 30 m</td></tr><tr><td>3</td><td>Raw water Pump house, forebay, Switchgear room, control room and transformer foundation plant area</td><td>Minimum 4 no of boreholes</td><td>20 to 25m</td></tr></table>					S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	Main Plant structures (Transformer Yard, Main power house, Boiler, ESP, Chimney, Mills, Fans etc)	About 40-50 m along the rows of main power house columns. Minimum 3 boreholes under each Boiler, Mill & Bunker, ESP structure and 3 boreholes under Chimney, Minimum 2 boreholes under each TG, ESP Control Room, TPs. 4 boreholes in Transformer yard	Depth of boreholes shall be 25 to 35m.	Depth of boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 50% whichever is	2	Switchgear room, control room and transformer foundation	Minimum 6 no of boreholes	25 to 30 m	3	Raw water Pump house, forebay, Switchgear room, control room and transformer foundation plant area	Minimum 4 no of boreholes	20 to 25m
	S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks																		
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	4	Cooling Tower	Minimum 3 no of borehole in each CT	25 to 35 m	earlier.
	5	FGD systems	Minimum 20 boreholes	25 to 35 m	
	6	Coal Handling Plant structures	Minimum one borehole under each TP and one under crusher and one borehole under each structure. Minimum 10 no of under each stockpile area, 3 in Track Hopper, 2 in crusher house	25 to 35 m	
	7	Ash Handling & AWRS Structures	Minimum 8 boreholes	25 to 30 m	
	8	FOPH and Other Off site structure /Facility	Minimum Two boreholes under each area / facility	20 to 25 m	
	9	Water treatment plant structures	Minimum 8 no of borehole	20 to 25 m	
	10	Switchyard Structures	Minimum 8 no of borehole	20 to 25 m	
	11	Reservoir	Minimum 20 nos	15 to 20 m	
	12	Gypsum and Lime storage area	Minimum 10 Nos.	20 to 25 m	
	13	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m	
	b) Other Field Tests (Minimum)				
	1	Plate Load Test (PLT)	1 no each in ESP, transformer yard area, Ash handling, switchyard and other area, where open foundations are feasible.	Test Depth from 2 to 4 m	
	2	Cyclic Plate Load Test (CPLT)	1 no in each TG, Mill, FGD and ID fans	Test Depth from 2 to 4 m	
	3	Trial Pit (TP)	About 25 Nos.	Depth upto 4 m	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	4	In Situ Permeability Test In Boreholes	In minimum 8 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.
	5	ERT	2 Nos. each in Transformer yard, TG, Boiler, Chimney, Ash handling area, ESP Control Room, coal handling area, ash handling area, 1 No near each Pump House other than mentioned above	
	6	CROSS HOLE	1No. in each TG, 1No. in each Mill & bunker and 2 Nos in ID Fan, 1 no in each FGD	Depths covering from 1.0 m to 20.0 m
	7	PMT	40 no of tests in main power house area covering power house to chimney, TPs.	Depths covering from 1.0 m to 20.0 m
	• Depth and location of Boreholes and other field tests (PLT, CPLT, CROSS HOLE TEST, PMT, TP, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work. • Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
D-1-8 8.01.00 8.01.01	GENERAL SPECIFICATION GENERAL REQUIREMENTS JOINTS IN CONCRETE STRUCTURES Construction Joints All horizontal construction joints shall be provided with a groove (shear key) for transfer of shear force. For construction joint in concrete wall, the maximum height of any lift should not exceed 2 meters. However, the time interval between the successive lifts should be as small as possible and the wall should be built to its full height in the least possible time. Expansion joints for all underground structures shall be made watertight by using ribbed PVC water stops with central bulb or of kicker type. The thickness and width of PVC water stops shall be as per the requirement of design. However, the minimum thickness and width shall be 6mm and 225mm respectively. Expansions Joints In case of expansion joints, preformed bitumen impregnated fibre board conforming to IS 1838 shall be used as joint filler. The joints shall be sealed with bitumen sealing compound conforming to IS 1834, however in case of liquid retaining/carrying structures, two parts polysulphide sealant conforming to IS 12118 or silicon sealing compound shall be used. IS 3414 shall be followed for details of joints in buildings. 3 mm thick stainless steel strip in matt or buff finish shall be provided over building expansion joints. Miscellaneous General Requirements All steel sections and fabricated structures, which are required to be transported on sea, shall be provided with anti-corrosive paint before shipment to take care of sea worthiness. Monorails, monorail girders and fixtures shall be provided, wherever required to facilitate erection / maintenance of equipment. Wherever possible all floor openings shall be provided with 100 mm thick 150 mm high RCC kerb all around. Angles 75 x 75 x 6 mm (minimum) with 8mm diameter and 150mm long MS lugs @ 150 c/c shall be provided for edge protection all around cut outs/openings in floor slabs. Angles 50 x 50 x 6mm with effective anchor lugs shall be provided for edges of concrete drains supporting grating/covers, edges of RCC cable / pipe trenches supporting covers/chequered plates/ grating, edges of manholes supporting covers, supporting edges of precast RCC covers and any other place where breakage of corners of concrete is expected. Floor of switchgear room shall be provided with embedded M.S. channel suitable for easy movement of breaker panels. Anti-termite constructional measures and chemical treatment measures shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundations of buildings, filling below the floors, etc., as per IS 6313 and other relevant Indian Standards. All cable & pipe routing shall be done as per system requirement and as stipulated elsewhere in the specification and shall run above ground on elevated trestles or other supporting structures except in some localized area (as approved by Employer) where the same can run in trenches. In case, pipes are to be routed on RCC pedestals, the height should not be less than 500mm above formation level/paving level. All trenches shall be of RCC with removable RCC covers.			
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	All cable trenches located inside buildings shall have minimum 6mm thick (o/p) chequered plate covers. Cable trenches, where allowed, located outside the buildings shall project at least 200mm above the finished formation level unless noted otherwise elsewhere in this specification so that no storm water shall enter the trench. The bottom of the trench shall be provided with a longitudinal slope of 1:500. The downstream end of trenches shall be connected through pipe drains to the nearby RCC manholes (to convey water from trenches) of storm water drainage system, but avoiding back flow of storm water. In general, the precast covers shall not be more than 300 mm in width and shall not weigh more than 65 kg. Lifting hooks shall be provided in the precast covers. All cable trenches, wherever required, shall be provided with suitable insert plates for fixing support angles of cable trays. In Main plant area wherever fire water pipe trenches are envisaged, these trenches shall be of RCC and provided with precast RCC cover flush with finished level of paving in that area. R. C. C. cable slits shall be filled with sand after erection of cables, up to top level and covered with 75mm thick PCC cover of minimum M15 grade.			
8.01.02.8	All steel platforms above grade shall be provided with 100 x 6 thick kick plates at edge of platform.			
8.01.02.9	Duct banks consisting of PVC conduits conforming to IS 4985 for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.			
8.01.02.10	Independent network of lines for sewerage and drainage shall be provided. Plant effluent shall not be mixed with either storm water or sewage.			
8.01.02.11	The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor density at Optimum moisture content (OMC.)			
8.01.02.12	Detailed scheme for dewatering shall be prepared, wherever required, before starting of deep excavation work. IS 9758 shall be followed as general guidance for dewatering.			
8.01.02.13	Structural steel column base plates and bolts, gussets, etc., shall not project above the floor level unless and noted otherwise. These shall be encased by concrete cover up to floor level with concrete grade M 25.			
8.01.02.14	Non-shrink flow able grout shall be used for under-pinning work below base plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing strength of the grout shall generally be one grade higher than that of the base concrete. Minimum grade of grout shall be M-30. Grouting of all pockets, blockouts, sleeves and the openings around the embedment, inserts, bolts etc. and under pinning below the base / sole plate shall be with non - shrink flow able grout. Grade of grout shall be one grade higher than concrete. However minimum grade of grout shall be M - 30. However, for equipment foundations, high strength (minimum characteristic compressive strength of 60 N/sq.mm at 28 days) ready mixed non-shrink, chloride free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer shall be used.			
8.01.02.15	All the buildings and site development including landscaping shall be designed to take care of rain water harvesting & ground water recharging. Development of rain water harvesting scheme for the buildings, structures, facilities in Bidder's scope and obtaining approval of the scheme from Central Ground Water board is in Bidder's scope.			
8.01.02.16	As required suitable steel frames shall be provided around openings in the roof and external walls for mounting exhaust fans.			
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8.01.02.17	750mm wide x 100 mm thick plinth protection in PCC (M-15) shall be provided around all buildings, pits / sumps, clarifiers, tanks, etc.		
8.01.02.18	All masonry walls shall be provided with Damp Proof Course at plinth level.		
8.01.02.19	All monorail openings in the walls shall be provided with double plate flush steel door shutters with suitable access platform and ladder as required.		
8.01.02.20	Hand rail (of minimum 1m height), size and material to be adopted shall be as per general architectural specification.		
8.01.02.21	In all buildings, suitable arrangement for draining out water collected from equipment blow downs, leakages, floor washings, firefighting etc. shall be provided for each floor with suitable floor drains.		
8.01.02.22	Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC.		
8.01.02.23	All buildings shall be provided with peripheral drains by the side of plinth protection for catering to the rain water from roofs and storm water from adjacent area. Plinth protection drains shall be provided all around the building and to be connected with nearest storm water drain. Minimum size of plinth protection drain will be 300mmx300mm.		
8.01.02.24	Minimum 2.0m wide walkway with plain cement concrete (nominal mix M15 grade) paving 150 mm thick laid over 75 mm thick bed of dry aggregate shall be provided connecting all buildings and facilities. The top of walkway shall be minimum 200mm above FGL, unless specified otherwise.		
8.01.02.25	For all buildings, finished floor level (FFL) shall be minimum 500mm above finished ground level (FGL).		
8.01.02.26	40mm Diameter MS rods as earthing mat, placed at a distance of 1.0m away and at depths between 0.60m and 1.00m shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per approved drawings. Riser of 40mm Dia. MS rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Raiser shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on the outside of the buildings, and minimum 2 (two) numbers for each structures and equipment. The contractor shall also supply and lay necessary number of 3.0 m deep 40 mm diameter MS rods Earthing electrodes and connect electrodes to the Earthing mat, as per the approved drawings and supplying and laying of 40 mm Dia. MS rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately.		
8.01.02.27	Hume pipes of required class shall be as per IS: 458. Hume pipe made of Geopolymer concrete may also be used. Details of ingredients for Geopolymer concrete is as per details specified elsewhere.		
8.01.02.28	Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.		
8.01.02.29	Interlocking concrete block , kerb blocks or concrete block specified for various uses shall be precast blocks made of alkali-activated concrete /Geopolymer concrete as per IS:17452-2020.		
8.01.02.30	Rail-track from transformer yard to unloading bay of Main Power House shall be provided with rigid type RCC foundation. Rail weighing 52 kg/m(minimum) shall be used.		
8.01.02.31	All opening in floors/roofs/cladding for routing of pipes/cables/ducts shall be suitably sealed by the contractors after completion of erection works.		
8.01.03	Acid/ Alkali Resistant Lining All structures receiving acid / alkali resistant lining shall be tested for water tightness and made		
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8.02.00 8.02.01	leak proof before lining work. The acid / alkali resistant lining shall be provided broadly in the areas identified. The Bidder shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Bidder shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period. The material for Acid/ Alkali Resistant Lining shall conform to the following: i) Bitumen primer shall conform to IS: 158. ii) Bitumastic compound shall conform to IS: 9510. Where the height of bitumastic layer on vertical surface is more than 2.0 m, the bitumastic layer shall be reinforced with diamond pattern expanded metal steel sheets conforming to IS: 412. iii) A.R. Bricks/ Tiles shall conform to class II of IS: 4860 & IS: 4457 respectively. iv) Mortar: Potassium silicate & resin type mortars shall conform to IS: 4832 Part-I&II respectively.																							
	CONCRETE GENERAL a) Concrete work shall be of grade as per IS 456. Mix design concrete shall be used for all areas other than lean concrete work and plain cement concrete where nominal/volume mix can be permitted. Design mix shall be carried out as per IS10262. Specific approval of the Engineer shall be obtained regarding degree of quality control to be adopted for design mix. b) Minimum grade of reinforced cement concrete for all foundations shall be M25 unless noted otherwise. Minimum grade of concrete for other structures/areas (other than machine foundations) shall be M25 for all superstructure and substructure unless noted otherwise elsewhere in this specification. c) The minimum grades of concrete for different machine foundations and some of other important structural members shall be as follows: <table><tr><th>Sl No</th><th>Description</th><th>Minimum grade of concrete</th></tr><tr><td>i)</td><td>ID, FD, PA fan & Mill foundations (block foundations)</td><td>M-30</td></tr><tr><td>ii)</td><td>TG top Deck</td><td>M50</td></tr><tr><td>iii)</td><td>TG Raft/ Substructure</td><td>M35</td></tr><tr><td>iv)</td><td>Complete wagon trippler/track hopper, Stacker and Reclaimer foundations, Crusher Deck foundation and other railway load bearing structures.</td><td>M35</td></tr><tr><td>v)</td><td>BFP foundations (in case of springs supported) / (in case of block foundation)</td><td>M35 / M30</td></tr><tr><td>vi)</td><td>Rail load Bearing Structures</td><td>M35</td></tr></table>				Sl No	Description	Minimum grade of concrete	i)	ID, FD, PA fan & Mill foundations (block foundations)	M-30	ii)	TG top Deck	M50	iii)	TG Raft/ Substructure	M35	iv)	Complete wagon trippler/track hopper, Stacker and Reclaimer foundations, Crusher Deck foundation and other railway load bearing structures.	M35	v)	BFP foundations (in case of springs supported) / (in case of block foundation)	M35 / M30	vi)	Rail load Bearing Structures
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	Concrete design mix of M50 grade concrete for TG top deck and substructure shall be carried out as per IS 10262 satisfying following conditions /Specification: i) OPC 43 grade cement shall be used to design M50 grade of concrete mix. However, in case the mix design using OPC 43 grade cement fails to achieve the target strength of M50 grade concrete, OPC 53 grade cement may be used provided adequate precautions for higher heat of hydration and quality assurance measures are in place. ii) The concrete slump shall be in the range of 150-180mm at pouring point. iii) Maximum cement content (OPC) shall be limited as stipulated in IS 456. iv) Free water-cement ratio shall be as per clause 5.1 of IS 10262. v) PCE type superplasticizers shall be used as high range water reducing admixtures (Type F as per ASTM C494 or equivalent) in the concrete mix. Dosage & mixing methodology of this chemical admixture shall be as per manufacturer's recommendation. vi) Fly ash conforming to IS 3812 part 1 shall be used as pozzolana (mineral admixture) considering approx 15%-30% (mass) replacement of total cementitious materials. d) Higher grade of concrete than specified above may be used at the discretion of the Bidder. e) Unless otherwise specified, 20mm and down aggregates shall be used for all structural concrete works. However, 40mm and down aggregates may also be used under special conditions for mass concreting in foundation. f) For thin concrete sections such as roof slab over profiled metal deck sheets, 12mm and down coarse aggregates shall be used for coarse aggregates. g) Minimum 75mm thick lean concrete M-7.5 shall be provided below all other underground structures, foundations, trenches, etc., to provide a base for construction. h) All structural(reinforced) concrete production shall be done at automated batching plant of suitable capacity, conforming to IS:4925., situated within the area allocated to the contractor. Batching plant shall also have provision to mix fly ash (by weight). The batching plant shall have facility of digitised recording of the materials added along with quantity of concrete produced in each batch and printout of the same. Batch-wise report for each shift shall be submitted to the Engineer.			
8.02.02	Reinforcement Couplers Reinforcement couplers (mechanical splicing systems with upset parallel threaded couplers) may be used in reinforced concrete works, subject to following conditions: a. Couplers shall meet the performance requirements of IS 16172 for class H. i. It shall have minimum tensile strength corresponding to Fe550D which is 600 N/mm2 and failure shall take place outside the length of splice as per clause no 9.2.1 of IS 16172. ii. Percentage elongation at maximum force in the reinforcing bar outside the length of mechanical splice shall be minimum 3 % before the failure of test piece as per clause no. 9.2.2 of IS:16172. iii. Slip test value shall not exceed 0.10 mm. as per clause no 9.3 of IS 16172. iv. Cyclic tensile test corresponding to Fe550D reinforcement bar as per clause no 9.4 of IS 16172. v. Low cycle fatigue test as per clause no 9.5.1 of IS 16172.			
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8.02.03	vi. High Cycle Fatigue test as per clause no 9.5.2 of IS 16172. b. The manufacturer shall mark the coupler in such a way that all finished reinforcement couplers can be traced to the original cast from which they were made along with date of manufacture. c. Sampling and other requirements of IS 16172 shall be complied with. d. Each lot shall be supplied with manufacturer's test certificate (MTC) indicating values of tests in line with IS 16172. e. The minimum clear cover requirements are to be ensured for reinforcement couplers also. f. The couplers shall be used only at the locations where joint is required as per standard lapping purpose and couplers shall not be used for joining of several cut pieces of reinforcement in a single bar. As a general guideline, the length of the bars in which coupler is to be provided should not be less than 4m. Vendors for the reinforcement couplers shall be subject to the approval of Engineer-In-Charge			
	Special requirements for concreting of major equipment foundations shall be as given below. a) Temperature Control of Concrete All the machine foundations such as Mills & Fans, top decks of TG & BFPs, the temperature of fresh concrete shall not exceed 25 deg C when placed. For maintaining the temperature of 25 deg C, crushed ice shall be used in mixing water. b) Admixture Plasticizer /super plasticizer admixture shall generally be added to the concrete for promoting workability. In addition, plasticizer/super plasticizer-cum-retarder shall be added to retard the setting time for mass concreting work as required. In case of pumping, suitable pumping additive shall also be added to avoid segregation and increase flowability. The slump shall generally be in the range given below: Top decks of TG & BFP - 150 mm to 180 mm Block foundations - 100 mm to 150 mm TG Column - 100 mm to 150 mm c) Form work Plywood with film face form work shall be used for the top decks of all machine foundations d) Placing of Concrete Base Raft and top deck of machine foundations shall be cast in a single pour. e) Scheme for Concreting Weigh Batching Plants, transit mixer, concrete pump shall be mobilized. Arrangements for standby Plant and Equipment shall also be made. f) Ultrasonic Testing Ultrasonic pulse velocity test shall be carried out for TG top deck including TG Columns & BFP top decks (in case of Block type, UPV testing is not required) to ascertain the homogeneity and integrity of concrete. In general, grid spacing of 1.0m to 1.5m may be adopted for carrying out the UPV testing. In addition, additional cubes (at the rate of one cube per 150 Cum of concrete subject to a minimum of six cubes)			
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8.04.00	minimum thickness as per the criteria specified in metal deck roof material clause in Architectural Design and concept. These profiled metal deck sheets shall be fixed to the structural steel secondary beams/ Purlins using Headed shear anchor studs. The detailed material property requirement of metal deck sheet is specified elsewhere in this specification. The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. Type 2 Formwork: (For RCC Buildings) Plywood with film face formwork shall be used for floor & roof slabs, Columns & Beams of all RCC buildings. CULVERTS /RACKS ACROSS RAIL TRACKS Design of bridges/ culverts or any other structure crossing the Railway tracks shall be as per Railways/ RDSO guidelines/specifications for Dedicated Freight Corridor (DFC) 32.5 T loads. The Bidder shall obtain necessary approvals from Railways before start of construction work. Construction of these structures is to be done as per Railways guidelines. Any statutory and codal charges payable to Railways/ RDSO for approval & execution of the above crossings shall be borne by the Bidder. Engagement of approved Railway Consultant for the above work by the bidder would be at his own cost. The levels/clearances of the above crossings are to be finalized by the bidder as per Railway standards and shall be subject to approval of Owner/Owner's Consultant. However, for design of the above crossings above rail track, the following minimum clearance from Rail track shall be maintained: A. Horizontal clearance: A minimum clearance of 3.5m shall be maintained between centre line of the Railway track to face of the crossing structure. B. Vertical clearance: A minimum vertical clearance of 8.5m shall be maintained between Rail top level and bottom of structure. However, a minimum vertical clearance of 6.5m shall be maintained between Rail top level and bottom of structure in case of FA silo. Bidder has to submit to the Owner two sets of railway approved drawings and two sets of (hard & soft copies) as built drawings. The construction of rail network inside the plant for transportation of coal, fly ash & POL is in the scope of Owner. The bidder should plan to complete the construction work of all roads/ drainage/ pipe line/ cable crossings etc which are crossing below the rail track well in advance to facilitate owner to undertake the construction work of siding.			
	8.05.00	FENCING AND GATE		
	8.05.01	FENCING Fencing with gate shall be provided around fuel oil area, and other areas wherever necessary due to security, safety, and statutory requirements as per following specifications. However for isolation between existing station/township and the project, the total height of fence may be		
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	reduced to 2.4m with 450mm barbed wire on top, while other details being same as given below. The fencing, with gate (unless specified otherwise) shall comprise of PVC coated G.I. welded wire mesh fencing of minimum 4 mm diameter (including PVC coating) of mesh size 75mmX75mm of height 2.4m above the toe wall with a 600mm high galvanised concertina at the top, such that total fence height of 3.0m above the toe wall is achieved. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 2.5 mm. The PVC coated chain link will be stretched by the clips at 0.5m intervals to three strands of galvanised high tensile spring steel wire (HTSSW) of 2.5 mm diameter interwoven with chain link wire mesh and kept under tension which in turn are attached to the fence post with security nuts and bolts. On every fourth post a clamping strip will be threaded through the links of chain link and bolted to the fence post with the help of security nuts and bolts. Above the chain link a 600mm high tensile serrated galvanised wire (HTSW) concertina made with wire diameter of 2.5mm will be stretched to 6m and attached to two strands of galvanised HTSSW of 2.5 mm diameter by means of clips at 1m intervals. These two HTSSW strands will be attached to the fence posts with 12 mm security fasteners. All nuts, bolts, fasteners, clamping strips, clamps, clips, etc., shall be galvanised. All fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R.C.C. foundations for the post and stays shall be provided based on the prevailing soil conditions. All posts of fencing shall be painted with chlorinated rubber paint over a suitable primer. Toe walls either of brick masonry with bricks of minimum 50 kg./sq.cm. Crushing strength or of hollow concrete block masonry shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200mm above the formation level with 50mm thick P.C.C. coping (1:2:4) and shall extend minimum 300mm below the formation level. Toe wall shall be plastered with cement sand mortar (1:6) on both sides and shall be painted with two coats of textured cement point (Sandtax Matt or equivalent) of approved colour and shade. Toe wall shall be provided with weep holes at appropriate spacing.			
8.05.02	Gate along Fencing All gates shall be of structural steel of minimum 3.75 metre width for single lane access road and 8.00 m width for double lane access roads. The height of gate shall be same as that of the fence unless noted otherwise. Each gate shall have provision for wicket gate of size 1.0 m x 2.1 m. The gate frame and post shall be fabricated from medium class MS pipe of nominal diameter not less than 75 mm. The panel plate shall be of minimum thickness 2.5 mm conforming to IS: 513. The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminium ball bearing arrangement, castor wheel, etc.			
8.06.00	GRATING All gratings shall be electroforged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 5 mm or as per design requirement whichever is higher. All gratings shall be hot dip galvanised at the rate of 610 g. per sq.m. after surface preparation by means of shot blasting or cleaned by acid pickling.			
8.07.00	FABRICATION & ERECTION OF STEEL STRUCTURES			
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8.07.01	The fabrication shall be done as per fabrication drawing which would clearly indicate various details of joints to be welded, type of weld, length and size of weld. All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Coal bunkers, Lime storage silo and biomass silo with hoppers and chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For coal bunkers, hoppers and chimney flue liners, to prevent coal dust/flue gas leakages, the applicable field joints shall necessarily be welded. Note: Steel structures shall mean Plant and Non-Plant building structures, boiler & ESP support structures, CHP structures, AHP structures, chimney flue liners support platforms & stairs, pipe and cable support structures. Site welding can be permitted in special cases where final inputs are not available before release of fabrication drawings. Before dispatching the fabricated structural members to site, it shall be ensured that all parts in the assembly fit accurately together by carrying out pre-assembly of fabricated structural members having bolted field joints, in the factory. All steelwork before and after manufacturing shall be smooth, straight and free of deformations, cracks, twists and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length and location of matching bolt holes for field connections.			
	Welding a) Welding of Structural steel shall be done by an electric arc process and shall conform generally to relevant acceptable standards viz. IS:816, IS:9595, IS:814, IS:2014, IS:4354 and Indian Standard Hand Book for metal arc welding, and other standards, codes of practice internationally accepted. For welding of any particular type of joint, Bidder shall give appropriate tests as described in any of the Indian Standards - IS: 817, IS: 7307 and international standards as relevant. b) Submerged arc-welding shall be used for welding longitudinal fillet welds (connecting flange with web) and longitudinal / transverse butt joints for fabrication of columns, framing beams and crane girders and all other built-up members, unless manual arc welding is specifically approved by the Engineer. Necessary jigs and fixtures and rotation of structures shall be so arranged that vertically down-hand position of welding becomes possible. 'Open-Arc-Welding' process employing coated electrodes shall be employed for fabrication of other welded connections and field welding. c) Wherever welding is done for assembling the components of structures, the job shall so positioned that down hand welding is possible. d) Any structural joint shall be welded only by those welders who are qualified for all welding procedures and positions in such type of joint that is welded. e) All records for entire welding operations such as welders identification marks, the joints welded by the each welder, the welding procedures adopted, welding machine employed, pre and post heating done and any non-destructive test done and stress relieving /heat treatment performed on such joints shall be accessible to the Engineer for scrutiny. f) In a fabrication of plated columns/beams and built up members all shop splices in each component part shall be done before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fitting between components to be assembled by welding, these welds shall be ground flush prior to assembly.			
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8.07.01.3	arc welding				
	Upto and including 20mm	None			
	Over 20mm and upto and including 40m	20°C			
	Over 40mm and upto and including 63mm	66°C			
	Over 63mm	110°C			
	c)	Preheating may be applied by external flame which is non-carbonising like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welding joint is obtained.			
	d)	Thermo-chalk, thermo-couple or other approved methods, shall be used for measuring the plate temperature.			
	e)	All butt welds with plates thicker than 50mm and all site butts weld of main framing beam shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600°C and rate of application shall be 200°C per hour. The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos free pads shall be used for covering the heated areas.			
	Sequence of Welding				
	a)	The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect or by a counter distortion. The direction of welding should be away from the point of restraint and towards the point of maximum freedom.			
b)	Each case shall be carefully studied before finally following a particular sequence of welding.				
c)	Butt weld in flange plates and/or web plates shall be completed before the flanges and webs are welded together.				
d)	The beam and column stiffeners shall preferably be welded to the webs before the web and flanges are assembled unless the web and flanges to the beam or column are assembled by automatic welding process.				
e)	All welds shall be finished full and made with correct number of runs, the weld being kept free from slag and other inclusions, all adhering slag being removed.				
f)	Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid as to leave the edges unmelted.				
g)	Pudding shall be sufficient to enable the gases to escape from the molten metal before it solidifies.				
h)	Non-uniform heating and cooling should be avoided to ensure that excessive stresses are not locked up resulting ultimately in cracks.				
i)	The ends of butt welds shall have full throat thickness. This shall be obtained on all main butt welds by the use of run off and run on pieces adequately secured on either side of main plates. The width of these pieces shall not be less than the thickness of				
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	the thicker part joined. Additional metal remaining after the removal of extension pieces shall be removed by grinding or by other approval means and the ends and surface of the welds shall be smoothly finished. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the end be welded to provide the ends with the required reinforcement. j) The fusion faces shall be carefully aligned. Angle shrinkage shall be controlled by presetting. Correct gap and alignment shall be maintained during the welding operation. k) All main butt welds shall have complete penetration and back surface of the weld being gouged out clean before first run of the weld is given from the back. However, partial penetration butt weld shall be permitted, when specifically shown in the design drawings. l) Intermittent welds shall be permitted only when shown in the design drawings. m) The welding shrinkage shall be minimised by adopting the correct welding procedure and method. In long and slender member extra length should be provided at the time of fabrication for shrinkage.			
8.07.01.4	Testing of Welders All the welders to be employed for the job shall have to qualify the appropriate tests laid down in IS: 817 and IS: 1181 and ASME IX/AWS D1.1. All the necessary arrangements required for the testing of welders are to be provided by the Bidder.			
8.07.01.5	Inspection of Welds a) Visual Inspection 100 percent of the welds shall be inspected visually for external defects. Dimensions of welds shall be checked. The lengths and size of weld shall be as per fabrication drawings. It may be slightly oversized but should not be undersized. The profile of weld is affected by the position of the joint but it should be uniform. The welds should have regular height and width of beads. The height and spacing of ripples shall be uniform. The joints in the welds run shall as far as possible be smooth and should not show any humps or craters in the weld surface. Welds shall be free from unfilled craters on the surface, under-cuts, stages on the surface and visible cracks. Such inspection shall be done after cleaning the weld surface with steel wire brushes and chisel to remove the spatter metal, scales, slag, etc., If external defects mentioned above are noticed, there is every possibility of internal defects and further radiographic/ultrasonic examination shall be undertaken. b) Production Test Plate Test plates shall be incorporated on either side of at least one main butt welds of each flange plate and web plate of every main frame columns and crane girder. The weld shall be continuous over the test plate. The test plate extensions of the main plates and shall be fixed so that metal lies in the same direction as that of the main plate. Test plates shall be prepared and tested in accordance with the accepted Standards, in the presence of the Engineer or his authorised representative. Should any of these tests fail, further radiographic examination of the welds shall be done. These tests for test plates and radiographic examination are additional to those contemplated under inspection and testing. c) Non-destructive and special testing Radiographic / ultrasonic or other non-destructive examination shall be carried out. All tests of welds shall be carried out by the Bidder at his own cost. The cordoning of			
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	radiation zone, while Radiography testing is going on, shall be done. In case of failure of any of the tests, re-testing of the joints shall also be carried out after rectification is done. d) Rectification of defective welding work Wherever defects like improper penetration, extensive presence of blow holes, undercuts, cracking, slag inclusion, etc., are noticed by visual inspection/other tests, the welds, in such location shall be removed by gouging process. The joints shall be prepared again by cleaning the burrs and residual matters with wire brushes and grinding, if necessary, and rewelded. The gouging shall as far as possible be done using gouging electrodes.
8.07.01.6	Inspection and Testing a) Fillet Welds Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification b) Butt Welds Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification c) Dimensional Tolerance and Acceptance Criteria of Welds Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification
8.07.01.7	Correction of Defective Welds Correction of defective welds shall be carried out without damaging the parent metal. When a crack in the weld is removed magnetic particles inspection or any other equally positive means shall be used to ensure that the whole of the crack and material up to 25mm beyond each end of the crack has been removed.
8.07.02	Painting a) Surface treatment and painting before and after delivery to site shall be in accordance with Clause no. 6.4.0 above. All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance in thickness (over the design thickness) of structural steel members shall be kept. b) For parts to be bolted, the surfaces in contact shall be provided with ethyl Zinc silicate primer as specified in clause 6.4.3 (a) and shall be free of oil, dirt, loose rust, burrs and other defects, which would prevent proper seating of the parts. For design of friction type bolted joints slip factor for surfaces with ethyl zinc silicate primer as given in IS 4000 shall be considered. c) Surfaces inaccessible after shop assembly shall receive the full-specified protective treatment before assembly. However, interior surfaces of Box-sections, which are effectively sealed from all ends, need not be painted.
8.07.03	Bolting The threaded portion of each bolt shall project through the nut by at least one thread. High strength friction grip bolts, preferably the type with indicated load, shall be used where specified and shall be tightened strictly in accordance with the manufacturer's instructions and the relevant regulations. When connections are made using high strength friction grip bolts the relevant standards shall be observed.
8.07.04	Erection of Structures
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	All erection work shall be done with the help of cranes, use of derrick is not envisaged. Erection Marks a) Erection marks in accordance with fabrication drawing shall be clearly painted on the fabricated steelwork. Each piece shall be marked in at least on two places. Each piece shall also have its weight marked thereon. c) The centre lines of all columns, elevations and girder bearings shall be marked on the sections to ensure proper alignment and assembly of the pieces at site. Erection Scheme a) The Erection Scheme for the erection of all major structures shall be furnished. The erectability of the structure shall be checked by the Bidder before commencement of fabrication work to avoid future modification. The erection scheme shall indicate the approximate weight of the structural members, position of lifting hook, crane boom length, crane capacity at different boom length and at different boom inclination, etc., b) The erection scheme shall also give details of the method of handling, transport, hoisting, including false work/staging, temporary, bracing, guying, temporary strengthening, etc., It will also give the complete details of the number and capacity of the various erection equipment that will be used such as cranes, winches, etc., along with disposition at the time of erection of columns, trusses, etc. c) The erection of columns, trusses, trestles, portals, etc., shall be carried out in one single piece as far as practicable. No column shall be fabricated and erected in more than 3 pieces. Galleries shall generally be erected as box i.e. the bottom chord and bracings, top chord and bracings, side vertical posts and bracings, end portals and roof-trusses shall be completely welded prior to erection and if required temporary strengthening during erection shall be made. The inside sheeting runners and roof sheeting purlins may be erected individually. When erection joints are provided in columns, their location shall generally be just above a floor level.			
8.08.00	STEEL HELICAL SPRINGS AND VISCOUS DAMPERS UNITS			
8.08.01	General Requirement This part of the specification covers the requirement for the manufacturing, testing, supply, transport to site, pre-stressing erection, supervision of erection by the vendor, release of pre-stress, alignment, commissioning, etc. of Steel helical springs and viscous dampers units.			
8.08.02	The Steel helical springs and viscous dampers units supplied should be of proven make. Codes and Standards Some of the relevant applicable Indian standards and codes, etc, applicable to this section of the specification are listed below: DIN : 4024 Machine foundations; Flexible supporting structures for machine with rotating masses. DIN : EN 13906-1 Cylindrical helical springs made from round wire and bar: calculation & design. DIN : 2096 Helical compression springs out of round wire and rod; quality requirements for hot formed compression springs. ISO : 10816 /IS:14817 Criteria for assessing mechanical vibrations of machine. ISO : 1940/IS: 11723 Criteria for assessing the state of balance of rotating rigid bodies.			
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8.08.03	Design & Supply of Material i) Supply Steel helical springs and viscous dampers and associated auxiliaries shall consist of: (a) Steel helical springs units (fully pre-stressable) and viscous dampers units along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc. (b) Frames for pre-stressing of spring elements. (c) Suitable hydraulic jack system including electric pumps, high pressure tubes etc. required for the erection, alignment etc., of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided. (d) Any other items which may be required for the pre-stressing, erection, release of pre-stress, alignment, and commissioning of the Steel helical springs and viscous dampers. ii) Design The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 50% of vertical stiffness. However, for projects in high seismic zones, the minimum stiffness in horizontal direction shall be reviewed based on the design requirement and in no case it shall be less than 15% of vertical stiffness. The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is between 2 Hz to 4 Hz. The damper units or spring-cum-damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50°C. The damping resistance of individual damper units should be such that the designed damping can be provided using reasonable number of Units. The Steel helical spring units and viscous damper units and their housings shall be designed for a minimum operating life of 30 years. Steel helical spring units shall conform to infinite life fatigue load calculations as per DIN EN 13906-1.		
8.08.04	Manufacturing & Testing Complete manufacturing and testing of the Steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved sub vendor / supplier. For this purpose the contractor / sub vendor shall submit the detailed quality plan for approval of engineer and take up the manufacturing / testing after approval of such quality plan. The quality plan shall include (a) Manufacturing schedule and quality check exercised during manufacturing. (b) Detail of test to be carried out at the manufacturing shop with their schedule. (c) Special requirements, if any, regarding concreting of top deck. (d) Complete step-by-step procedure covering the installation and commissioning of the spring system. (e) Manuals for erection, commissioning, testing and maintenance of the Steel helical springs and viscous dampers. (f) A checklist for confirming the readiness of the civil fronts for erection of Steel helical springs and viscous dampers. (g) Checklist for equipment required at each stage of erection. (h) Bill of materials and data sheet of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.		
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	(i) Bill of material and data sheet for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc., with their rating and umbers. (j) Any other details which may be necessary to facilitate design and construction of the foundations / structures.		
8.08.05	The springs shall conform to codes DIN EN 13906-1 and DIN 2096. The quality assurance and inspection procedure shall be finalized on the basis of the above codes and the quality plans be drawn accordingly.		
8.08.06	Transportation Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.		
8.08.07	Erection and Commissioning Complete erection and commissioning of the Steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. shall be carried out by a specialist supervisor of vendor. The contractor shall guarantee the performance of the Steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as Guarantee Period”.		
8.08.08	Supervision The supervision of installation of Steel helical springs and viscous dampers including pre-stressing, placing, releasing and alignment of spring units shall be done by a specialist supervisor of sub vendor / supplier, trained for this purpose.		
8.08.09.1	Realignment of Spring System If any realignment of the Steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the contractor.		
8.08.09.2	Acceptance Criteria Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096. Following acceptance criteria shall be followed: General workmanship is being good as recommended by the manufacturer and approved by Equipment supplier. Tolerances are within the specified limit. Manufacturer’s test certificate (MTC) shall be in compliance with the applicable codes / standards. Bought out material is from the approved manufacturer / vendor. Bought out material is matching with the approved sample.		
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	Information on Geopolymer Concrete- A) Ingredients: Geo-Polymer Concrete is a special type of concrete where no cement is used unlike conventional cement concrete. Major ingredients of Geo-polymer concrete are as below: - Fly Ash (to be collected from location within existing operating plant/from existing fly ash silos near plant boundary) - Ground Granulated Blast Furnace slag - Aggregates (Coarse and fine) - Sodium Silicate - Sodium Hydroxide - Chemical admixtures like super-plasticiser, retarder, shrink-reducing compound, evaporation reducer etc. Fly ash produced by coal-based power stations of NTPC, if available, will be issued free of cost for the production of Geo-polymer concrete on 'as is where is' basis. B) Batching & Mixing: Geopolymer concrete of minimum required grades of M10 and M35 shall be prepared for Dry Lean Concrete (DLC) and Pavement Quality Concrete (PQC), respectively. The solid constituents of geo-polymer concrete mix such as coarse aggregate, fine aggregate, fly ash and slag are to be mixed dry for 2-3 minutes, then Geo-activator solution, consisting of sodium silicate and sodium hydroxide pre-mixed in tanks at site, is added to the dry mix in batching plant mixer. The whole mixture is mixed until a homogeneous cohesive mix is obtained. Pumping devices shall be used for transferring activator solution from tank to the mixer. Proportion of different ingredients and mixing process are to be finalized/established during mix design finalization and trial mix at site. However, if any constraint is observed related to initial setting time of the geopolymer concrete and time required for transporting the geopolymer concrete mix from batching plant to the point of application then suitable alternative option such as mixing of geoactivator solution may have to be mixed in transit mixer instead of batching plant. Bidder shall make available concrete batching plant suitably customized for handling/feeding/dosing/weighing etc of ingredients and capable of production of Geo-Polymer Concrete of suitable grade. C) Geo-activator: This solution shall be prepared using Sodium Hydroxide & Sodium silicate with water in a certain ratio. The ratio of Sodium Silicate and Sodium Hydroxide in activator solution shall be decided during finalization of Design mix. Separate tanks having adequate capacity are to be constructed close to batching plant with fencing and a lockable gate for preparation of Sodium Hydroxide and Sodium Silicate solution. These tanks shall be provided with acid-alkali resistant lining and covered with GI sheet. Each tank shall be fitted with a chemical resistant pump of suitable capacity and dual valve in the discharge line for recirculation (to enable mixing) and also for transferring the Geo-Activator solution to mixer. This connection pipe from Pump discharge to batching plant mixer shall be HDPE of suitable Diameter.		
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	Preparation of Geo-activator solution is a critical process and extra care needs to be taken during the preparation in respect of safety of personnel handling the chemicals. Worker handling the chemicals shall be provided with proper PPE's. A dedicated shower with water tank shall be available close to chemical handling area/tank on permanent basis for washing of affected person, in case of emergency. Bottles filled with distilled water in cupboard / Boxes near work place shall also be kept for emergency eye wash by worker exposed to such hazardous chemicals. D) Placing: Laying /placing of Geopolymer concrete DLC and PQC manually with hand-guided means or by semi-mechanized methods may be permitted provided acceptance criteria as per MORT&H specification is achieved.		
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D-1-9	Architectural Concepts and Design			
9.01.00	For Architectural Concepts and Design refer to 5.01.00 in this specification.			
9.02.00	General Architectural Specifications			
9.02.01	General			
	a) Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc., wherever the height of the building is more than 12m, railing height shall be 1.2m. All handrails and ladder pipes (except at operating floors) shall be 32 mm nominal bore MS pipes (medium class) conforming to IS: 1161 and shall be galvanised as per IS: 4736 and finished with suitable paint. All rungs and ladders shall also be galvanised. Minimum weight of galvanising shall be 610 g/sqm. The spacing of vertical posts shall be maximum 1500mm. Two number of horizontal rails shall be provided including the top member. In addition, toe guard/ kick plate of min size 100x6th shall be provided above the floor level. For handrailing at operating floors of Main Power House including RCC stairs (for one flight above and below operating floor level), passages, around all floor openings shall be Stainless Steel (SS) pipes shall be used. Height of the handrail shall be 1000 mm /1200mm in accordance with the preceding para. For SS handrail 32NB/50NB/60NB (polished) stainless steel pipe shall be provided. The spacing of vertical posts shall not be more than 1500mm. Two number of horizontal rails shall be provided including the top member. SS Toe guard and kick plate shall be provided above the floor level.			
	b) All stairs shall have a maximum riser height of 180mm and a minimum tread width of 275 mm. Minimum clear width of stair shall be 1200 mm unless specified otherwise.			
	c) All buildings having metal cladding shall be provided with 1M high brick wall at ground floor level. All buildings having metal cladding shall be provided with a 150 mm high RCC toe kerb (on upper floor) at the edge of the floor along the metal cladding. 1000 mm high hand railing shall be provided on this RCC kerb, wherever required from the safety point of view.			
	d) In all buildings, structures, suitable arrangement for draining out water collected from equipment blowdowns, leakages, floor washings, fire fighting, etc., shall be provided for each floor. All the drains shall be suitably covered with grating or precast RCC panels.			
	e) RCC staircase shall be provided for main entrance of all RCC construction buildings.			
	f) Parapet, Chajjas 450mm over window and 600mm door heads, 900mm over rolling shutters, architectural fascia, projections, etc., shall be provided with drip course in cement sand mortar 1:3.			
	g) All fire exits shall be painted with fire resistant paint P.O red/signal red colour shade which shall not be used anywhere except to indicate emergency or safety measure. Fire safety norms shall be followed as per National Building Codes and fire safety requirements for providing fire exits, escape stairs and fire fighting equipment. In detailing of all buildings, fire safety requirements conforming to IS: 1641 and IS:1642 shall be followed.			
9.03.00	Water Supply and Sanitation			
9.03.01	Roof water tanks of adequate capacities depending on the number of users and 8 hours requirement shall be provided for each building and pump house. Polyethylene water storage tanks conforming to IS:12701 shall be used. The tanks shall be complete with all fittings including lid, float valve, stop cock, vent pipe, etc.			
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9.03.02	Galvanised MS pipe of medium class conforming to IS:1239 shall be used for internal piping works for service water and potable water supply. The pipes shall be concealed, and painted with anti-corrosive bituminous paint (as per IS: 158) wherever required. UPVC (conforming to IS:13592) shall be used for sanitary works above ground level. All Buildings shall be designed with Toilets as per NBC norms. All buildings shall have minimum 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 in subsequent clause. 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. Each Toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of Chromium plated brass (fancy type). a) One number wall mounted coloured glazed vitreous China European water closet and flushing valve system, water faucet, toilet paper holder as per IS:2556 b) One number colour glazed ceramic oval shaped wash basin 450x 550 mm (approx.) mounted over 18mm thick granite beveled edge counter fitted with photo-voltaic control system for water controls, bottle trap as per IS:2556. For common toilets, number of washbasins shall be as per requirement. However, for Pump Houses the same shall be provided without photo voltaic control system for water control. c) For Male Toilets Urinal as per requirements, with all fittings with photovoltaic control flushing system as per IS: 2556. d) One number looking mirror 600 x 900 x 6 mm, edge mounted with teak beading and minimum 12 mm thick plywood backing, one number stainless towel rail 600 x 20 mm, one number liquid soap dispenser e) One toilet with required facilities shall be provided for physically challenged persons as per National Building Code requirements f) Janitor Space & space for drinking water cooler. g) Electric operated hand dryer with photo voltaic control. h) The pantry shall consist of one number stainless steel pantry sink, as per IS : 13983, of size 610 x 510 mm, bowl depth 200 mm with drain board of at least 450 mm length with trap, hot and cold water mixer, one number geyser of 25 liters capacity, with inlet and outlet connections, one number over head water storage tank, as per IS : 12701 and of 500 liters capacity, complete with float valve, overflow drainage pipe arrangement, GI concealed water supply pipe of minimum 12 mm diameter of medium class, cast iron sanitary pipe (with lead joints) of minimum 75 mm diameter, floor trap with Stainless Steel grating, inlet and outlet connections for supply and drainage, with all bends, tees, junctions, sockets, etc., as are necessary for the commissioning and efficient functioning of the pantry (all sanitary fittings shall be heavy duty chrome plated brass, unless noted otherwise) One number of pantry shall be provided on Control Room floor of ESP control room building and One number of pantry shall be provided in Buildings having Control Room . i) Laboratory sink shall be of white vitreous china of size 600x400x200 mm conforming to IS: 2556 (Part-5).			
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9.04.00	j)	In addition, adequate number of portable toilet units with adequate plumbing and sanitary arrangement, shall be provided during construction stage for workers.		
	k)	Adequate number of toilet units with adequate plumbing and sanitary arrangement, shall be provided for workers (O&M workers).		
9.04.01	Flooring Floor finishes of approved shade and colour (non - premium colours), over under bed of cement mortar / concrete, at all levels and for all kind of works, elevations, on horizontal and vertical surfaces for all types of work (like flooring, skirting, dado, wall lining & facing, tread and risers etc.), including topping, spreading white cement slurry at an average rate of 2.5 kg/Sq. M., (unless noted otherwise), jointing and joint filling with white cement (unless noted otherwise) slurry mixed with colour pigment, to match the shade of the finishing material, laying to plumb and water level in desired pattern, line and flush butt square jointing, curing, rubbing, grinding, polishing, edge moulding, finishing and cleaning, testing, providing opening of required size and shape, casting in panels wherever specified.			
9.04.02	The nominal total thickness of floor finish shall be 50 mm i.e. underbed and topping. The floor shall be laid on an already laid and matured concrete base. The underbed for floors and similar horizontal surfaces shall consist of cement concrete M20 grade. Stone chips shall be 12.5 mm down well graded & proper filling shall be done with brick bats/cinders. Flooring like Tiles/ Stones shall be laid with 1:4 cement sand mortar and Tile/ Stone Cladding on wall shall be laid with 1:3 cement sand mortar.			
9.04.03	All toilets shall have sunken slab to accommodate sanitary pipes and the finish level of floor shall match with general floor finish level. Sunken slabs shall be made watertight by suitable water proofing treatment.			
9.04.04	Metallic hardener topping -with ordinary grey cement shall be- 12 mm thick (insitu) or finishing the concrete / mortar surfaces topping shall be furnished with neat cement slurry (with ordinary grey cement)			
9.04.05	Heavy duty cement concrete tiles 300 mm x 300 mm shall be in using white cement with pigment, with hard and abrasion resistant carborundum / quartz chips for wearing course as per IS:1237. Laying of tiles shall be as per IS: 1443.			
9.04.06	Digitally glazed ceramic tiles shall be as per IS: 15622. Designer digitally glazed ceramic floor and wall tiles a) 300x300mm in white colour of Kajaria/ Nitco/ Somany/ Orient/ Johnson or equivalent b) 300x450mm in DIGITAL series of Kajaria/ Nitco/ Somany/ Orient/ Johnson or equivalent c) 300x600mm in DIGITAL series of Kajaria/ Nitco/ Somany/ Orient/ Johnson or equivalent			
9.04.07	12mm/20mm / 38mm / 75 mm/ 115mm thick acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works shall include one coat of bitumen primer followed by 12 mm thick bituminastic layer, 20mm / 38mm/ 75 mm / 115mm thick A.R. tiles, 6 mm thick under-bed by potassium silicate mortar conforming to IS:4832 (Part-I), pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar conforming to IS:4832 (Part-I), up to a depth of 20 mm and bituminastic end sealing. Battery Room in all buildings shall be provided with acid/ alkali resistant tiles on flooring & dado 1200mm high.			
	(i)	Mirror polished Digitally glazed vitrified & Matt Finish Digitally glazed Vitrified ceramic tiles (minimum 9.0mm thick) with 3mm groove joints as per approved pattern pointed neatly with 3x4mm stainless epoxy grout mix of 0.70kg of organic coated filler of desired shade (0.10kg of hardener and 0.20kg of resin per kg) with sizes of the tiles shall be as under:		
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	a) Size of tile 600x600/605x605 of Premium Series Kajaria/ Royale Series Somany/ OMA00025 Series Johnson or equivalent b) Size of tile 800x800 of Polished and Lapatto Series Kajaria/Diamond Series Somany/ Polished and Lapatto Series Johnson or equivalent ii) Anti-Skid Full Body Vitrified Tiles Antiskid, full body Vitrified Tiles of size 600X600X20 mm thick as specified below of approved make, shade, colour and pattern, over under bed of cement mortar / PCC shall be provided in TG Hall flooring at operating level. Full body Vitrified Tiles shall be laid on properly laid leveled floor, with joints 3 to5 mm wide & 8 to10 mm deep & shall be filled with approved Epoxy Grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardner and 0.20 kg of resin per kg). Full body Vitrified Tiles shall have water absorption less than 0.5%, Modulus of Rupture more than 38N/mm2, Breaking strength more than 7500 N, Mohs scale more than 6, Abrasion resistance less than 144 mm3 and coefficient of friction more than 0.4. Vitrified Tiles shall generally conform to IS: 15622			
9.04.08	For pathway, chequered and designed concrete tiles minimum 22 mm thick, 200x200 mm size conforming to IS: 13801 of approved shade and colour shall be used. 1000 wide pathways shall be provided for maintenance on rooftops of all buildings.			
9.04.09	Epoxy Flooring Epoxy Flooring shall be provided with surface preparation of concrete substrate with Captive Shot Blasting Machine OR Light Grinding to form the required anchor profile on the floor substrate followed by application of epoxy resin based moisture barrier underlay of 2 mm thickness including filling of saw cut joints with epoxy cementitious resin based moisture barrier underlay as per manufacturer specification. Application of self smoothing epoxy floor topping of epoxy based resin of 2 mm thickness over epoxy resin based moisture barrier underlay including application of solvent free epoxy resin based two component primer. It shall include application of PU Sealant at Expansion and Isolation Joint respectively including surface preparation of the joint, fixing of backup strip and application of sealant.			
9.04.10	Wherever required, carpet flooring shall be provided over cement concrete floor. The carpet shall be of tile/roll form, machine/handmade tupled un-cut loop pile and lay with under lay of 10mm thick and shall be laid as per manufacturer's recommendations, in matching grains. It shall be treated with anti fungus and anti-termite before laying.			
9.04.11	Mirror polished (6 layers of polish) Granite stone (slab) - 18 mm thick (minimum) / Flame finish/ (making top surface rough by burning)/ honed finish granite stone (slab) - 18 mm thick (minimum) shall be provided.			
9.04.12	Decorative/designer prepolished, plain and pigmented, high wearing resistance concrete tiles of 20mm thickness (minimum) in various non-standard interlocking patterns.			
9.04.13	Skirting in general shall be 150 mm high. Dado in toilets & pantries, shall be upto false ceiling level from finished floor level. Skirting and Dado shall match with the floor finish.			
9.04.14	Interlocking concrete blocks shall be of various sizes and thickness having M35 grade of concrete and pigmented to specified colours, in different pattern (in different textures chequered or other patterns in indentation for guiding band/s for visually impaired persons) including the preparation of sub base with 20mm thick sand and filling of joints with sand.			
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9.04.15	Matt finish (with grooves) Porcelain tiles (for guiding band/s for visually impaired persons) shall be with 3mm groove joints as per approved pattern pointed neatly with 3x4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. 24 mm x 24 mm x 3.8 mm thick (minimum) glass mosaic tiles in decorative murals and pattern. Laminated wooden flooring (11mm thick) shall be provided in VIP area, conference rooms.			
9.04.16	Rubber Flooring Rubber flooring shall conform to IS 809. The minimum thickness shall be 4 mm with sheet size of 602mm x 602mm. Rubber flooring shall consist of 100% virgin elastomer reinforcing agents, resins, curing agents, anti-oxidants and pigments. It shall have excellent abrasion resistance and shall have class-I fire rating. It shall be acid & alkali resistant and shall be of anti static grade. In general, BS code shall apply for their technical characteristics.			
9.05.00	Epoxy Resin Floor Finish Self-smoothing, seamless epoxy resin floor finish shall be provided on horizontal and vertical surfaces including preparation of surface, application of epoxy based primer coat, of approved colour, quality and make to give minimum thickness of 300 micron (in two coats)			
9.06.00	Roof			
9.06.01	Except for the roofs subjected to heavy loads, roof of all buildings having structural steel frame work shall consist of permanently colour coated (on exposed face) troughed metal sheet decking of approved profile as specified in clause 9.08.00. Silicon modified polyester paint having DFT of minimum 20 microns shall be used for permanent coating. The sheeting shall be fixed by means of concealed fixing system or any other compatible method approved by the Engineer. RCC slab of minimum 40 mm clear thickness in excess of trough depth shall be provided over the metal decking. Water proofing cum plasticiser compound shall be added to concrete over the metal decking. Bidder shall demonstrate that the roof is leak proof by carrying out the water-retaining test by maintaining the minimum water depth of 50mm over the roof surface for a period of 48 hours. Water Proofing Treatment as given below for RCC roof slabs shall be provided to ensure that the roof is watertight.			
9.06.02	DELETED			
9.06.03	For efficient disposal of rainwater, the run off gradient for the roof shall not be less than 1:100 and the roof shall be provided with RCC water gutter, wherever required. Gutter shall be made water tight using suitable watertight treatment. This gradient can be provided either in structure or subsequently by screed concrete 1:2:4 (using 12.5 mm coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.			
9.06.04	Medium class galvanised mild steel pipes conforming to IS 1239/IS 3589 with welded joints shall be provided to drain off rain water from the roof. These shall be suitably concealed with masonry work, cement concrete / or sheeting work to match with the exterior finish. The number and size of down comers shall be governed by IS 1742 and IS 2527. Roof drain level of all RCC framed buildings having cast-in-situ RCC roof shall be provided with Rain water gutter and/or 45 x 45 cm size Khurras having minimum thickness of 30 mm with 1:2:4 concrete over PVC sheet of 1 m x 1 m x 400 micron and finished with 12 mm thick cement sand plaster 1:3. All the pipes shall be provided with suitable fittings and fixtures.			
9.06.05	Roof Water Proofing Roof water proofing treatment shall be as follows: a) For roofs having structural slope: Top surface of sloped R.C.C. slab shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane shall be laid. The elastomeric			
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	shall comprise of high solid content liquid applied urethane laid over reinforcing layer of polyscrim cloth or non woven geo-textile. The top of the elastomeric membrane shall be finished with 20 mm thick cement: sand (1:4) mortar with chicken wire mesh and pressed precast concrete tiles of 20 mm thickness where applicable shall be laid over mortar at green stage. Provision for thermal expansion of roofing tiles shall be kept by providing an expansion gap in both directions filled up with polysulphide joint sealant. The expansion gap shall be provided in the cement sand mortar underbed layer also.			
	b) For roofs having no structural slope: Screed concrete mix (1:2:4) grading having minimum 25mm thickness at the lowest point of the slope shall be laid over R.C.C. slab and shall be laid as per the slope specified elsewhere in the specification. Top surface of grading underbed shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane shall be laid and top of the elastomeric membrane shall be finished with 20 mm thick cement: sand (1:4) mortar with chicken wire mesh and pressed precast concrete tiles of 20 mm thickness where applicable shall be laid over mortar at green stage. Provision for thermal expansion of roofing tiles shall be kept by providing an expansion gap in both directions filled up with polysulphide joint sealant. The expansion gap shall be provided in the cement sand mortar underbed layer also			
9.06.06	Roof of all buildings shall be provided with access/approach through staircase or ladder. Roof where equipment are mounted shall be provided with access through staircase.			
9.06.07	RCC parapet wall of minimum 1000 mm height (above top of slab) for all accessible roofs and 600 mm height for all non-accessible roofs shall be provided. Alternatively, parapet wall comprising structural steel post, runner and sheeting may be provided for buildings with metal sheet cladding.			
9.06.08	Fillets at junction of roof and vertical walls shall be provided with cast-in-situ cement concrete (1:1.5:3) nominal mix followed by 12mm thick 1:4 cement sand plaster.			
9.06.09	Pathways for handling of materials and movement of personals shall be provided with 22mm thick chequered cement concrete tiles as per IS:13801 for a width of 1000mm.			
9.07.00	Walls			
9.07.01	All walls shall be non-load bearing infill panel walls.			
9.07.02	For initial height up to 1 metre in buildings one brick thick masonry wall shall be provided wherever metal cladding is specified.			
9.07.03	All internal walls shall be with one brick thick in cement mortar (1:6). However, internal partition walls for toilets shall be with half brick masonry thick with cement mortar (1:4).			
9.07.04	For ESP Control Room Building, wall shall be of Autoclaved Aerated Concrete Block. Autoclaved Aerated Concrete (AAC) block masonry shall be with blocks having dimensions of 625 mm x 250 mm. thickness ranging from 100 mm to 300 mm conforming to I.S. :2185(part III).The jointing cement sand mortar in the composition of 1: 6 (Cement: sand) shall be used with suitable plasticizer(optional). Sand having modulus of fineness 1.1 shall be used. The horizontal and vertical joint thickness shall be approximately 10 mm. In case of partition walls (100 mm /125 mm thk.) the joint reinforcement i.e. 1 number of 6-8 mm diameter bars shall be placed at every alternate course to be anchored properly with the main structure. All other structural requirements like stiffening of masonry, joint reinforcement etc. in the AAC masonry work strictly be carried out as per instructions laid down in IS 6041 – 1985, IS - 1905. For control room , control equipment room in MPH Building , walls shall be of factory made composite modular light weight aerated concrete panels,(minimum 2 hours of fire rating) consisting of 2 fiber reinforced cement sheets (minimum 4 mm thick) on either side of light weight concrete core, having minimum compressive strength of 35 Kg / Cm2 and the density in the range of 700-900 Kg. / cu.m. of the thickness and fire rating as specified below, to provide external wall and internal partition at all levels, capable of sustaining wind pressure of			
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	3.00 M height (H) within limiting deflection of span/250, fixed in position in tongue and groove jointing system by screwing the panels to top and bottom U channels, (channels minimum 1.25 mm thick and galvanised to grade 180 (minimum) as per IS : 277), fixing U profiled top and bottom channels to concrete / primary steel members which are placed at the maximum vertical spacing of 4.5m with the help of galvanised steel expansion fasteners, filling the joints from both faces with silicon acrylic paste and making the same water tight by covering with fibre glass tape (minimum 50 mm wide and minimum 0.5 mm thick) or by any other suitable material, so as to ensure that the entire construction done with the light weight aerated concrete panels are weather proof and panel surfaces are flush for painting, creating opening for doors / windows /ventilators / ducts / pipes/fans/AC etc. and finishing the opening face with the same U profiled galvanized steel channel which is used at the top and bottom.			
9.07.05	Toilet Block in ESP Control Room Building shall be of Brick Masonry			
9.07.06	50 mm thick DPC in Cement concrete (1:1.5:3) with water proofing compound followed by two layers of bitumen coating 85/25 grade as per IS: 702 @ 1.7 kg./sq.m. shall be provided at plinth level before starting the masonry work.			
9.07.07	Enclosure of the elevator shall have 2hours fire rating and it shall be sealed from outside to ensure dust free environment.			
9.08.00	COLOUR COATED AND OTHER SHEETING WORK			
9.08.01	Material			
	a) Wall Cladding & Roofing Material			
	Troughed permanently colour coated sheet of approved shade and colour shall be			
	i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y250 as per IS 15961 / grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150			
	ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y350 as per IS15961/ grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.			
	iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y550 as per IS 15961/ grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS: 1254.			
	Bidder to ensure that same profile is to be used throughout the package for all facilities to maintain uniformity.			
	b) Metal Deck Roof Material			
	Troughed permanently colour coated metal decking sheets shall be			
	i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per			
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	AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275. ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275. iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided. Bidder to ensure that same profile is to be used throughout the package for all facilities to maintain uniformity. In addition, the depth of the profile shall be restricted to 60 mm (maximum) to reduce the overall thickness of floor slab and thus minimizing the dead load of the floor slab. If the bidder proposes to use two different metal deck sheets (same profile but different grades or thicknesses), the unexposed (concrete) side of the metal deck sheets shall be painted with clearly distinct colours to facilitate identification. Bidder to ensure that both cladding sheet and decking sheet supplied at site to be provided with transparent organic film of thickness of 40 microns on each face. Also they should be stored in a covered place on wooden sleepers till erection.			
9.08.02	Colour Coating	Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP) paint or Super Polyester paint or SDP paint (Super Durable Polyster with no TGIC Triglycidyl Isocynurate) . The silicon content in the SMP paint to be 30 to 50%. The paint to be , of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint/SDP systems shall be of industrial finish of product type 4 of AS/NZ2728. Also the heavy metal content (Lead, Cadmium, Chromium etc) to be within environmental norms so that the sheet is also suitable for rainwater harvesting		
9.08.03	Design Criteria	For wall cladding insulated / uninsulated and conveyor gallery sides and roof, permanently colour coated sheet of troughed profile shall be used. However alternative profile meeting the strength, deflection and other functional requirements such as section modulus and moment of inertia shall be provided. Sheet shall be of profile, sectional properties, colour and shade as per specifications. For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of		
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	troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.			
9.08.04	Fasteners Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. Shear anchor studs shall also be provided through metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams as specified in Clause no. 8.03.00. Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.			
9.08.05	Miscellaneous Details To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing. Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer. For insulation of cladding and other areas, mineral wool conforming to IS 8183 shall be used. The density shall be 32 or 48 kg. /cu.m for glass or rock wool respectively. The nominal thickness of insulation shall be 50mm. All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer. The contractor shall prepare working drawings of sheeting system including end and side laps, flashing, fixing details etc. before starting sheeting work at site.			
9.08.06	Pre-Fabricated Insulated Metal Sandwich Panels For buildings where Pre-Fabricated (Factory made) Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently			
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	colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y250 as per IS15961/ grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y350 as per IS15961/ grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y550 as per IS15961/ grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively, aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade. Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. The insulation shall be of Polyurethane type. The polyurethane shall be Chlorofluorocarbon (CFC) free and self-extinguishing and shall conform to IS 12436: 1988. It shall have Modular Density 40 +/- 2 Kg/m3 and Thermal Conductivity @ 10 Deg.C 0.017 - 0.020 W/M Ok, Water absorption (% by vol) 3.1, Critical Oxygen Index 23 and Compressive Strength 1.2 Kg/sq.cm.			
9.08.07	Polycarbonate Sheets The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details.			
9.09.00	Plastering			
9.09.01	Outer face (i.e. rough side) of all brick walls shall have 18 mm thick and inner face (i.e. smooth side) of all walls shall have 12 mm thick cement sand plaster 1:6.			
9.09.02	Acrylic wall putty in two coats shall be applied over cement plastered surfaces in interior of building. The finish surface shall be smooth and shall be of 2 mm nominal thickness.			
9.09.03	All R.C.C. walls shall have minimum 12mm thick cement sand plaster 1:6.			
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9.09.04	All RCC ceilings (except areas provided with false ceiling, cable vault ceiling and metal decking) shall be provided with 6mm thick cement sand plaster 1:4.			
9.09.05	Groove of uniform size 12 x 12 mm up to 20 x 15 mm in plastered surface as per approved pattern, shall be provided as per approved drawing.			
9.09.06	All plastering work shall conform to IS: 1661.			
9.10.00	Painting, Aluminium Composite Panel,			
9.10.01	All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush then same shall be finished off with roller.			
9.10.02	All paints shall be of approved make including chemical resistant paint.			
9.10.03	Minimum 2 finishing coats of paint shall be applied over a coat of primer. Stone work for wall lining etc. (Veneer work) over 20 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry @3.3kg/sq.m, including rubbing and polishing in complete. (Black polished granite stone slab, 18 mm thick / polished Sadarhally grey granite slab 18 mm thick). The final, finished coating shall be fungus resistant, UV resistant, water repellant, alkali resistant, and extremely durable with colour fastness.			
9.10.04	Acrylic emulsion paint shall be as per IS: 15489. Acrylic distemper shall be as per IS: 428. Cement paint shall conform to IS: 5410, white wash/colour wash shall conform to IS: 627.			
9.10.05	All fire exits shall be painted in post office red/signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measure.			
9.10.06	For painting on concrete, masonry and plastered surface IS: 2395 shall be followed. For painting on wood work IS: 2338 shall be followed.			
9.10.07	For painting on steel work and ferrous metals, BS: 5493 and IS: 1477 shall be followed. The type of surface preparation, thickness and type of primer, intermediate and finishing paint shall be according to the painting system adopted.			
9.10.08	Bitumen primer used in acid/alkali resistant treatment shall conform to IS: 158.			
9.10.09	All internal paints shall be of low VOC (Less than 50 g /L) content conforming to GRIHA rating for reduction of VOC content.			
9.10.10	Aluminium Composite Panel Aluminum Composite Panel cladding with open grooves shall be designed, fabricated, tested installed and fixed for linear as well as curvilinear portions of the building for all heights and levels including: a) Structural analysis & design and preparation of shop drawings for pressure equalization or rain screen principle as required, proper drainage of water to make it watertight including checking of all the structural and functional design. b) Aluminium Composite Panel cladding in pan shape in metallic/ solid colour of approved shades made out of 4mm thick aluminium composite panel. ACP consisting of 3mm thick Fire Retardant mineral filled Core comprising of around 70% Inorganic compound which is 100% non-combustible mineral and balance 30% is food grade virgin polymer sandwiched between two Aluminium sheets (each 0.5mm thick). The aluminium composite panel top and bottom skin should confirm to Aluminium Alloy 5005 (AlMg 1) marine grade series and H 22/24 temper.			
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	The ACP sheet shall be coil coated with Kynar 500 based (70:30 ratio) PVDF / Lumiflon based fluoropolymer resin coating of approved colour and shade on face # 1 and polymer (Service) coating on face # 2 as specified using stainless steel screws, nuts, bolts, washers, cleats, weather silicone sealant, backer rods etc. c) The fastening brackets of Aluminium alloy 6005 T5 / MS with Hot Dip Galvanised with serrations and serrated washers to arrest the wind load movement, fasteners, SS 316 Pins and anchor bolts of approved make in SS 316, Nylon separators to prevent bi-metallic contacts all complete required to perform as per specification and drawing.			
9.10.11	DELETED.			
9.10.11	DELETED			
9.10.13	Exterior Painting on Wall (Premium Acrylic Smooth Exterior Paint with Silicone Additives) The paint shall be (premium acrylic smooth exterior paint with silicone additives) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge. Preparation of Surface For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced. Application of Base Coat Base coat shall be of water proofing cement paint. Preparation of Mix for Base Coat Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere. Application of Base Coat			
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	The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade. Precaution Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement. Application of exterior paint Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-charge shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.			
9.11.00	Doors & Windows			
9.11.01	Doors, windows and ventilators of air-conditioned areas, entrance lobby of all buildings (where ever provided), and all windows and ventilators of all buildings (unless otherwise mentioned) shall have aluminium framework with glazing. The aluminium section shall have minimum 2 mm thickness. The aluminium frame shall be electro colour dyed (anodised with 15 micron coating thickness) when used on outer side of the building and it shall be powder coated(50 microns coating thickness) when used in interior of the building. All doors of toilet areas shall be of steel framed solid core flush shutter. For Mill Bunker Building, transfer points, crusher house, conveyor gallery, steel louvered windows shall be provided.			
9.11.02	Control Rooms of all buildings shall be provided with Aluminium Glazed door.			
9.11.03	Single glazed panels with aluminium framework shall be provided as partition between two air-conditioned areas wherever clear view is necessary.			
9.11.04	a) The doors frames shall be fabricated from 1.6 mm thick MS sheets and shall meet the general requirements of IS: 4351.			
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	b)	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 35 mm (min.) thick with two outer sheets of 1.2 mm rigidly connected with continuous vertical 1.0 mm stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 1.2 mm. 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, locks etc.		
9.11.05		Steel windows and ventilators shall be as per IS: 1361 and IS: 1038.		
9.11.06		Wherever functionally required Rolling shutter (fully closed/partly grilled) with suitable operating arrangement (manual/Electric) shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248. M.S sliding doors with suitable mechanical and electrical operations fixtures as per requirement for bigger openings shall be used.		
9.11.07		All windows and ventilators on ground floor of all buildings shall be provided with suitable Aluminium grill.		
9.11.08		Fire-Proof doors with panic devices shall be provided at all fire exit points as per requirements. These doors shall generally be as per IS 3614 (Part 2). Fire rating of the doors shall be of minimum 2 hours. These doors shall be double cover plated type with mineral wool insulation.		
9.11.09		Hollow extruded section of minimum 2 mm wall thickness as per IS: 1285 (Grade of Alluminum shall be Alloy 63400) shall be used for all aluminium doors, windows and ventilators.		
9.11.10		Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20m.		
9.11.11		Electrically operated, self operable/closing, aluminium framed with tinted glass, sliding doors shall be provided at the entrance of all common control rooms, entrance lobby of facility building. At the entrance of all common control rooms in MPH G.I. framed with fire resistant glass, sliding doors shall be provided. The oter doors in commomn control rooms in MPH shall be G.I. framed with fire resistant glass as per fire zoning .FIRE RESISTANT GLAZED DOOR SYSTEM shall be of UNIFORM PROFILE 50X50 mm with 14mm EI 20 GLASS For Interior Application FIRE RESISTANT GLAZED DOOR SYSTEM shall have 120 minutes of integrity and radiation control (EW 120) with symmetrical (Bi-Directional) fire protection. The frames shall be cold rolled profiles as per EN standard EN 10327/ Indian Standard IS 513 . The door frames are cold rolled from 1.5 mm steel sheet to form a profile of 50 mm x 50 mm on all sides. The door shutter shall have the top rail, side rail and bottom rail dimensions of 50 mm x 50 mm. The overall door opening shall be as per tested evidence and tested as per EN 1634-1/ ISO 834-1 / ISO 3009 /(Indian Standard) IS 16947:2018 in an accredited laboratory. The glass must be minimum 14mm clear (MADE IN INDIA)120 min fire rated for Integrity, Radiation control (EW 120) and partially insulation (EI 20) Non Wired Toughened Interlayered glass with a light transmission of 86% and a sound reduction of 38 dB and manufactured in UL & TUV audited Facility and including UL-EU Certification and compliant to class 1(B)1 category of Impact Resistance as per EN 12600. The glass shall be tested and certified for no formation of bubbles or yellowing after 5000 hours of exposure to UV radiation by TUV Rheinland as per EN 12543-4.The base glass and finished glass must made in India . The shutters shall be fixed to the frame using Weld-on hinges of dimensions 179mm X 20mm. The profiles shall have grooves to incorporate Fire Resistant gaskets. The glass shall be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on non-combustible 6 mm Calcium		
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	Silicate setting blocks. The door shall be fitted with offset pull handle and door closer of Dorma (TS 73V, TS 83V, TS93V), Geze (TS 2000NV) or equivalent. The inactive leaf (in case of double leaf only)shall be fixed to the frame using a tower bolt at meeting edge at top or as per the tested evidence. The doors shall be manufactured in a TUV audited facility. The maximum glazing size shall be as per the test certification. The profile has to be fixed to the supporting construction by means of M10 or bigger steel bolts at every 150 mm from the edges and every 500 mm (approx.) c/c. The doors shall offer C4 level of wind resistance when tested as per EN12211 and shall provide class 4 level of air permeability as per EN 1026. The door shall also be subjected to durability tests as per EN 12400 for C5 classification (200,000 cycles). The doors shall also be tested for class 5 of impact resistance when tested as per EN 13049. The doors & partition shall also be tested for class 4 level of Mechanical strength when tested as per EN13115. The door shall have water tightness level of 8A when tested as per EN 1027. Fire Rated Door shall be of Makes- Saint Gobain, Acodor , IGI, Matrix.			
9.11.12	Minimum area of windows in building on each floor level shall be 10% of floor area.			
9.12.00	Glazing			
9.12.01	All windows and ventilators (not specified elsewhere) shall be provided with minimum 6 mm thick toughened glass conforming to IS: 5437.			
9.12.02	For single glazed aluminium partitions and doors, 8mm thick clear toughened glass shall be used.			
9.12.03	Toughened tinted glass of 6 mm thickness shall be used for all windows and ventilators in toilets.			
9.12.04	All glazing work shall conform to IS: 1083 and IS: 3548.			
9.12.05	For glazings of Air Conditioned Buildings Composite double glazing shall be 24mm thick consisting of 6mm thick clear float glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermetically sealed by beading of anodized aluminium with outer edge sealed with silicon sealant. Outer glass of 6mm thickness shall have following technical characteristics: Solar factor 25% or less, Maximum U-value 3.3 W/ SQMK, VLT min 30%: Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) The glass to be used should be from the manufacturers of glass like Saint Gobain (India) or Asahi (India) or equivalent. The glass should be free from distortion and thermal stress			
9.12.06	For internal glazed partition, 8mm thick clear toughened glass shall be provided. Internal Glazed partition in in MPH shall be Vetrotech Saint-Gobain fully glazed fire rated fixed partition with 120 minutes of integrity and radiation control (EW 120) with symmetrical (Bi-Directional) fire protection. The frames shall be cold rolled profiles As per EN standard EN 10327/Indian Standard (IS 513) . The frames are cold rolled from 1.5 mm steel sheet to form a profile of 50 mm x 50 mm on all sides. he system shall be tested as per EN 1364-1/(Indian Standars) IS 16945:2018 in an accredited laboratory. The glass shall be Contraflam Lite 14mm (MADE IN INDIA)clear 120 min fire rated for Integrity, Radiation control (EW 120) and partially insulation (EI 20) Non Wired Toughened Interlayered glass with a light transmission of 86% and a sound reduction of 38 dB and manufactured in UL & TUV audited Facility and including UL-EU Certification and compliant to class 1(B)1 category of Impact Resistance as per EN 12600. The glass shall be tested and certified for no formation of bubbles or yellowing after 5000 hours of exposure to UV radiation by TUV Rheinland as per EN 12543-4 The glass shall provide bi-directional (Symmetrical) fire protection. The base glass and processed glass must be made in INDIA.			
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	The glass shall be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on non-combustible 5 mm Calcium Silicate setting blocks. The maximum glazing size shall be as per the test certification. The profile has to be fixed to the supporting construction by means of M10 or bigger steel bolts at every 150 mm from the edges and every 500 mm (approx.) c/c. The Partitions shall offer C4 level of wind resistance when tested as per EN12211 and shall provide class 4 level of air permeability as per EN 1026. The Partitions shall also be tested for class 5 of impact resistance when tested as per EN 13049. The Partitions shall also be tested for class 4 level of Mechanical strength when tested as per EN13115. The Partitions shall have water tightness level of 8A when tested as per EN 1027. Partitionr shall be of Makes - Saint Gobain,Acodor , IGI , Matrix ,Tata Pravesh.			
9.13.00	False ceiling			
9.13.01	False ceiling of 12.5 mm thick tapered/square edge glass fibre reinforced gypsum board conforming to IS : 2095 having fine texture finish, including providing and fixing of frame work at all levels, for all kind of work, consisting of light weight galvanised steel member (minimum 0.8 mm thick and galvanised as per IS: 277) having maximum grid size of 1200 mm x 600 mm for supporting panels of specified size, suspended from RCC structural steel or catwalkway grid above, with 4 mm (minimum) galvanised wires (rods), with special height adjustment clips, providing angle section of minimum 25 mm width along the perimeter of ceiling, supporting grid system (minimum 0.8 mm thick and galvanised as per IS: 277), expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. (concealed grid and finished flat seamless and curve shape (dome etc.), finished smooth(seamless) along with the galvanised light gauge steel supporting system laid in profile to suit the profile of dome).			
9.13.03	False ceiling of 12 mm thk calcium silicate board of 'HILUX' or equivalent with suspension system as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. (With concealed grid and finished flat seamless).			
9.13.05	ALUMINIUM FALSE CEILING : Aluminium false ceiling shall be in 600 mm x 600 mm tile or plank type of 0.6 mm thickness (minimum) with perforation of 2.5 mm dia in combination with built in nonwoven tissue for providing good acoustic properties. False ceiling shall have coil coating of thickness 25micron (minimum)and it shall be installed with T-Grid (of profile 24 mm) in same or contrasting colours or with 6 mm recess joints. The whole system shall be level adjusting arrangement and shall be suspended as per manufacturer guidelines.			
9.13.08	Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, A.C. ducts etc.			
9.13.09	Suitable M.S. channel (Minimum MC75 with maximum spacing of 1.2 m C/C both ways) grid shall be provided above the false ceiling level for movement of personnel and to facilitate maintenance of lighting fixtures, AC ducts etc.			
9.13.10	Underdeck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air-conditioned area depending upon the functional requirements. This underdeck insulation shall consist of 50mm thick mineral wool insulation with 0.05 mm thick aluminium foil & 0.6 mm x 25mm mesh wire netting and shall be fixed to the ceiling with 2 mm wire ties.			
9.13.11	Suitable cut-outs shall be provided in false ceiling to facilitate fixing of lighting fixtures, AC grills, smoke detectors, etc.			
9.14.00	Elevator Machine Room Elevator machine room shall be as per NBC requirements in either way.			
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9.15.00	a) Floor of the elevator machine room shall be of RCC and wall shall be of one brick thick masonry wall. It shall be provided with fire door and other requirements as per NBC and elevator norms. b) Floor of Machine Room shall be provided with profiled metal decking sheet. Trough shall be filled with Insulating Material (glass wool or rock wool) and thereafter finished with Minimum 50 mm thick wooden flooring, consisting of 37 mm thick hardwood planks, finished with 11mm thick laminated wooden flooring (of 'pergo' or equivalent) with plank size 193x1195mm (material class shall be 34 as per EN13329), over 2 mm expanded polystyrene foam and polythene sheet under laying. Roof and Side enclosure of Machine Room shall be provided with Prefabricated Insulated Metal Sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described in Clause 9.08.00 of Part-B (Civil) of Technical Specification. Doors of Machine Room shall be Double Plate Steel flush doors of thickness 45 mm with steel sheets of 18 gauge with necessary stiffeners. Space between two sheets shall be filled with mineral wool insulation. Frame of doors shall be pressed steel sheets of 16 gauge. All necessary fittings for the doors shall be provided by the Bidder. Rubber sealing, for making the Doors airtight shall also be provided. Windows/ventilators shall be of standard extruded anodised Aluminium Sections of minimum 2 mm thickness with 24 mm hermitically sealed double glazing consisting of two 6 mm thick toughened glass separated by 12 mm. gap. Technical requirements of prefabricated insulated metal sandwich panels/decking sheets shall be same as given elsewhere in this specification.			
	Interior Design A comprehensive interior design scheme shall be conceived with the intention of projecting a definite theme and aesthetic appearance to inside working environment. It shall take into account the multidisciplinary engineering activities involving power plant technology, and architectural & civil engineering for a smooth control hierarchy and man machine interface. All the design aspects such as flooring, false ceiling, furniture, colour scheme equipment design & layout, illumination, fire fighting, acoustics and ergonomics requirements shall be detailed out so as to present an overall unified aesthetic spatial appearance. The areas to be undertaken for this interior design process shall be control room complex including common control room, computer room, conference rooms and office areas in the buildings and the following aspects shall be reviewed and evaluated for design. Furniture to be supplied by Bidder for the control room complex and other control rooms shall be as specified under C&I specification. a) Layout, keeping in view the man-machine interface and suitable ergonomic practices. b) Integration of civil engineering with architecture and interior design. c) Illumination levels, noise levels, electromagnetic interference levels, taking into account the equipment and furniture. d) Comfort and safety requirements such as air conditioning, fire fighting, fire escapes, etc. e) Microprocessors based control system to control the functional requirements. The above design philosophy put into practice shall be detailed out through presentation drawings, perspective views, scale models, detail drawings, etc.			
9.16.00	Stainless Steel Hand railing Providing and fixing knockdown railing system comprising of SS 304 Grade Stainless Railing of 50mm diameter handrail fixed on 50 mm SS round baluster placed at maximum 1000 c/c along with five numbers 19 mm diameter midrail connected at side of baluster by special brackets, both the end of mid rail should be bush inserted for jointing and to give extra strength			
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9.17.00	(joints should not be welded and invisible). The balustrade should be fixed onto floor with casted plate of minimum 6mm thickness. Base plate shall be concealed with suitable SS 304 cover cap so that the mounting height fasteners are not visible after installation. Only high strength anchor fasteners would be used for fixing of baluster, as giving extra strength, rust proof and more durable. Onsite welding is strictly not allowed. Wherever welding is required, it should be Tig welding process with same grade 304/316 at factory only so that floor stone and other things would not be damaged and for safety purpose also. Baluster and handrail connector should be screwed tightened and not to be welded on site. Wall thickness of all pipes shall be taken as 2 mm. Along with all visible components developed in high grade SS and whenever required, joints to be filled with bushings for extra strength. Railing Height to be taken @ 1000/ 1200 mm from floor level. Finishing Schedule Interior and Exterior Finishes shall be as given in Tables-A & B respectively attached at the end of these specification.			
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TABLE –A
INTERIOR FINISHING SCHEDULE

S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
1.	Main power house Building.			
	a) Unloading Bay	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Cable vault	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	c) Balance area including passage	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	d) SWAS Room	Matt Finished Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns upto false ceiling level	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	e) Equipment Area, ESP SWGR/ ACP Room/ UAF Room	Cement concrete with Metallic hardener topping	Acrylic distemper.	Acrylic distemper (except metal deck area)
	f) UPS Battery charger room	Matt finished Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns upto false ceiling level	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	g) Deaerator floor	Cement concrete with Metallic hardener topping.		-

TABLE –A
INTERIOR FINISHING SCHEDULE

S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	h) Operating Floor	20 mm thick heavy duty anti skid full body vitrified tile in TG Hall. Rubber flooring at TG deck.	Colour coated Metal cladding on A-Row& Gable end, up to crane girder level.	Metal deck roofing (bottom of sheeting with RAL 9002 finish)
	i) General circulation and movement areas	20 mm thick heavy duty anti skid full body vitrified tile		Acrylic distemper (except metal deck area).
	j) Switchgear room	Heavy duty tiles (Cement Concrete 300mmx300mm)	Acrylic distemper	Acrylic distemper (except metal deck area)
	k)MCC Room	Heavy duty tiles (Cement Concrete 300mmx300mm)	Acrylic distemper	Acrylic distemper (except metal deck area)
	l) Control room area including control room	Matt Finish Vitrified ceramic tiles flooring of size 1000 x1000 mm	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Designer metal false ceiling

CLAUSE NO.	TECHNICAL REQUIREMENTS				
TABLE –A					
INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	m) control equipment room,	Matt finish Vitrified ceramic tiles.	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Designer metal false ceiling	
	n)Conference room, senior executive room., Computer Room	Matt finish Vitrified ceramic tiles	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Designer metal false ceiling	
	o)Record room	ceramic tiles	Acrylic distemper.	Designer metal false ceiling	
	p)Locker room	Ceramic Tiles	Acrylic Emulsion Paint	Allu Designer metal false ceiling	
	q)Toilet area	ceramic tiles	Digitally glazed ceramic wall tiles up to False Ceiling Height	Calcium Silicate False Ceiling	
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TABLE –A INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	r) Office Room, Staff Room	Matt Finished Vitrified ceramic tiles.	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design	
	s)Laboratory area	Vitrified Ceramic / Acid/alkali resistant tiles.	Designer ceramic wall tiles up to False Ceiling Height/ Aluminium composite panel cladding for columns and walls in case of A.C Panel	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design	
	t) RCC Stair case	18mm thick Granite (Polished and honed Finished) stone	Polished Granite Stone up to 1.2m. ht. & Acrylic Distemper Paint over wall putty finish for balance height.	Acrylic Distemper	
	u) Lift and Staircase Lobby	18mm thick polished granite stone as pattern.	18mm thick polished granite & glass mosaic tile cladding up to False Ceiling Height	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design	
	v) Passages and general circulation areas.	Deleted	Deleted	Deleted	
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CLAUSE NO.		TECHNICAL REQUIREMENTS			
TABLE –A					
INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	w) Battery Room	Acid and alkali resistant tile.	Acid and alkali resistant tile up to 1.2m height and chemical resistant paint for balance height	Chemical Resistant paint except in locations where Metal deck has been provided	
	x) Oil canal, oil room, oil purification Tank and other areas where oil spillage is likely to occur.	Oil resistant paint (epoxy based) 150 micron over primer.	As above except oil canal Oil resistant Paint	As above except oil canal.	
	y)Pathways including roof area.	22mm thick concrete chequered tiles.	-	-	
2.	ESP control building/Air compressor house				
	a) Operating/Maintenance areas	Cement concrete with Metallic hardener topping	Pre color coated metal panel cladding.	Acrylic distemper (except metal deck area)	
	b) Office Room, Staff Room	Digitally glazed Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns	Mineral fiber Board False Ceiling	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
TABLE –A INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	c) Control Room	Digitally glazed Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns in ESP Control Room Building	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design	
	d) MCC Room	Heavy duty tiles (Cement Concrete tiles 300mmx300mm)	Acrylic distemper	Acrylic distemper (except metal deck area)	
	e) RCC Stair case	18mm thick Granite (Polished and Honed Finished) stone	Polished Granite stone up to 1.2m.ht. & Acrylic Distemper	Acrylic Distemper (except metal deck area)	
	f) Battery Room	Acid, Alkali resistant tile	Acid, Alkali resistant tile 1.2m height / chemical resistant paint above dado	Chemical resistant paint (except metal deck area)	
	g) AHU/ AC Plant room/ Cable vault	Cement concrete with Metallic hardener topping	Acrylic Distemper	Acrylic Distemper (except metal deck area)	
	h) Toilets	ceramic tiles.	Designer ceramic wall tiles dado up to false ceiling level.	Calcium silicate false ceiling.	
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TABLE –A
INTERIOR FINISHING SCHEDULE

S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
3.	Mill & Bunker building/ T.P.s / Conveyor Galleries	Cement concrete with Metallic hardener topping	Acrylic distemper on masonry walls/ color coated Metal panel cladding	color coated Metal panel cladding
4.	Fire water pump house/ Fire water booster water pump house.			
	a) Maintenance /Pump floor/PLC	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Control room /PLC.	Matt Finished Vitrified Ceramic Tiles	Acrylic emulsion paint.	Mineral fiber board false ceiling.
	Toilet area	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2200 mm	Acrylic distemper

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TABLE –A INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
5.	Ash slurry pump house/ Ash water pump house / Silo Area Utility Building / Transport air compressor house/ HCSD pump house/Fuel Oil Unloading Pump House with switchgear building& control room /H2 generation Building/ Miscellaneous Switchgear room CW Pump house, Switchgear room, control room/ RW Pump house, Switchgear room, control room/Any other Building..				
	a) Operating/Mainte nance areas/ MCC room	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)	
	b) Control room /PLC /Office area.	Matt Finished Vitrified Ceramic Tiles	Acrylic emulsion paint.	Mineral fiber board false ceiling.	
	c) Toilet/Pantry area	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2200 mm	Acrylic distemper	
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TABLE –A INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
6.	O&M store building/Dozer Shed				
	a) Stores/dozer shed	Cement concrete with Metallic hardener topping.	Acrylic distemper/ color coated Metal panel cladding	Acrylic distemper (except metal deck area)	
	b)Office Room, Staff Room/ Electronic Store	Matt Finished Vitrified ceramic tiles.	Acrylic emulsion paint.	Acrylic Emulsion Paint. / Mineral Fibre Board False Ceiling in A.C area	
	c)Passages	Matt Finished Vitrified Ceramic Tiles	Acrylic distemper	Acrylic distemper	
	d)RCC Stair case	18mm thick polished Marble stone finish.	Marble stone up to 1.2m.ht. & Acrylic Distemper above.	Acrylic Distemper	
	e) Toilets	ceramic tiles.	Designer ceramic wall tiles dado up to 2.1 m Height from FFL.	Acrylic distemper	
7.	Rest Room for O&M Workers				
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CLAUSE NO.		TECHNICAL REQUIREMENTS			
TABLE –A					
INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	Rest room	Cement concrete with Metallic hardener topping.	Acrylic distemper	Metal roof	
	Toilets	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2100 high, Acrylic Distemper paint above	Metal roof	
8.	Occupational Health Centre with Crèche Facilities				
	a)Waiting Lobby cum Reception/ Doctor's Chamber /First Aid Room/ Patient Room	Matt finish vitrified tiles	Acrylic Emulsion paint	Acrylic Emulsion paint	
	b) Driver's Room	Digitally Glazed vitrified tiles	Acrylic Distemper Paint	Acrylic Distemper Paint	
	c)Toilet area	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to false ceiling level.	Calcium Silicate False Ceiling	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
TABLE –A INTERIOR FINISHING SCHEDULE					
S.N O.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH	
	Creche	5 mm thick vinyl flooring	Glass mosaic tiles in murals & patterns and Acrylic Emulsion Paint	Acrylic Emulsion paint	
9.	Watch Tower				
	Viewing area	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper	

Note :

1.

All wall above false ceiling shall be plastered.

2.

The colour and pattern of finish shall be as per approved details.

3.

All materials shall be of reputed and established brand approved by Engineer-in-charge.

4.

Wherever alternative materials are specified, the final selection rests with Engineer-in-charge.

5.

This finishing schedule shall also be applicable to similar functional areas for all other buildings and facilities.

6.

All the finishing materials shall be applied/provided as per manufacturer specification and guidelines under the supervision & guidelines of manufacturer.

7.

Requirement given above are suggestive and minimum. Bidder is welcome to suggest alternative scheme conforming to design functional requirement subject to approval of the Engineer-in-charge.

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TECHNICAL REQUIREMENTS



**TABLE –B
EXTERIOR FINISHES SCHEDULE**

Sl.No.	DESCRIPTION OF AREA	WALL AND PROJECTIONS	SOFFIT OF PROJECTIONS
1.	Auxiliary building in steel framed structure.	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface/ Aluminium Composite Panel Approved colour/ colour combination of colour coated metal cladding	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface Approved colour/ colour combination of colour coated metal cladding
2.	Building with concrete frame work, etc.	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface
3.	Steel Structure, trestles, etc.	High performance Paint of approved specification and shade.	
4			

NOTE : 1. The colour and pattern of finish shall be as finalized by Engineer.
2. All materials shall be of reputed and established brand approved by Engineer.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
D-1-10 10.01.00	MATERIAL SPECIFICATION Cement Fly ash based portland pozzolana cement conforming to IS: 1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code. Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Ordinary Portland Cement (OPC) shall necessarily be used for RCC for Chimney shell. b) TG foundation top deck/ Substructure c) Spring supported decks of all machine foundations such as TDBFP/MDBFP The grade of cement shall be Grade 43 for OPC conforming to IS: 269. In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS: 3812(Part I). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement			
10.02.00	Aggregates a) Coarse Aggregate Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. However, use of aggregate manufactured from other than natural sources (Listed in Annexure-A of IS 383) and Bottom Ash from Thermal Power Plants shall be permitted only in Lean Concrete of Grade M7.5 and M10 (for % of utilization refer Table-1 of IS 383). b) Fine Aggregate Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS: 383. Bidder can use either natural sand or crushed sand, confirming to IS:383, based on availability. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116. However, use of aggregate manufactured from other than natural sources (as Listed in Annexure-A of IS 383) and Bottom Ash from Thermal Power Plants conforming to IS:383 shall be permitted only in Lean Concrete of Grade M7.5 and M10 (for % of utilization refer Table-1 of IS 383). c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals for machine foundations, etc. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed. The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-10 CIVIL WORKS MATERIAL SPECIFICATION	PAGE 1 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.03.00	reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results are not satisfactory, shall be submitted to the Engineer for his review, in a report form. In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10o Celsius to 65o Celsius and for 60 temperature cycles) the material shall not be used for concreting of TGs', BFPs' and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.			
	Reinforcement Steel Reinforcement steel shall be of high strength deformed TMT steel bars of grade Fe-415/Fe-500/Fe 500D/550D and shall conform to IS 1786 and IS 13920. However, minimum elongation shall be 14.5%. Relevant clause of IS 13920 are quoted below for clarity: Quote 5.3.1 Steel reinforcement shall comply with all of the following: a) Elongation shall be at least 14.5 percent, b) Ratio of ultimate stress to 0.2 percent proof stress shall not exceed 1.25, c) Ratio of ultimate stress to 0.2 percent proof stress shall be at least 1.15, and d) Steel shall be only of strength grades with minimum 0.2 percent proof stress of 415 MPa, 500 MPa or 550 MPa, in addition to other requirements of IS 1786.' 5.3.2 The actual 0.2 percent proof stress of steel bars based on tensile test must not exceed their characteristic 0.2 percent proof stress by more than 20 percent Unquote Mild steel and medium tensile steel bars shall conform to Grade A of IS:432-Part 1 and hard drawn steel wire shall confirm to IS:432-Part II. Welded wire fabric shall conform to IS 1566.			
	Structural Steel Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.			
10.04.01	Mild Steel a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS: 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240 and minimum thickness shall be 4 mm..			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-10 CIVIL WORKS MATERIAL SPECIFICATION	PAGE 2 OF 4

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	d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.			
10.04.02	Medium and High Tensile Steel Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS: 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.			
10.05.00	Bricks Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm². Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS: 13757 and IS: 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.			
10.06.00	Foundation Bolts Material and details of foundation bolts shall conform to IS: 5624. Mild steel bars used for the fabrication of bolt assembly shall conform to grade 1 of IS: 432 and/ or grade A of IS: 2062. Hexagonal nuts and lock nuts shall conform to IS: 1363 & IS: 1364 upto M36 diameter and IS: 5624 for M42 to M150 diameter.			
10.07.00	Stainless steel The material specification for stainless steel plates are mentioned in the design concept area of Mill Bunker building.			
10.08.00	Water Water used for cement concrete, mortar, plaster, grout, curing, washing of coarse aggregate, soaking of bricks, etc. shall be clean and free from oil, acids, alkalis, organic matters or other harmful substances in such amounts that may impair the strength or durability of the structure. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. When water from the proposed source is used for making the concrete, the maximum permissible impurities, development of strength and initial setting time of concrete shall meet the requirements of IS: 456. All materials brought for incorporation in works shall be of best quality as per IS unless specified otherwise.			
10.09.00	PTFE (Poly Tetra Fluoroethylene) Bearing The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.			
10.10.00	Autoclave Aerated Concrete (AAC) Block AAC Block shall have the following physical properties: Density(Oven dry): 550-650kg/cum Compressive Strength: Minimum 30kg/sqm Thermal Conductivity: 0.162W/mk(avg)			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-10 CIVIL WORKS MATERIAL SPECIFICATION	PAGE 3 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS		
10.11.00	Resistant to fire: 2-6hrs depending upon thickness Dry Shrinkage: 0.02%(avg) Design Gross Density: 800kg/cum(approx.) Statutory Requirements Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc. Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc. Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tariff Advisory Committee. Statutory clearances and norms of State Pollution Control Board shall be followed. Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-10 CIVIL WORKS MATERIAL SPECIFICATION	PAGE 4 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
D-1-11	Inspection, Testing and Quality Control			
11.01.00	Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used. The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.			
11.02.00	Workmanship and dimensional tolerances shall be checked as stipulated else where in the specification			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-11 CIVIL WORKS INSPECTION ,TESTING AND QUALITY CONTROL	PAGE 1 OF 1

CLAUSE NO.	TECHNICAL REQUIREMENTS		
D-1-12 D-1-12(A)	ANNEXURES ANNEXURE (A) (a) List of Codes and Standards All applicable standards, references, specifications, codes of practice, etc., shall be the latest edition including all applicable official amendments and revisions. A complete set of all these documents shall be available at site with Bidder. List of some of the applicable Standards, in original Codes and references is as following: Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, EN, CICIND and other International Standards. <u>LIST OF CODES AND STANDARDS</u> Excavation and Filling IS :2720 Methods of test for soils(relevant parts) IS:4701 Code of practice for earth work on canals. IS:9759 Guide lines for dewatering during construction. IS:10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS:269 33 grade for ordinary Portland cement. IS:383 Coarse and fine aggregates from natural sources for concrete. IS:432 Specification for mild steel and medium tensile steel bars and (Part 1&2) hard drawn steel wires for concrete reinforcement. IS:455 Portland slag cement. IS:702 Industrial bitumen. IS:712 Specification for building limes. IS:1077 Common burnt clay buidling bricks. IS:1161 Steel tubes for structural purposes. IS:1239 Mild steel tubes, tubulars and other wrought steel fillting - MS tubes. IS:1363 Hexagon head bolts, screws and nuts of productions (Part 1-3) grade - C. IS:1364 Hexagon head bolts, screws and nuts of productions (Part 1-5) grade-A & B. IS:1367 Technical supply condition for threaded fasteners. (Part 1-18) IS:1489 Portland-pozzolana cement. (Part-I) Fly ash based		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 1 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:1542 IS:1566 IS:1786 IS:2062 IS:2116 IS : 2185 (Part 1) (Part 2) IS:2386 (Part I-VIII) IS:3812 IS:4082 IS:8112 IS:8500 IS:12269 IS:12894 IS:13757 Cast in-situ Concrete and Allied Works IS:280 IS:456 IS:457 IS:516 IS:1199 IS:1791 IS:1834 IS:1838 IS:2438 IS:2502 IS:2505	Sand for Plaster. Hard drawn steel wire fabric for concrete reinforcement. High strength deformed steel bars & wires for concrete reinforcement. Hot Rolled Low, Medium and High Tensile Structural Steel Sand for masonry mortars. Hollow & solid concrete blocks. Hollow & solid light weight concrete blocks. Testing of aggregates for concrete. Specification for fly ash for use as pozzolona and admixture. Recommendation on stacking and storage of construction materiel and components at site 43 grade ordinary portland cement. Structural steel-Microalloyed (Medium and high strength qualities). 53 grade ordinary portland cement. Specification for fly ash lime bricks. Burnt clay fly ash building bricks. Mild steel wire for general engineering purpose. Code of practice for plain and reinforcement concrete. Code of practice for general construction of plain and reinforced concrete for dams and other massive structures. Method of test for strength of concrete. Methods of sampling and analysis of concrete. General requirement for batch type concrete mixers. Hot applied sealing compound for joints in concrete. Preformed fillers for expansion joints in concrete pavement and structures. Specification for roller pan mixers. Code of practice for bending and fixing of bars for concrete reinforcement. Concrete vibrators - immersion type.	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 2 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:2506 IS:2722 IS:2750 IS:2751 IS:3150 IS:3366 IS:3370 (Part 1-4) IS:3558 IS:4014 (Part-1&2) IS:4326 IS:4656 IS:4925 IS:4990 IS:5256 IS:5525 IS:6461 IS:6494 IS:6509 IS:7861 (Part -1&2) IS:9012 IS:9103 IS:9417 IS:10262 IS:11384	General requirements for screed board concrete vibrators. Specification for Portable Swing weigh batchers for concrete (single and double bucket type). Steel scaffoldings Recommended practice for welding of mild steel plain and deformed bars for reinforced construction. Hexagonal wire netting for general purposes. Specification for pan vibrators. Code of practice for concrete structures for the storage of liquids. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earth quake resistant design and construction of buildings. Form vibrators for concrete. Concrete batching and mixing plant. Plywood for concrete shuttering work. Code of practice for sealing expansion joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete works. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground reservoir and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. Recommended practice for shotcreting. Admixtures for concrete. Recommendations for welding cold worked bars for reinforced concrete construction. Recommended guidelines for concrete mix design. Code of practice for composite construction in structural steel and concrete.	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 3 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:12118	Two parts polysulphide based sealants.	
	IS:12200	Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams.	
	IS:13311	Non destructive testing of concrete - methods of test.	
	(Part 1)	Ultrasonic pulse velocity.	
	(Part 2)	Rebound hammer.	
	IS:17452	Use of Alkali Activated Concrete for Precast Products-Guidelines	
	SP-16	Design codes for reinforced concrete to IS:456-1978.	
	SP-23	Hand book of concrete mixes.	
	SP-24	Explanatory handbook on Indian standards code for plain and reinforced concrete. (IS : 456)	
	SP-34	Hand book on concrete reinforcement and detailing.	
	ACI-318	American Concrete Institute code for structural concrete.	
	Precast Concrete Works		
	SP:7 (Part 6/Sec.7)	National Building Code - Structural Design Prefabrication and system building and mixed / composite construction.	
	IS:10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.	
	IS:10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete waffle units.	
	IS:15658	Pre-cast concrete block for paving.	
	Masonry & Allied Works		
	IS:1905	Code of practice for structural use of unreinforced masonry.	
	IS: 2185	Part-1 Concrete Masonry Units - Specification Part 1 Hollow and Solid Concrete Blocks Part-3 Specification for concrete masonry units: Part 2 Hollow and solid light weight concrete blocks	
	IS:2212	Code of practice for brick work.	
	IS:2250	Code of practice for preparation and use of masonry mortars.	
	IS:2572	Code of practice for construction of hollow concrete block masonry.	
	SP:20	Hand book on masonry design and construction.	
	Sheeting Works		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:277	Galvanised steel sheets (Plan & corrugated).	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION-VI, PART-B SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS PAGE 5 OF 16
	IS:513	Cold-rolled low carbon steel sheets & strips.	
	IS:730	Hook bolts for corrugated sheet roofing.	
	IS:801	Code of practice for use of cold formed light gauge steel structural members in general building construction.	
	IS:2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.	
	IS:7178	Technical supply condition for tapping screw.	
	IS:8183	Bonded mineral wool.	
	IS:8869	Washers for corrugated sheet roofing.	
	IS:12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.	
	IS:12436	Preformed rigid Polyurethane (PUR) and isocyanurate (PIR) foams for thermal insulation.	
	IS:12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).	
	IS:14246	Continuously pre-painted galvanised steel sheets and coils.	
	BS:5950	Code of practice for design of light gauge profiled	
	(Part-6)	steel sheeting	
	Fabrication and Erection of Structural Steel Works		
	IS:800	Code of practice for General Construction of steel.	
	IS:813	Scheme for symbols for welding.	
	IS:814	Covered electrodes for manual metal arc welding of carbon & carbon manganese steel.	
	IS:816	Code of practice for use of metal arc welding for general construction in mild steel.	
	IS:817	Code of practice for training and testing of metal arc welders.	
	IS:1024	Welding in bridges and substructured subject to dynamic.	
	IS:1181	Qualifying tests for Metal Arc welders (engaged in welding structures other than pipes).	
	IS:1182	Recommended practice for Radiographic examination of fusion welded butt joints in steel plates	
	IS:1608	Mechanical testing of metals - tensile testing	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:1852 IS:2016 IS:2595 IS:2629 IS:3502 IS:3613 IS:3658 IS:3664 IS:3757 IS:4000 IS:4353 IS:4759 IS:5334 IS:5369 IS : 6623 IS:6649 IS:6911 IS:7205 IS:7215 IS:7307 (Part - I) IS:7310 (Part-I) IS:9178 (Part-1to 3) IS:9595 IS:12843	Rolling and Cutting Tolerances for Hot rolled steel products. Specification for Plain washers. Code of practice for Radiographic testing Hot dip galvanising of iron and steel Steel chequered plate. Acceptance tests for wire flux combination for submerged arc welding. Code of practice for liquid penetrant flaw detection. Code of practice for ultra sonic pulse echo testing contact and immersion method High strength structural bolts. High strength bolts in steel structure - code of practice. Sub merged arc welding of mild steel and low alloy steel Recommendation Hot dip zinc coating on structural steel and other allied products. Code of practice for magnetic particle flaw detection of welds. General requirements for plain washers and lock washer High strength structural nuts. Hardened and tampered washers for high strength structural bolts & nuts. Stainless steel plate, sheet and strip. Safety code for erection of structural steel. Tolerances for fabrication of structural steel. Approved test for welding procedures Fusion welding of steel. Approval test for welders working to approval welding procedure. Fusion welding of steel Criteria for design of steel bins for storage of bulk material. Recommendations for metal arc welding of carbon & carbon manganese steel. Tolerances for erection of steel structures.	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 6 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	SP:6 ISI Hand book for structural Engineers. (Part 1 to 7) Plastering and Allied Works IS:1661 Code of practice for application of cement and cement lime plaster finishes. IS:2402 Code of practice for external rendered finishes. IS:2547 Gypsum building plaster. (Parts 1&2) Acid and Alkali Resistant Lining IS:158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. IS:412 Expanded metal steel sheets for general purpose. IS:4441 Code of practice for use of silica type chemical resistant mortars. IS:4443 Code of practice for use of resin type chemical resistant mortars. IS:4456 Method of Test for chemical resistant tiles. (Part I & II) IS:4457 Ceramic unglazed vitreous acid resisting tiles. IS:4832 Specification for chemical resistant mortars. (Part - 1) Silicate type (Part - 2) Resin type (Part - 3) Sulfur type IS:4860 Acid resistant bricks. IS:9510 Bitumastic acid resisting grade. Water Supply, Drainage and Sanitation IS:458 Precast concrete pipes (with & without reinforcement). IS:554 Pipe threads where pressure tight joints are made on the threads – dimensions, tolerances and designation. IS:651 Salt glazed stoneware pipes and fittings. IS:774 Flushing cisterns for water closets and urinals. IS:775 Cast iron brackets and supports for wash basins and sinks. IS:778 Copper alloy gate, globe and check valves for water works purposes.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 7 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	IS:781 Cast copper alloy screw down bib taps & stop valves for water services. IS:782 Caulking lead. IS:783 Code of practice for laying of concrete pipes. IS:1172 Code of basic requirements of water supply, drainage and sanitation. IS:1230 Cast iron rain water pipes and fittings. IS:1239 Mild Steel tubes, tubulars and other wrought steel fittings (Part 1&2) IS:1536 Centrifugally cast (Spun) iron pressure pipes for water. IS:1537 Vertically cast iron pressure pipes for water, gas and sewage. IS:1538 Cast iron fittings for pressure pipe for water, gas and sewage. IS:1703 Copper alloy float valve for water supply fitting. IS:1726 Cast iron manhole covers and frames. IS:1729 Cast iron / Ductile iron drainage pipes and pipe/fittings for over ground non pressure pipeline socket and spigot series. IS:1742 Code of practice for building drainage. IS:2064 Selection, installation and maintenance of sanitary appliances. IS:2065 Code of practice for water supply in buildings. IS:2326 Automatic flushing cisterns for urinals. IS:2548 Plastic seats and covers for water closets. IS:2556 Vitreous sanitary appliances (vitreous china). IS:3114 Code of practice for laying of cast iron pipes. IS:3311 Waste plug and its accessories for sinks and wash basins. IS:3438 Silvered glass mirrors for general purposes. IS:3486 Cast iron spigot and socket drain pipes. IS:3589 steel pipe for water and sewage (168.3 to 2540mm outside diameter) IS:3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS:4111 Code of practice for ancillary structure in sewerage system. (Part 1 to 5) IS:4127 Code of practice for laying of glazed stone ware pipes.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 8 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS : 4733	Methods of sampling and testing sewage effluents.	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION-VI, PART-B SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS PAGE 9 OF 16
	IS:4764	Tolerance limits for sewage effluents discharged into inland surface waters.	
	IS:1068	Electroplated coating of nickel plus chromium and copper plus nickel plus chromium.	
	IS:5329	Code of practice for sanitary pipe work above ground for buildings.	
	IS:5382	Rubber sealing rings for gas mains, water mains and sewers.	
	IS:5822	Code of practice for laying of electrically welded steel pipes for water supply.	
	IS:5961	Specification for cast iron grating for drainage purpose.	
	IS:7740	Code of practice for construction and maintenance of road gullies.	
	IS:8931	Copper alloy fancy single taps combination tap assembly and stop valves for water services.	
	IS:9762	Polyethylene floats for float valves.	
	IS:10592	Industrial emergency showers, eye and face fountains and combination units.	
	IS:12592	Specification for precast concrete manhole covers and frames.	
	IS:12701	Rotational moulded polyethylene water storage tanks.	
	IS:13983	Stainless steel sinks for domestic purposes.	
	SP:35	Hand book on water supply and drainage with special emphasis on plumbing.	
	CPH&EEO	Manual on sewage and sewage treatment	
	Publication	- as updated.	
	Doors Windows and Allied Works		
	IS:204	Tower Bolts.	
	(Part 1)	Ferrous metals	
	(Part 2)	Non - ferrous metals	
	IS:208	Door Handles.	
	IS:281	Mild steel sliding door bolts for use with padlocks.	
	IS:362	Parliament Hinges.	
	IS:419	Putty, for use on window frames.	
	IS:451	Technical supply conditions for wood screws	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:733 IS:1003 (Part I) IS:1003 (Part-1) IS:1038 IS:1081 IS:1285 IS:1341 IS:1361 IS:1823 IS:1868 IS:2202 (Part-2) IS:2209 IS:2553 (Part-1) IS:2835 IS:3548 IS:3564 IS:3614 (Part-1) (Part-2) IS:4351 IS:5187 IS:5437 IS:6248	Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes. Timber panelled and glazed shutters (doors shutters). Timber panelled and glazed shutters door shutters. Steel doors, windows and ventilators. Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes). Steel butt hinges. Steel windows for Industrial buildings. Floor door stoppers. Anodic coatings on Aluminium and its alloys. Wooden flush door shutters (solid core type) particle board face panels and hard board face panels. Mortice locks (vertical type) Safety glass. General purposes Flat transparent sheet glass. Code of practice for glazing in buildings. Door closers (Hydraulically regulated) Specification for fire check doors : plate, metal covered and rolling type. Resistance test and performance criteria. Specification for steel door frames. Flush bolts. Figured, rolled and wired glass. Specification for metal rolling shutters and rolling grills.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	IS:6315	Specification for floor springs (Hydraulically regulated) for heavy doors.		
	IS:7196	Hold fast.		
	IS:7452	Hot rolled steel sections for doors, windows and ventilators.		
	IS:10019	Mild steel stays and fasteners.		
	IS:10451	Steel sliding shutters (top hung type)		
	IS:12823	Prelaminated particle boards.		
	Roof Water Proofing and Allied Works			
	IS:3067	code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.		
	ASTM	Standard specification for high solid content cold		
	C836-89a	liquid applied elastomeric water proofing membrane for use with separate wearing course.		
	ASTM	Standard guide for high solid content cold		
	C898-89	liquid applied elastomeric water proofing membrane for use with separate wearing course.		
	Floor Finishes and Allied Works			
	IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.		
	IS:8042	White portland cement.		
	IS:13755	Dust pressed ceramic tiles with water absorption of 3%, E 6% (Group B11a).		
	IS:13801	Chequered cement concrete tiles.		
	Painting and Allied Works			
	IS:162	Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required.		
	IS:428	Distemper, oil, emulsion, colour as required.		
	IS:1477	Code of practice for painting of terrous metals in buildings.		
	(Part -1)	Pretreatment.		
	(Part -2)	Painting.		
	IS:1650	Specification for colours for building and decorative materials.		
	IS:2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming.		
	IS:2338	Code of practice for finishing of wood and wood based materials.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(Part -1) Operations and Workmanship. (Part -2) Schedule. IS:2395 Code of pratice for painting concrete, masonry and plaster surfaces. (Part-1) Operations and Workmanship. (Part -2) Schedule. IS:2524 Code of practice for painting of nonferrous metals in buildings. (Part -1) Pretreatment (Part -2) Painting. IS:2932 Enamel, synthetic, exterior, (a) under coating and (b) finishing. IS:2933 Enamel exterior, (a) under coating, (b) finishing. IS:4759 Hot dip zinc coatings on structural steel and other allied products. IS:5410 Specification for cement paint. IS:15489 Plastic emulsion paint. IS:6278 Code of practice for white washing and Colour washing. IS:10403 Glossary of term related to building finish. IS:12027 Silicone based water repellent IS:13238 Epoxy based zinc phosphate primer (2 pack) IS:13239 Epoxy surfacer (2 pack) IS:13467 Chlorinated rubber for paints IS:14209 Epoxy enamel, two component glossy. BS:5493 Code of practice for protective coating of iron and steel structures against corrosion. Piling and Foundation IS:1080 Code of practice for design and construction of shallow foundations on soils. IS:1904 Code of practice for design and construction of foundation in Soils : General Requirements. IS:2314 Steel sheet piling sections. IS:2911 Code of practice for design and construction of pile foundations. (Relevant Parts)		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 12 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:2950 Code of practice for designs and construction of Raft foundation. (Part-1) Design IS:2974 Code of practice for design and construction of machine foundation. (Part-1 to 5) IS:4091 Code of practice for design and construction foundations for transmission line towers and poles. IS:6403 Code of practice for determination of Bearing capacity of Shallow foundations. IS:8009 Code of practice for calculation of settlement of foundation. (Part -1) Shallow foundations. (Part -2) Deep foundations. IS:12070 Code of practice for design and construction of shallow foundations on rocks. ISO 10816 Criteria for assessing mechanical vibrations of machines. ISO 1940 Criteria for assessing the st of balance of rotating rigid bodies. DIN : EN 13906-1 Helical compression spring made of round wire and rod : calculation and design of compression . DIN:2096 Helical compression spring out of round wire and rod : Quality requirements for hot formed compression spring. DIN:4024 Flexible supporting structures for machine with rotating machines. Roads IRC:5 Standard specifications and Code of practice for road bridges, (Section-1) General Features of Design. IRC:14 Recommended practice for 2cm thick bitumen and tar carpets. IRC:15 Standard specifications and code of practice for construction of concrete roads. IRC:16 Specification for priming of base course with bituminous primers. IRC:19 Standard specifications and Code of practice for water bound macadam. IRC:21 Standard specifications and Code of practice for road bridges. (Section-III) Cement concrete (plain and reinforced). IRC:34 Recommendations for road construction in water logged areas. IRC:36 Recommended practice for the construction of earth embankments for road works.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	IRC:37 Guidelines for the Design of flexible pavements. IRC:56 Recommended practice for treatment of embankment slopes for erosion control. IRC:58 Guidelines for the design of rigid pavements for highways. IRC:73 Geometric Design standards for rural (non-urban) highways. IRC : 86 Geometric Design standards for urban roads in plains. IRC:SP:13 Guidelines for the design of small bridges & culverts. IRC - Publication Ministry of Surface Transport (Road wing), specifications for road and bridge works. IS:73 Paving bitumen. Loading IS:875 Code of practice for design loads (other than earthquake) for (Relevant parts) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of practice for design and construction of foundation for transmission line towers and poles. IRC:6 (Section-II) Standard specifications & Code of practice for road bridges. loads and stresses Safety IS:1641 Code of practice for fire safety of buildings - General principles of fire grading and classification. IS:1642 Code of practice for fire safety of buildings - Details of construction. IS:3696 (Part-1&2) Safety code for scaffolds and ladders. IS:3764 Excavation work - code of safety. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Demolition of buildings - code of safety. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection of structural steel work. IS:7293 Safety code for working with construction machinery.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 14 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:7969 Safety code for handling and storage of building materials. Indian Explosives (As updated) Act 1940) Architectural Design of Buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings) ECBC Energy Conservation Building Code GRIHA Green Rating For Integrated Habitat Assessment. Tall Structures, Chimneys IS:4998 Criteria for design of reinforced chimneys IS:6533 Code of practice for design and construction of steel chimneys ICAO International Civil Aviation Organisation (ICAO) DGCA Instruction of Director General of Civil Aviation , India ACI:307 Specification for the design and construction of reinforced concrete chimneys BS:4076 Specification for steel chimneys CICIND Model Code for concrete chimneys Model code for steel chimneys ASCE Code Design and construction of steel chimney liners prepared by Task committee on steel chimney liners. Fossil power committee, Power division published by ASCE - 1975. IS:1554 PVC insulated (heavy duty) electric cables IS:2606 Alloy lead anodes for chromium plating IS:3043 Code of Practice for Earthing IS:9537 Conduits for electrical installations. The Indian Electricity Rules The Indian Electricity Act The Indian Electricity (Supply) Act The Indian Factories Act IS:2309 Practice for protection of buildings and allied structures against lightning Miscellaneous IS:802 Code of practice for use of structural steel in overhead trans-		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 15 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(Relevant parts) IS:803 IS:10430 IS:11592 IS:12867 IS 11504 BS:4485 (IV) CIRIA Publication IS 4671	mission line towers. Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. Criteria for design of lined canals and guidance for selection of type of lining. Code of practice for selection and design of belt conveyors. PVC handrails covers. Criteria for structural design of reinforced concrete natural draught cooling towers British Standard : Code of design for water cooling towers Design and construction of buried thin-wall pipes. Expanded polystyrene for thermal insulation purposes.	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12(A) CIVIL WORKS Annex(A)-LIST OF CODES AND STANDARDS	PAGE 16 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS		
D-1-12(B)	ANNEXURE (B) CONSTRUCTION METHODOLOGY Construction and erection activities shall be fully mechanized from the start of the work. All excavation and backfilling work shall be done using excavators, loaders, dumpers, dozers, poclains, excavator mounted rock breakers, rollers, sprinklers, water tankers, etc. Manual excavation can be done only on isolated places with specific approval of engineer. For controlled rock blasting specialized agency, equipped with sensors to assess the impact of the blast on the adjoining existing structures, shall be employed. Dewatering shall be done using the combination of electrical and standby diesel pumps. Pile installation equipment suitable for flushing with air lift technique shall be used for construction of bored piles. For concreting, weigh batching plants, transit mixers, concrete pumps, hoists, etc. shall be used. All fabrication and erection activities of structural steel shall be carried out using automatic submerged arc welding machines, cutting machines, gantry cranes, crawler mounted heavy cranes and other equipment like heavy plate bending machines, shearing machines, lathe, milling machines, etc. Use of derricks shall not be permitted. Special enclosures, for blast cleaning of steel structure surface preparation, shall be used. All handling of materials shall be with cranes. Heavy trailers shall be used for transportation. Mechanized modular units of scaffolding and shuttering shall be used. Grouting shall be carried out using hydraulically controlled grouting equipment. Roadwork shall be done using pavers, rollers and premix plant. All finishing items shall be installed using appropriate modern mechanical tools. Manual punching etc. shall not be permitted. Heavy duty hoists for lifting of construction materials shall be deployed. Compressors for cleaning of foundations and other surfaces shall be used. Field laboratory shall be provided with all modern equipment for survey, testing of soil, aggregates, concrete, welding, etc. For testing of steel works, ultrasonic testing machines, radiographic testing machines, dye penetration test equipment, destruction testing equipment, etc. shall be deployed. All persons working at site shall be provided with necessary safety equipment and all safety aspects shall be duly considered for each construction/ erection activity. Moreover, only the persons who are trained in the respective trade shall be employed for executing that particular work.		
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-D-1-12(B) CIVIL WORKS ANNEX_B CONSTRUCTION METHODOLOGY PAGE 1 OF 1

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
D-1-12(C)	Annexure(C) GEOTECHNICAL DATA		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-12 (C) CIVIL WORKS FOUNDATION SYSTEM	PAGE 1

EPC Package for Lara Super Thermal Power Project, Stage II (2 X 800 MW)
Amendment No. 1 to Technical specification Section VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Existing	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
D-1-01	VI / B	D-1-7	7.00.00	1 TO 12	Sub-Section D-1-7	Refer revised Sub-section D-1-7 at Annexure A
D-1-02	VI / B	D-1-12 ANNEXURE (C)	----	----	Sub-Section D-1-12 Annexure (C)	Refer revised Sub-Section D-1-12 Annexure(C) at Annexure-B.

Doc No.: CS-9587-001R-2-TECH-AMDT. 01	EPC Package for Lara Super Thermal Power Project, STAGE II (2 X 800MW)	Amendment No. 01 to Technical Specifications Section-VI

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.00.00	FOUNDATION SYSTEM AND GEOTECHNICAL DATA			
7.01.00	Soil Data Owner has carried out detailed geotechnical investigation at the project site. Bore logs data and Bearing capacity for design of foundations are given at Annexure - C of this specification. The detailed geotechnical investigation report comprising of Boreholes, Laboratory tests, Chemical analysis, etc for the sub-strata prevailing at site would be made available for the Bidder's study at the Owner's office, if required. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data lies with the Bidder. In case, bidder feels that the available data is inadequate, he may carry out his own geotechnical investigation. Further, if any change in layout or for any area not covered in the provided geotechnical data, the bidder has to carry out geotechnical investigation in the area at no cost to Owner. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.01. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. Net allowable bearing pressure shall be limited to Table-1 and Table-1a of Annexure-C. The report shall be submitted for Owner's approval prior to commencement of design of foundation. Bidder may refer enclosed topographical survey drawing and general layout plan along with borelogs for variation in existing/ natural ground level (NGL) and finished ground level (FGL). Wherever ash/coal deposit/brick-bats etc. is found the same shall be treated as filled up soil.			
7.01.01	The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable.			
7.01.02	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional			
LARA STPP STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:	SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM	PAGE 1 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level. e) Wherever the intended bearing stratum is weathered rock, but the actual strata encountered during excavation consists of both overburden soil and weathered rock at founding level, under such cases, the overburden upto the weathered rock level including 0.5 m into the weathered rock shall be removed and built up through PCC (1:3:6) upto the designed founding level. Thus, maintaining the same founding level for all the footings of a structure. f) The last layer of about 300 mm before reaching the founding level shall be excavated carefully by such equipment so that soil / rock at the required level will be left in its natural condition.		
7.03.00	Special Requirements		
7.03.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment, cement type, grade of concrete, type of reinforcement, cover to reinforcement and protective coating to foundations, etc. shall be as mentioned in Annexure-C of this specification		
7.04.00	Excavation, Filling and Dewatering		
7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.		
7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.		
7.04.03	<u>Backfilling In Power House & Boller Area</u> Backfilling around foundations, trenches, sumps, pits, plinths, etc. shall be carried out with sand in layers not exceeding 300 mm compacted thickness and each layer shall be compacted to minimum 80% of relative density. <u>Backfilling In other area</u> Backfilling around foundations, pipes, trenches, sumps, plts, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non cohesive soils. Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.		
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.		
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.		
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more		
LARA STPP STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:	SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM
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Annexure-A to Amendment-1

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
7.05.00	EXCAVATION IN ROCK Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.			
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).			
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.01	Geotechnical Investigation work may be got executed by the Contractor through the following suggested agencies 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad 5. Secon Private Limited, Bangalore 6. Soil Engineering Consultants, New Delhi 7. CEG Test House and Research Centre Private Limited, Jaipur 8. Geomarine Consultants Pvt Ltd., Chennai 9. Soiltech India Private Limited, Pune			
LARA STPP STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:	SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM	PAGE 4 OF 7

Annexure-A to Amendment-1

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																																																																						
	Annexure-C SOIL DATA AND FOUNDATION SYSTEM Employer has carried out geotechnical investigation in the proposed area. Logs of boreholes of proposed area are enclosed with this Annexure. a) The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 1 below (except CWPB, FOPB, Switchyard, crusher house and stacker reclaimer area). Table-1 <table><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing Pressure T/m2</th></tr><tr><th>Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata</th><th>Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata</th><th>Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata</th></tr><tr><th colspan="2">Width upto 6.0m</th><th></th></tr><tr><td colspan="4">In case of foundation stratum is soil</td></tr><tr><td>1.0m below NGL</td><td>8</td><td>10</td><td>12</td></tr><tr><td>2.0m below NGL</td><td>12</td><td>18</td><td>22</td></tr><tr><td>3.0m below NGL</td><td>15</td><td>22</td><td>25</td></tr><tr><td>4.0m below NGL</td><td>20</td><td>25</td><td>28</td></tr><tr><td>5.0m below NGL</td><td>25</td><td>28</td><td>30</td></tr><tr><td>6.0m below NGL</td><td>30</td><td>35</td><td>35</td></tr><tr><td>7.0m below NGL</td><td>35</td><td>40</td><td>40</td></tr><tr><td>8.0m or more than 8.0m below NGL</td><td>45</td><td>45</td><td>45</td></tr><tr><td colspan="4">In case of founding stratum is rock</td></tr><tr><td>0.6m embedment into weathered rock</td><td>35</td><td>35</td><td>35</td></tr><tr><td>1.0m embedment into weathered rock</td><td>40</td><td>40</td><td>40</td></tr><tr><td>2.0m embedment into weathered rock</td><td>50</td><td>50</td><td>50</td></tr><tr><td>3.0m embedment into weathered rock</td><td>52</td><td>52</td><td>52</td></tr><tr><td>3.5m or more than 3.5m embedment into weathered rock</td><td>55</td><td>55</td><td>55</td></tr></table> The minimum founding level and the corresponding net allowable bearing pressure for CWPB, FOPB, crusher house, Switchyard and stacker reclaimer area shall be as given in Table – 1a below. Table-1a	Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2			Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata	Width upto 6.0m			In case of foundation stratum is soil				1.0m below NGL	8	10	12	2.0m below NGL	12	18	22	3.0m below NGL	15	22	25	4.0m below NGL	20	25	28	5.0m below NGL	25	28	30	6.0m below NGL	30	35	35	7.0m below NGL	35	40	40	8.0m or more than 8.0m below NGL	45	45	45	In case of founding stratum is rock				0.6m embedment into weathered rock	35	35	35	1.0m embedment into weathered rock	40	40	40	2.0m embedment into weathered rock	50	50	50	3.0m embedment into weathered rock	52	52	52	3.5m or more than 3.5m embedment into weathered rock	55	55	55	
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LARA STPP STAGE-II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:	SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM	PAGE 5 OF 7																																																																					

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																																																										
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For Finished ground level (FGL) refer General layout plan (GLP) To determine the Natural Ground Level (NGL) the following two tender drawings titled "TOPGRAPHICAL SURVEY OLD SURVEY DATA FOR NGL PURPOSE" and "TOPGRAPHICAL SURVEY (EXISTING GROUND LEVEL)" shall be referred. Further the above two tender drawings shall also be referred in conjunction with borelog data attached at Annexure to this chapter. The NGL for any particular structure/facility shall be the lowest of all the NGLs mentioned in the extent of the building/facility. The NGL of any point shall be the lowest of the levels at (a) TOPGRAPHICAL SURVEY OLD SURVEY DATA FOR NGL PURPOSE (b) TOPGRAPHICAL SURVEY (EXISTING GROUND LEVEL) and (c) Borelog data attached at Annexure to this chapter. In case any loose/soft pockets is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8). The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.																																																																															
LARA STPP STAGE-II (2X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:		SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM	PAGE 6 OF 7																																																																											

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:			
	Isolated & Raft (Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil			25 mm
	Isolated & Strip (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil			40 mm
	Raft (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil			75 mm
	Foundations in Weathered rock / rock			12 mm
	In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.			
	c)	Special Requirements:		
	i) Chemicals in ground water and subsoil, as observed during investigation are:			
	Chemical	Sulphates	Chlorides	pH
Ground Water	60-120 mg/L	57-88 mg/L	7.64-7.95	
Sub-soil	<0.05%	0.007-.010	5.04-8.32	
ii) In view of the above, the following shall be adopted.				
Cement Type		As specified elsewhere in the specifications		
Concrete Grade		As specified elsewhere in the specifications		
Type of Reinforcement		As specified elsewhere in the specifications		
Cover to Reinforcement		As specified elsewhere in the specifications		
LARA STPP STAGE-II (2X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO:		SUB-SECTION CIVIL WORKS FOUNDATION SYSTEM
				PAGE 7 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC								
D-1-12(D)	Annexure- (D) CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – I for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures/ RCC structures</td><td>: 2.0%</td></tr><tr><td>c) Prestressed concrete structures</td><td>: 1.6%</td></tr><tr><td>d) Steel stacks</td><td>: As per IS: 6533 & CICIND Model Code whichever is more critical.</td></tr></table>				a) Welded steel structures	: 1.0%	b) Bolted steel structures/ RCC structures	: 2.0%	c) Prestressed concrete structures	: 1.6%	d) Steel stacks	: As per IS: 6533 & CICIND Model Code whichever is more critical.
a) Welded steel structures	: 1.0%											
b) Bolted steel structures/ RCC structures	: 2.0%											
c) Prestressed concrete structures	: 1.6%											
d) Steel stacks	: As per IS: 6533 & CICIND Model Code whichever is more critical.											
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(D) CIVIL WORKS WIND DESIGN CRITERIA	PAGE 1 OF 2									

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<u>ANNEXURE-I</u> <u>SITE SPECIFIC DESIGN PARAMETERS</u> The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed "V_b" at ten metres above the mean ground level : 44 metres/second b) The risk coefficient "K_1" : 1.07 c) Category of terrain : Category-2	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(D) CIVIL WORKS WIND DESIGN CRITERIA
		PAGE 2 OF 2

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
D-1-12(E)	Annexure-(E)			
	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT			
	All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.			
	A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.			
	Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.			
D-1-12(E)	The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).			
	Damping in Structures			
	The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:			
	a)	Steel structures	:	2%
	b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%	
d)	Steel stacks	:	2%	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(E) CIVIL WORKS SEISMIC DESIGN CRITERIA	PAGE 1 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1). The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(E) CIVIL WORKS SEISMIC DESIGN CRITERIA	PAGE 2 OF 8	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	APPENDIX – I SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration (MCE) : 0.16g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra a) For special moment resisting steel frames designed and detailed as per IS:800 : 0.04 b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.03 c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024 d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.08 e) For Liquid retaining tanks : 0.048 f) for Steel chimney, Absorber tower, Vessels : 0.06 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) : 0.04 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(E) CIVIL WORKS SEISMIC DESIGN CRITERIA	PAGE 3 OF 8	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																																																																																				
	Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages. APPENDIX – I <u>HORIZONTAL SEISMIC ACCELERATION</u> <u>SPECTRA COEFFICIENTS</u> <u>(In units of ‘g’)</u> <table><tr><th>Time Period</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>(Sec)</th><th>2%</th><th>3%</th><th>5%</th></tr><tr><td>0.000</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.030</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.031</td><td>1.032</td><td>1.025</td><td>1.021</td></tr><tr><td>0.050</td><td>1.646</td><td>1.480</td><td>1.379</td></tr><tr><td>0.060</td><td>1.966</td><td>1.702</td><td>1.546</td></tr><tr><td>0.070</td><td>2.284</td><td>1.915</td><td>1.704</td></tr><tr><td>0.080</td><td>2.602</td><td>2.122</td><td>1.853</td></tr><tr><td>0.086</td><td>2.792</td><td>2.243</td><td>1.940</td></tr><tr><td>0.088</td><td>2.855</td><td>2.283</td><td>1.968</td></tr><tr><td>0.090</td><td>2.919</td><td>2.322</td><td>1.996</td></tr><tr><td>0.095</td><td>3.077</td><td>2.421</td><td>2.065</td></tr><tr><td>0.098</td><td>3.171</td><td>2.479</td><td>2.106</td></tr><tr><td>0.100</td><td>3.234</td><td>2.518</td><td>2.133</td></tr><tr><td>0.103</td><td>3.329</td><td>2.576</td><td>2.173</td></tr><tr><td>0.108</td><td>3.487</td><td>2.671</td><td>2.238</td></tr><tr><td>0.110</td><td>3.549</td><td>2.709</td><td>2.264</td></tr><tr><td>0.112</td><td>3.612</td><td>2.747</td><td>2.290</td></tr><tr><td>0.115</td><td>3.707</td><td>2.803</td><td>2.328</td></tr><tr><td>0.118</td><td>3.801</td><td>2.859</td><td>2.366</td></tr><tr><td>0.121</td><td>3.895</td><td>2.914</td><td>2.404</td></tr><tr><td>0.122</td><td>3.927</td><td>2.933</td><td>2.417</td></tr><tr><td>0.125</td><td>4.021</td><td>2.988</td><td>2.454</td></tr><tr><td>0.127</td><td>4.083</td><td>3.025</td><td>2.478</td></tr><tr><td>0.129</td><td>4.146</td><td>3.061</td><td>2.503</td></tr><tr><td>0.130</td><td>4.177</td><td>3.079</td><td>2.515</td></tr><tr><td>0.131</td><td>4.210</td><td>3.097</td><td>2.527</td></tr><tr><td>0.134</td><td>4.210</td><td>3.152</td><td>2.564</td></tr></table>				Time Period	Damping Factor (as a percentage of critical damping)			(Sec)	2%	3%	5%	0.000	1.000	1.000	1.000	0.030	1.000	1.000	1.000	0.031	1.032	1.025	1.021	0.050	1.646	1.480	1.379	0.060	1.966	1.702	1.546	0.070	2.284	1.915	1.704	0.080	2.602	2.122	1.853	0.086	2.792	2.243	1.940	0.088	2.855	2.283	1.968	0.090	2.919	2.322	1.996	0.095	3.077	2.421	2.065	0.098	3.171	2.479	2.106	0.100	3.234	2.518	2.133	0.103	3.329	2.576	2.173	0.108	3.487	2.671	2.238	0.110	3.549	2.709	2.264	0.112	3.612	2.747	2.290	0.115	3.707	2.803	2.328	0.118	3.801	2.859	2.366	0.121	3.895	2.914	2.404	0.122	3.927	2.933	2.417	0.125	4.021	2.988	2.454	0.127	4.083	3.025	2.478	0.129	4.146	3.061	2.503	0.130	4.177	3.079	2.515	0.131	4.210	3.097	2.527	0.134	4.210	3.152	2.564
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(E) CIVIL WORKS SEISMIC DESIGN CRITERIA	PAGE 4 OF 8																																																																																																																					

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION
SPECTRA COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.755	2.677	2.159	1.821
0.800	2.526	2.038	1.719
0.850	2.378	1.918	1.618
0.900	2.246	1.811	1.528
0.950	2.127	1.716	1.447
1.000	2.021	1.630	1.375
1.050	1.925	1.552	1.310
1.100	1.837	1.482	1.250
1.150	1.757	1.417	1.196
1.200	1.684	1.358	1.146
1.250	1.617	1.304	1.100
1.300	1.555	1.254	1.058
1.350	1.497	1.207	1.019
1.400	1.444	1.164	0.982
1.450	1.394	1.124	0.948
1.500	1.347	1.087	0.917
1.550	1.304	1.052	0.887
1.600	1.263	1.019	0.859
1.650	1.225	0.988	0.833
1.700	1.189	0.959	0.809
1.750	1.155	0.931	0.786
1.800	1.123	0.906	0.764
1.850	1.092	0.881	0.743
1.900	1.064	0.858	0.724
1.950	1.036	0.836	0.705
2.000	1.011	0.815	0.688
2.050	0.986	0.795	0.671
2.100	0.962	0.776	0.655
2.150	0.940	0.758	0.640
2.200	0.919	0.741	0.625
2.250	0.898	0.724	0.611
2.300	0.879	0.709	0.598

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION
SPECTRA COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
2.350	0.860	0.694	0.585
2.400	0.842	0.679	0.573
2.450	0.825	0.665	0.561
2.500	0.808	0.652	0.550
2.550	0.793	0.639	0.539
2.600	0.777	0.627	0.529
2.650	0.763	0.615	0.519
2.700	0.749	0.604	0.509
2.750	0.735	0.593	0.500
2.800	0.722	0.582	0.491
2.850	0.709	0.572	0.482
2.900	0.697	0.562	0.474
2.950	0.685	0.553	0.466
3.000	0.674	0.543	0.458
3.050	0.663	0.534	0.451
3.100	0.652	0.526	0.444
3.150	0.642	0.517	0.437
3.200	0.632	0.509	0.430
3.250	0.622	0.502	0.423
3.300	0.612	0.494	0.417
3.350	0.603	0.487	0.410
3.400	0.594	0.479	0.404
3.450	0.586	0.472	0.399
3.500	0.577	0.466	0.393
3.550	0.569	0.459	0.387
3.600	0.561	0.453	0.382
3.650	0.554	0.447	0.377
3.700	0.546	0.441	0.372
3.760	0.538	0.434	0.366
3.800	0.532	0.429	0.362
3.850	0.518	0.423	0.357
3.900	0.505	0.418	0.353

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
D-1-12(F)	Annexure-(F) QA REQUIREMENT All Civil, Structural and Architectural construction work at the project shall be executed strictly in accordance with the Quality Assurance guidelines specified in separate part of the Specification.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION-D-1-12(F) CIVIL WORKS QA REQUIREMENT	PAGE 1 OF 1

CLAUSE NO.	TECHNICAL REQUIREMENT				एनटीपीसी NTPC
D-1-12(G)	Specification For High Performance Moisture Compatible Corrosion Resistant Coating System				
	a) Providing & applying High Performance Moisture Compatible Corrosion Resistant Coating System manufactured as per technical specifications of Central Electrochemical Research Institute, Karaikudi, (C.S.I.R. affiliate Institute), Tamil Nadu, Pin - 630 006.				
	b) The coating system shall be water compatible, compatible for applying in wet conditions also and shall be tolerant to under-prepared surfaces and existing residual tar / paint. The system shall also be quick curing so as to be suitable for application during shut downs.				
	The coating material shall be stored in the manner as per recommendations of the manufacturer until ready for use. The coating material shall be used within the manufacturer’s written recommended shelf life.				
	c) The coating system shall conform to the following :				
	PROPERTIES OF PAINT				
	Base		High Performance Moisture Compatible Corrosion Resistant Coating System CECRI know-how system		
	Volume Solids		70%		
	Specific Gravity (ASTM-D-1475)		1.25 ± 0.1		
	Dry Film Thickness (ASTM-D-1186)		160 ± 10 µm per coat		
Coverage		4 - 4.5 sq.m/ ltr			
Touch Dry		2 Hours			
Recoating		24 Hours			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART B	SUB SECTION D-1-12(G) High Performance Moisture Compatible Corrosion Resistant Coating System	Page 1 of 2

CLAUSE NO.	TECHNICAL REQUIREMENT			एनटीपीसी NTPC
	PROPERTIES OF COATING			
	Salt Spray (ASTM-B 117)	2000 Hours		
	Resistance to sea water (Carried out upto 6 months)	Passes		
	Coating Resistance (Carried out upto 6 months)	10 ⁹ Ω. cm ²		
	Adhesion (ASTM-D 4541)	4.5 N/mm Sq		
	Flexibility (ASTM-D-522)	1/8" passes		
	Elongation	33%		
	Impact (ASTM G 14–04)	45 cm passes		
	d)	Paint material & its application method shall be obtained from any manufacturer who has been granted License by CECRI, Karaikudi for technical know how for High Performance Moisture Compatible Corrosion Resistant Coating System . The application method of coating shall be got duly approved from CECRI, Karaikudi.		

NTPC Limited

(A Government of India Enterprise)



LARA SUPER THERMAL POWER PROJECT STAGE-II (2x800 MW)

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – B

(BOOK 1 OF 5 – MECHANICAL)

SECTION - VI

BIDDING DOCUMENT NO.: CS-9587-001R-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

PART – B

MECHANICAL

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC. NO. CS-9587-001R-2**

PART –B	
SUB-SECTION	TITLE
PART-B COMMON CHAPTERS (BOOK 1 OF 5)	
G-01	OPERATING CAPABILITY OF THE PLANT
G-02	UNIT OPERATING PHILOSOPHY
G-03	LAYOUT REQUIREMENTS
G-04	STANDARD PG TEST PROCEDURE
G-05	STANDARD TYPE TEST PROCEDURE
G-06	PRE-COMMISSIONING & COMMISSIONING
G-07	MDL AND DATA REQUIREMENT
PART - B (MECHANICAL) (BOOK 1 OF 5)	
A -01	EQUIPMENT SIZING CRITERIA
A -02	STEAM GENERATOR AND AUXILIARIES INCLUDING ESP
A -03	SELECTIVE CATALYTIC REDUCTION SYSTEM (REFER TO ANNEXURE-SS1)
A -04	HYBRID (SCR+SNCR) SYSTEM (REFER TO ANNEXURE-SS2)
A -05	FLUE GAS DESULPHURISATION SYSTEM
A -06	NOT USED
A -07	STEAM TURBINE & AUXILIARIES SYSTEM
A -08	POWER CYCLE PIPING
A -09	LOW PRESSURE PIPING
A -10	NOT USED
A -11	CONDENSATE POLISHING UNIT
A -12	SURFACE PREPARATION & PAINTING
A -13	THERMAL INSULATION
A -14	WATER TREATMENT PLANT
A -15	CW SYSTEM
A -16	COMPRESSED AIR SYSTEM
A -17	AIR CONDITIONING AND VENTILATION SYSTEM
A -18	FIRE PROTECTION AND DETECTION SYSTEM
A -19	FUEL OIL UNLOADING SYSTEM (Not Used)
A -20	COAL & BIOMASS AND GYPSUM HANDLING PLANT
A -21	ASH HANDLING PLANT
A -22	MILL REJECT HANDLING SYSTEM
A -23	LP DOSING AND OXYGENATED TREATMENT SYSTEM
A -24	ELEVATORS, CRANES AND HOISTS
A-25	SOLAR P.V.
	ANNEXURE-SS1 : SELECTIVE CATALYTIC REDUCTION SYSTEM
	ANNEXURE-SS2 : HYBRID (SCR+SNCR) SYSTEM

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC. NO. CS-9587-001R-2**

SUB-SECTION – G-01

OPERATING CAPABILITY OF THE PLANT

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	OPERATING CAPABILITY OF PLANT			
1.00.00	OPERATING CAPABILITY OF PLANT			
1.01.00	The plant, it's unit (s) and its all auxiliaries equipment/systems shall be designed to operate with all the specified margins for continuous operation without any limitations under any of the conditions indicated in the Technical Specification. The major operating capabilities for the unit(s)/plant shall be as follows: (a) Operate continuously with turbine under VWO condition with rated steam parameters, design condenser pressure and 3% cycle make up. (b) Sliding Pressure Operation from rated pressure down to 40% of rated pressure with as well as without any throttle reserve. For modified sliding pressure condition, at any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% of the corresponding load, by opening turbine control valves wide open. However, the output after instantaneous increase shall be limited to 105% of TMCR Load. The throttle reserve shall be 0% for pure sliding pressure mode of operation. (c) Operate continuously with HP heaters out of service with maximum specified cooling water temperature, 3% cycle make up and normal auxiliary steam requirement being tapped from cold reheat line, to generate maximum output without over stressing turbine components. The power output of the unit under this operating condition shall not be less than 800 MW or output corresponding to design BMCR heat duty, whichever is lower. (d) Automatic run back capability of the unit load on loss of critical auxiliary equipments (except PA fan), ensuring smooth and stable runback of the Steam Generator and Steam Turbine Generator equipments and systems. (e) Continuous TG output of 800 MW under rated steam conditions, specified worst condenser pressure, 3% cycle make-up and 47.5 Hz grid frequency. (f) The equipments and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz. (g) Unit shall be capable of increasing the load through condensate flow regulation in order to meet the load cycling requirement. Necessary measurements and logics shall be provided for implementation of the same. During condensate flow regulation hotwell level may be maintained through excess condensate dump line to condensate storage tank. (h) Turbine Generator set shall be capable of continuous operation with HP heaters out of service with maximum output not less than 800 MW. (i) Turbine shall be capable of operation on variable pressure mode during part load & start-up operation. (j) TG set shall be capable of operating on house load during sudden total export load throw off using HP-LP bypass system. Unit shall not trip on overspeed in the event of			
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	total export load throw-off. TG output for house load operation may be considered 50 MW atleast for 1 hours. (k) In case of sudden reduction in demand (load throw off), the unit should get safely unloaded and stabilized for operation at house load with HP-LP bypass open to full capacity. All the components including valve body of HP and LP Bypass valves shall be designed for boiler highest safety valve set pressure due to sudden load throw off under transient conditions. (l) HP-LP Bypass should be capable of operation in parallel with turbine with all feed water heaters in service. (m) Bidder shall furnish Pure sliding pressure & Modified sliding pressure operation curves. (n) Plant shall be designed to give life of not less than 25 years. Further, expected numbers of Steam Turbine Generator start ups during design life are as follows: <table><tr><td></td><td>Type of starts</td><td>Number of starts</td></tr><tr><td>a</td><td>Hot Start</td><td>4000</td></tr><tr><td>b</td><td>Warm start</td><td>1000</td></tr><tr><td>c</td><td>Cold start</td><td>150</td></tr></table>					Type of starts	Number of starts	a	Hot Start	4000	b	Warm start	1000	c	Cold start	150
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1.02.00	All the systems/equipments/auxiliaries under Bidder's scope shall be designed to cater to the above operating conditions envisaged for the unit(s)/plant by the Owner. Unless specified otherwise in the Technical Specification the design should cater to the above operating conditions with adequate margin as per standard practice prevailing in the fossil fired power plants.															
1.03.00	The plant shall be suitable for load cycling which implies that it should be designed to operate continuously under two shift mode (daily start stop with one shift off) and load follow mode as specified. The design would cover adequate provision for quick startup and loading of the units to full load at a fast rate. The unit shall have minimum rate of loading or unloading of 3% per minute above the control load (i.e. 50% MCR). Plant shall be capable of minimum N1 number of daily load cycles (N1 shall not be less than 2), load variation from 100% to 50 % (and vice versa) of MCR with a minimum ramp rate of 3% per minute without affecting the design life of boiler and turbine-Generator systems. In addition, the plant shall also be capable of minimum N2 number of daily load cycles (N2 shall not be less than 1) from 50% to boiler minimum once through load (and vice versa) with a minimum ramp rate of 1% per minute without affecting the design life of boiler and turbine-Generator systems. The main plant and its auxiliaries with their controls would be designed to permit operation of the units on house load without there being any necessity to shut down the units in the event of sudden loss of total load due to tripping of transmission lines or any other grid disturbances. The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control. To make unit capable of continuous two shifting operation, the number of hot start ups shall be increased from 4000 numbers specified elsewhere to 6700 numbers without changing cold and warm start up as well as daily N1 (minimum 13400 cycles in total design life) and N2 (minimum 6700 cycles in total design life) requirements as defined above.															
1.04.01	Bidder shall design Turbine-Generator system meeting the load cycling conditions as indicated at clause no 1.03.00. In no case the design life of Turbine-Generator system shall be affected due to 1. 'Fatigue Damage', resulting from															
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1.04.02	a. The number of Cold start up, Warm start up and Hot start up as defined elsewhere in the specification and b. Load cycling during defined plant life. 2. 'Creep damage' 3. The combined creep fatigue damage shall lie within acceptable limits. For the steam generator, in addition to the above requirement, specific design features incorporated and design/process improvements which are being offered for N1/N2 cycles shall be submitted along with the bid. Such design features and design/process improvements over and above conventional design shall be clearly brought out by the bidder in its bid. The Bidder shall provide references for earlier supplied steam generators which meet the specified cyclic duty requirements. The analysis and design/process improvements for cyclic operation suitability shall include all critical boiler components like headers (final Super heater outlet, economizer outlet, final reheater outlet etc.), membrane wall construction elements (tubing attachments, tension bars etc.), wind-box elements, boiler recirculation pump casing, superheater/reheater attachments, dissimilar weld joints etc. The Bidder shall provide information to the process adopted and analysis carried out for the design and operational improvements. Following shall be necessarily included: a) Header thickness reduction: the intervention may include improvement in proper-ties of materials or materials, increase in number of headers etc. b) Use of full penetration welds for header/stub welds and header ligament de-sign improvements c) Design improvement in the mechanical design of water walls d) Design improvements to prevent economizer steaming e) Stress concentration improvements: identification of critical zones, fatigue analysis, operational feedback of regular de-signs; analysis/redesign of water-walls tube/fin system, SH/RH attachments, BRP (boiler recirculation pumps) casing design etc. f) Water chemistry improvements g) Vent/drain/spray system sizing improvements h) Expansion joints design improvements and fatigue tests i) Refractory improvements Analysis of designs shall include CFD and FEM investigations. The bid proposal may be developed by the bidder based on earlier studies/investigations. CFD studies and FEM investigation shall be specifically carried out for the equipment/component selected/designed for the subject project/package. Necessary reports for the analysis (CFD and FEM) shall be furnished to the employer. The performance data re-quired for the analysis shall be developed using dynamic modelling for the steam generator. Visual/NDE protocols additionalities for critical components/equipment, analysis of fatigue damage and load cycling consideration as per the BS-EN 12952-3 or other equivalent code or other equivalent code etc.			
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1.05.00	Results of design analysis which are required to be submitted as part of the EIFS (Engineering information flow system) shall be tied up with the Contractor. The Contractor shall be required to establish the design additionalities (changes in design, dimensions etc.) for making the steam generator suitable for load cycling as part of the bid proposal. The same shall be submitted as a separate document which shall be identified under EIFS. The document shall comprehensively cover each of the above-mentioned areas/components and others identified by the bidder. The process of analysis and results shall include in the document along with conceptual designs. The Contractor shall be required to help employer's engineer run through the complete analysis (as many areas shall not form part of the submitted document). Periodic inspection shall be carried out by the Contractor during the warranty period of all pre-identified areas with stress con-centration. The specifications include thermo-couples and other instruments to collect necessary data for the field test which shall be collected to enable further confirmation of the offered design and/or trouble-shooting. Bidder shall recommend additional instrumentation that may be required for the purpose. a) Provision for life consumption/Equivalent Operating Hours (EOH) of critical components due to Creep & Fatigue shall be made available online (display in CCR) for Operating personnel. Also program/measures shall be made available online (display in CCR) to guide the operating personnel for maintenance planning. b) Resulting Damage Factor due to Creep-Fatigue interaction shall be made available online (display in CCR) for Operating personnel.			
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SUB-SECTION – G-03

LAYOUT REQUIREMENTS

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1.00.00	PLANT LAYOUT PHILOSOPHY															
1.01.00	Broad Guidelines for General Layout Plan															
1.01.01	General layout plan indicating the available spaces for proposed project is as shown in the tender drawing. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.															
1.01.02	Bidder shall develop his own layout for the equipment offered considering sequential erection & ease of operation and the same are to be clearly brought out in the bid. Further while preparing the detailed layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction/ erection strategy and functional requirements, the bidder shall ensure the following aspects: a) The entire construction activity shall take into account the commissioning of the units in phases matching with the final commissioning of the plant. b) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder within the overall area available within the plant boundary as shown in General Layout Plan. In case bidder requires additional area, he shall make his own arrangement at his cost outside the plant boundary. Development of the same including security etc. for the intended use will also be his responsibility. c) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 15 m with respect to center line of double lane road and 12 meter with respect to center line of single lane road. The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations. In case of rail track minimum 3m horizontal clearance between face of adjacent structure to center line of rail and 8.5m vertical clearance between bottom of structure to top of rail shall be maintained. Further as per the practice adopted in railways, any crossing below the rail track, minimum opening size of culvert shall be 2.0m wide X 1.8m deep. A walkway of min 600mm width shall also be made available in the culvert. d) The finished floor level at ground level of the TG building shall be designated at EL. 0.0M and shall be 500mm above the finished ground level (FGL) of that area. The finished floor level for various areas / facilities shall be as follows:- <table><tr><td>i)</td><td>FFL of Main Plant Building</td><td>EL. 0.00M</td></tr><tr><td>ii)</td><td>Top of paving for boiler / ESP area</td><td>EL. (-) 0.20M</td></tr><tr><td>iii)</td><td>Top of paving for Transformer Yard</td><td>EL. (-) 0.10M</td></tr><tr><td>iv)</td><td>FFL of Mill Bunker building and Chimney</td><td>EL. 0.00M</td></tr></table>				i)	FFL of Main Plant Building	EL. 0.00M	ii)	Top of paving for boiler / ESP area	EL. (-) 0.20M	iii)	Top of paving for Transformer Yard	EL. (-) 0.10M	iv)	FFL of Mill Bunker building and Chimney	EL. 0.00M
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1.01.03	v) FFL of other buildings in main plant area EL. 0.00M			
	vi) FFL of offsite buildings 500 mm above FGL of respective area			
	e) Fuel storage tanks, hydrogen cylinder room, etc., shall be designed in accordance with statutory agencies guideline.			
	f) All the buildings and facilities shall be approachable by fire tenders.			
	g) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws are met.			
	Control Room for Offsite facilities			
	A) Control Equipment room (only for placing control and power system panels) for each of the following areas shall be provided near to their respective area/MCC/SWGR. However, HMIPIS for operation & monitoring of these control systems shall be placed at suitable locations complying requirements of clause no 2.04.03 of Sub-section-IIC of Part A .			
	- Ash Handling system - FOPPH system - RAW water pump house - Water System			
	B) Control room for placing panels as well as HMI shall be provided for following areas:			
	- FGD System (This is In addition to LVS, Control desk and workstation at centralized offsite control room in control tower. - CHP System			
NOTE: FGD Control Building may be a part of ESP Control Building.				
Further Remote I/O (RIO) rooms shall be additionally provided on as required basis for offsite areas/FGD system. The exact RIO locations shall be finalized based on standard design practices, operational requirements, optimization of spaces etc. subject to owner's approval during detailed engineering stage. Also remote I/O room shall be provided for unitized ACW pumps (if required).				
Control Rooms / Control Equipment Rooms/ RIO rooms shall be air-conditioned. Batteries for power supply systems as required shall be placed in separate ventilated Battery rooms.				
If offsite control rooms are located at EL 0.0m then cable trench to be provided. However, for FGD building, cable vault shall be provided below switchgear & control room.				
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1.02.00	Main Plant Layout			
	Introduction The proposed location of main plant block is indicated in the general layout plan enclosed with the bid documents. However, bidder has an option to develop his own layout keeping the location/orientation of the main power block, power evacuation corridor, make-up water corridor same as shown in General Layout Plan. However, while developing the layout the bidder must give due consideration to the following requirements: a) Centralized control room (CCR) for unit # 1 & # 2 shall be located between the two units in the Control Tower in TG building towards boiler side at operating floor level. Besides this CCR, control equipment room (CER), programmer room, PC room, UPS/ charger room and battery room shall be provided for each unit. Symmetry to be ensured in finalizing CCR, CER, Programmer room, PC room, UPS/ Charger and battery room layouts. Bidder to ensure space to place standalone/common systems in first unit. One separate Offsite Control Room adjacent to main CCR at operating floor in control tower to be provided for operation and monitoring of Ash handling system, Water system and FGD system. So, the HMI of AHP, Water system and FGD system is to be located in this control room while control panels for these systems shall be located near process area. b) The control tower for unit # 1 & 2 shall be multi-level, which can be extended from C-Row towards chimney side and shall essentially house but not be limited to the following facilities at operating floor :- i) Common control room at operating floor. Further, Control room to be free of any auxiliary/stub columns other than the C row central column with minimum depth as possible. ii) Offsite control room adjacent to main CCR at operating floor. iii) Control equipment room (CER) at operating floor. Unitized CER shall have sufficient space to accommodate all the panels except some miscellaneous panels like bottom ash DCS panels, Public address system panels, CCTV panels, CPU Service area panels etc. which can be placed at mezzanine floor. iv) Programmer room with programmer station & associated consoles. v) Conference room for 20 persons. vi) Shift supervisor room (min size 3M X4M) and C&I engineer room. vii) 24V charger, UPS & batteries on individual unit basis below at mezzanine floor level.			
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	viii) Cabling and all other facilities associated with the above system as brought out at para (f) below. ix) No vertical bracing is permitted at front face of Control room i.e. B-row of TG building. x) Further no vertical bracing shall be envisaged in HT/LT switchgear room and associated cable vault area. xi) Viewing Gallery at the entrance. xii) Office area for 25 nos executive approx. 350 m2 inclusive of conference area, toilet and pantry as detailed in civil part. This area shall be positioned over the CR with good aesthetic view and noise and dust isolation . c) A common SWAS room for both units shall be provided and shall be located at 0.0M in TG building. An air conditioned space of 10mX10m shall be provided adjacent to SWAS room for locating water analysis lab including office space. d) CCR, CER, Offsite control room, programmer room, 24V charger & UPS room, SWAS room, Conference room, C&I engineer room, Shift supervisor room shall be air conditioned areas. Battery Rooms for power supply systems as required shall be well ventilated areas. Pantry & separate Washroom/Toilet facilities for ladies & gents shall be provided contiguous to common control room. Further, no vertical bracings, pipes, cable shafts etc. shall be routed through control room or control equipment room. e) The following clearances to be maintained for C&I DDCMIS cabinets: i) Inter panel spacing - 1200mm ii) Clearance from back wall - 1200mm iii) Clearance from front wall - 1200mm iv) Clearance from side wall - 1000mm The above clearances are the minimum requirement and may increase with increase in door swing of the cabinets. f) The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger room & Battery Rooms, Boiler MCC room shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables. Proper unit wise segregation / separation of cables shall be provided in cable vault area. False floor to route cables is not permitted. The Bidder shall provide unit wise space for transformers (minimum 5m X 5m)			
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1.03.00	preferably in BMCC room along with motorized handling arrangement. The unit wise segregation and separation of BMCC room shall be provided with partition between them. No transformers shall be placed inside cable vault room and in open area. The transformers shall be placed inside the closed area.			
	g) Bidder as a safety requirement shall provide Fire wall on A-row of TG building in front of power transformers as per the statutory and safety requirements.			
	h) Operating floor in the main plant building and the floor of control Equipment rooms shall match with top level of TG deck.			
	i) For other layout requirements of electrical, the Bidder to refer chapter B-10 of technical specifications.			
	Equipment layout			
	While developing the layout, the Bidder shall ensure the following minimum requirements:			
	1. Area of unloading bays	Minimum Three (3) nos. of maintenance bays (one number at the start of first unit and two nos. between both units) shall be provided in TG building. Width of maintenance bay shall be 10.5M (minimum). Further additional bays may be provided as per system/layout requirements.		
	2 Distance between TG hall (C-row) column and first row of boiler columns.	12 M (Clear passage width will be minimum 10 m)		
	3. Arrangement of TG set	Longitudinal		
	4. Basement, Pits & Trenches	a) Regular Basement floors are not acceptable in Main Plant Building. b) Regular Basement floors, trenches and pits in boiler/ mill bay area for routing pipes, cables etc are not acceptable		
5. Clear walkways along A-row & B-row of Power House.	a) 1.5m at all the levels of AB Bay			
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		b) 3.0m along B-row at operating floor level in front of CCR. 6. Control Room Common Control room for unit #1 & #2 shall be provided between the units at operating floor level in B-C bay. 7. Control Equipment Room The Control Equipment Room shall be located at operating floor adjacent to control room and shall be unitized. In case, based on the plant optimization few panels are required to be located at Mezzanine floor then the same must be located below control room. . 8. Minimum clear working space around the equipment 1200mm 9. Minimum clear working space around the Coal mills 1500mm 10. Minimum width of all staircase 1200mm 11. Clear approach width/height between Boiler & ESP 12m minimum (Height=8m) 12. Clear approach width/height between ESP & ID fan 10m minimum (Height=8m) 13. Clear passage between two ESP 10m wide (Minimum) 14. Clear head room for material movement at ground level in Boiler Envelop 5.0m (Minimum) (Unless specified Otherwise) 15. Clear head room for personal movement at ground level of Boiler below ducts. 2.5m(Minimum) 16. Clear head room for personal movement over all Boiler Platforms 2.1m (Minimum) 17. Clear Head room at different floors within Main Plant Building below pipes, ducts, Structures & cable trays etc 2.5m (Minimum)	
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	18. Clear head room in Passage bay between TG hall and first row of boiler column i.e. CD bay 19. Shape of Raw Coal Bunkers 20. No. of Fire Escape staircases in the main plant with fire doors at each landing. 21. Minimum straight length in flue Gas duct at ESP outlet for Opacity meters 22. Coal Mills can be located on the side/rear/front of the boiler. However, bunker emptying discharge chutes shall be placed outside the mill bunker building towards the side opposite of boiler envelope. 23. Adequate space and provision for handling/removal of pumps, motors, heaters, heat-exchanger, fans, Mills, Switchgear Panels, and Transformers during maintenance shall be provided. 24. Monorail beams with electrical hoists/ chain pulley block/ HOT crane as required shall be finalized during engineering stage and shall be supplied by the bidder. Opening provided in the floor for handling these equipment shall be closed with removable chequered plate. 25. Independent floor drains with separate down comers shall be provided wherever fire protection system is provided. 26. In TG bay at crane rail level, chequered plate walkway of minimum 500mm clear width from face of the column to the hand rail (excluding hand rail) on crane side to be provided for full length of the building along A-row & B-row columns. Further, in-between columns, walkway shall be provided in entire column sectional depth. 27. Two (2) nos. of interconnecting walkways (minimum 2.0m clear width) between TG building and boiler (on both side of boiler) at mezzanine, Operating, PRDS/Deaerator floor level shall be provided by Bidder for side mill/rear mill arrangement. In case of front mill arrangement, the mill bunker building shall be interconnected with 2.0m clear width platform with TG building at two levels (with one level necessarily connected with TG Hall operating floor and other interconnection level shall be decided during detailed engineering). The interconnection shall be on both sides of boiler center line for each elevation. 7m (Except in control tower area, where the minimum head room shall be 5.0m) Circular Min-4 Nos. per unit- However the number shall meet the requirement of insurance companies. As required for accurate dust measurement within the battery limits.			
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	Further cables between boiler and TG building shall be routed through interconnecting structure. Also interconnecting platform (min. 1.5m clear width) between Boiler and Coal Bunker Building at Feeder floor level and Tripper floor levels shall be provided by the bidder. Number of interconnecting platform between boiler and coal bunker building for each level/floor specified above shall be two numbers on each side of boiler, i.e. four numbers per floor for side mill arrangement and two nos. for front and rear mill arrangement. 28. Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipment, piping, cabling, ducts routed in the area. 29. While developing the layout, all roof extractor fans on AB bay roof shall be kept staggered and shall not be near the centerline of Turbo generator set. 30. The equipment / valves in the local pit / trenches are to be located in such a manner, that the same can be maintained / operated without any hindrance. 31. Inside T.G building all piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement. Further, valves including actuators and instrument tapings shall be located in accessible positions and operating/maintenance platform for the same shall be provided. 32. Steam turbine, Generator and other equipment located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. Wherever special handling procedures are to be followed such as for the generator stator, rotor withdrawal of Generator etc., the same shall be described in written out document and attached with the bid. The offered layout of TG Hall shall be such that it shall be feasible to remove the Generator Stator and send it for repair without removal of any equipment located in TG Hall. Erection of STG Stator shall be carried out by tandem operation of EOT cranes 33. In case auxiliaries such as BFP set are not in the reach of TG hall EOT crane, then separate EOT crane for each unit with proper maintenance area near BFP set shall be provided for complete maintenance of BFP and its auxiliaries. The Bidder shall furnish the equipment lay down area for TDBFP and MDBFP parts/components with details such as blocks indicating orientation of dismantled items, travel path etc. for each unit necessarily by BFP EOT crane. Further, Bidder shall furnish handling arrangement drawing including special arrangements, pedestals, fixtures etc. for withdrawal / placement in laydown area. Bidder shall ensure obstruction free access path/walkway around TDBFP and MDBFP sets and approach to measuring instruments, valves, bearings etc. In case acoustic enclosures is envisaged, free access as elaborated above shall		
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	also be ensured with in the enclosure. Bidder to plan accordingly taking care of integral piping, lube oil piping, cabling, LIE/LIR etc. and 3D model shall incorporate all these facilities and 2D drawing extracted from 3D drawing shall be submitted. Pit shall be avoided for housing the lube oil system of TDBFP. In case bidder opts for pit, pit invert level shall be kept such that the clear headroom of min 2.1 m shall be available from the grating platform. Access to top of the oil tank shall be ensured from EL 0.0M floor. Bidder shall ensure 600mm walkway all around the equipment/tank after all the oil/water/firefighting piping, cable trays etc. are considered. Free access to the pumps, valves and instruments shall be ensured. Entire access path shall be approachable from all the staircases. Further Bidder to plan in advance and model all the equipment and piping including firefighting pipes inside oil pit area, in order to maintain clear walkway requirements. 34. The bidder has flexibility to route tie Bus ducts and DG Sandwich Bus ducts in side TG hall below operating floor level or mezzanine floor level or outside A - row on cantilever structure. The bus ducts shall be routed with minimum bends. In case Bus-ducts are routed outside A-row on cantilever structure, the bidder shall provide walkway of 600 mm wide and 2100 mm clear height for maintenance. 35. Bidder to note that Power and earth conductor connecting transformer yard and switchyard shall be anchored on A-row columns. The loads due to the same shall be considered while designing the TG building. 36. FD, ID and PA fans handling arrangement complete with electrically operated hoist and handling facilities along with removal space shall be provided. A continuous platform shall be provided between fan and motor end for ID/PA/FD fans in order to facilitate movement of personnel. 37. Mill handling arrangement complete with crane and handling facilities along with removal space shall be provided. For side mill arrangement, one bay shall be provided as maintenance space on each side. For front mill and rear mill arrangement, one maintenance bay shall be provided on both side of mill bunker building. The mill maintenance bay shall be of minimum 7.0 m width. 38 Fuel oil (F.O) piping shall be routed over trestles. The clear headroom for F.O. Trestle in Boiler/ESP area shall be 8.0m till the road behind chimney as per the layout requirement. The headroom for F.O. trestle in outlying area shall be 2.0m except at road crossing where the headroom shall be 8.0m and for rail crossing the headroom shall be provided as per clause no. 1.01.02(c) of this chapter.		
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	39. For the routing of cable trays & piping which includes F. O. piping, Station Piping, Ash handling system piping, firefighting pipes etc & ducting, Bidder to ensure the following- I. Trestle height from TG hall to road behind chimney /in front of Transformer yard/ Boiler/ESP area shall be 8.0 m (headroom). II. In the outlying area, pipe and cables can be routed on trestle with headroom of 2m or on pedestals .At road crossings pipe/cable to be routed through either trestle or underground (RCC /PCC or hume pipe) . In case road crossing through trestle, height of trestle shall be minimum 8m or as per statutory requirement. For Fly ash pipes trestle height shall be minimum 8.0m or higher as per the system requirement. III. The provision of overhead cable tray arrangement shall be in such a way that separation and segregation of cables for each system is achieved. IV. Fire water pipes in main plant area shall generally be routed either on trestle or shall be supported from main plant structure, except in transformer yard area and in C-D bay, where the FW pipes shall be routed in trenches. Further, fire water pipes shall be routed underground (with proper encasement of pipes at roads/passage bay crossings) by the sides of main plant roads (inside the main plant area) from transformer yard to chimney area after clearing the road side drains. Fire water pipes shall not be routed on the same trestle over which the fuel oil pipes and steam pipes are running. In offsite areas, fire water pipes can be routed on trestles or on pedestals. In exceptional cases, fire pipes can be buried. VI. Head room below cable/ pipe rack in transformer yard area for movement of spare GT shall be such that the same can be moved with bushing installed. A clear gap of 500mm between top of bushing and BOS of the trestle shall be ensured. VII. A walkway of 600mm (minimum width) with hand rails & toe guards shall be provided all along length of the gallery of pipe & cable trestle for maintenance of cables where the height of trestle is more than 3 m Ladders for approach to these platforms shall be provided near roads, passage ways and turning points. In the tier of trestle, wherever fly ash handling pipes are routed, grating platform all along the length and for full width of the gallery and trestle of that tier shall be provided. Further, one walkway of 600mm clear width shall also be ensured on the tier meant for routing the fly ash handling pipes. VIII. A clear head room of 2.1 m over the walkways of Pipe/cable trestle galleries for all tiers shall be ensured. Wherever, dry ash pipes are routed on the top most portion of the pipe/cable trestles, a clear head room of 2.1			
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	m over the walkways of dry ash pipe rack shall be ensured. Also, clear gap between structures of each tier of trestle shall be maintained as 2.1 m (minimum). IX. Height of trestles at approach roads to various buildings/facilities shall be 8m. In case building are located in offsite area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0m. X. The layout shall be developed so as to meet the requirements of the Cabling philosophy indicated in respective electrical chapters mentioned elsewhere. 40. Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC. Further minimum two number fireproof double door shall be provided in Cable vaults, HT/LT switch gear room and Boiler MCC rooms. 41. All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms shall be considered by the bidder. 42. Conventional type elevators shall be provided inside the TG building .Further, Conventional type elevators (One Passenger and one goods) shall be provided for each boiler. Landing shall be provided for each floor and up to the topmost floor of TG Building/ Boiler. Location of elevators shall be fixed during detail engineering stage, while finalizing the Layout. For further technical details refer respective portion of the Technical Specification. 43. For Ventilation requirement from A-row side of TG building, space for installation of multiple modular type Air washer units along with pumps shall be considered in AB bay at suitable elevations. No separate room outside A-row for locating Air Washer equipment and no trestle outside A-row for routing Ventilation duct shall be considered. Further, for Ventilation requirement in BC bay, adequate number of multiple modular type Air washer units along with pumps in BC bay for each unit shall be considered. All fresh air ventilation louvers shall be 2500mm from floor level and directed downward at an angle. 44. Battery room shall be properly ventilated to release the gases produced. No roof openings leading to electrical / C & I panels shall be allowed. Spaces for locating fans for Electrical / C & I battery rooms shall be identified in TG building layout drawings. An easily accessible wash basin with mirror shall be provided in the battery room. The enclosure of battery room shall be of brick wall. 45. Routing of pipes and cables is not permitted as cantilever to TG building outside A-Row. These shall be suitably routed within TG building.			
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	46. ESP cum FGD Control room/ Electrical building shall be provided either unitized or combined for both units. If the ESP cum FGD Control room / Electrical building is more than two (2) storey, elevator of specified capacity shall be provided. 47. Minimum one (1) number of staircase shall be provided between two adjacent passes of ESP. These staircases shall be equally distributed on the inlet and outlet side of ESP. 48. Equipment operating/maintenance platforms at Mill Hoist Level, Mill Discharge Valve level, Bunker/Feeder Outlet Level, Cold and Hot air damper level, scanner approach level, oil gun approach level, approach to bottom of hopper for ash handling and for other equipment shall be provided. The platform shall be such that minimum 1.2m space is available all around the equipment for operation & maintenance. However, complete platform for mill maintenance shall be provided at one level in the mill bunker building. Further, 2.1m clear height shall also be available on all such platforms for the person to stand on the platform. 49. Equipment operating & maintenance platforms including supporting structures such as grating platform in the oil equipment room, control fluid equipment room, valve room, De-aerator, Gland Steam Condenser, Flash tank and for other equipment shall be supplied and erected by the Bidder. 50. Suitable motorized rolling shutters shall be considered in the equipment layout to be developed by the bidder on `A'-row to facilitate the movement of Generator Transformers, Station & Unit transformers to the maintenance bay. The size of rolling shutter for TG hall shall be such that largest Power transformer can be brought inside TG hall for maintenance etc. The rail track shall be laid in maintenance bay for handling Power transformers. Further rolling shutters at different location shall be provided in TG hall for the movement of material. 51. In offsite buildings MCC, minimum 2 (two) nos. fire door along with one rolling shutter of adequate size/ capacity shall be provided 52. Bidder to route ash slurry pipe lines on pedestal and pipe culverts shall be provided at rail/road crossings. 53. A suitable rail track and associated facilities like Jacking pads, mooring posts etc., shall be provided to facilitate the movement of Generator transformers. Station and Unit transformers to the maintenance bay. These rail tracks shall be accessible from the equipment unloading area of TG bay by a rail track. 54. Approach platform shall be provided from ESP outlet to ID fan suction gate.		
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1.04.00	55. Flue Gas Desulphurization (FGD) shall be located within the main plant block beyond ESP. The common facilities of FGD can be located outside the main plant block. Bidder to bring out the details regarding FGD and its location basis clearly in bidding documents. FGD Switchgear/MCC room shall be sized for LT & HT Switchgear meeting the functional requirements. 56. De-NOx System shall be located in boiler area. Bidder to bring out the details regarding De-NOx system and its location basis clearly in bidding documents. 57. An area of 3000 sqm to be kept near chimney for owner facility (required for carbon capture). 58. All facilities of mill reject handling system specified elsewhere in the specification such as pump, tank, conveyor, piping etc shall be above ground level in boiler area. 59. In case of front mill arrangement, all staircase wells in TG hall C-row side, shall be pressurized and also all doors/ shutters provided this side shall have a provision of air curtains to avoid ingress of coal/ash dust from boiler side.			
	Laydown area for maintenance and overhauling. 1. The layout of the steam turbine building/units shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations without any restrictions and without any hindrance to the operating personnel of other units. 2. Each steam turbo-generator unit shall be provided with its own lay down area on operating floor level, thus enabling simultaneous maintenance and overhauling of all steam turbine generator units. In case any special arrangement for rotor maintenance is required, the same should be provided. 3. All handling arrangement including any special arrangements like trolley, drive, pedestals etc. for carrying out maintenance and overhauling for steam turbine generator and its auxiliaries shall be provided by the bidder. 4. The Bidder shall furnish general arrangement drawings indicating the equipment lay down area with details such as blocks indicating orientation of dismantled items, travel path etc. 5. The Bidder shall also make arrangement for storing following mandatory spares (whichever is applicable as per scope of the package) inside TG hall with access from EOT crane:			
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	a. Complete assembly of HPT module or its alternative, as applicable b. Complete assembly of IPT module or its alternative, as applicable c. LP Turbine bladed rotor assembly d. HP/IP/LP casing e. Drive Turbine bladed rotor for TDBFP f. Generator Stator/ Generator Rotor g. Boiler Feed Pump motor The bidder shall provide the storage space for these spares at EL. 0.00 m of turbine hall. However, bidder can also store these spares on operating floor level at the end of last unit. Further the option of keeping spares at operating floor shall be exercised after allocating the space for laydown of TG component during overhauling of unit. The storage of spares shall also not hinder any movement of man and material. The number of maintenance bay specified elsewhere in the specification shall not be used for storing these unit assemblies. 1.05.00 Local Pits/trenches in Main Plant building are to be avoided. However, pits/sumps which are unavoidable such as condensate drain pit etc. shall be provided with required permanent dewatering arrangements by means of drainage pumps and piping. Drain network shall be provided to collect effluent generated from floor wash, equipment drain and process drain in TG hall/Boiler/Mill Bay/TP/ESP areas for further disposal upto final disposal point. Underground pipes for this purpose shall not be acceptable. 1.06.00 Bidder's shall prepare the detailed layout of main power block area indicating the location of all major equipment. The layout shall be furnished along with the bids submitted by the bidder. 1.07.00 In addition to above, layout requirements regarding Coal handling plant and Ash Handling Plant etc. specified elsewhere in the specification shall also be followed. 1.08.00 Bottom flange level of Air-Preheaters (Both Primary and Secondary) hoppers and additional hoppers (if any) shall be fixed based on dry ash evacuation system as offered by the bidder taking care of clear height requirement between Boiler & ESP and considering unobstructed route for Fly Ash conveying pipes avoiding vertical bends. 1.09.00 Bottom flange level of ESP outlet Hopper shall be at EL (+) 3.5m (Minimum). In case bidder opt for keeping the ESP Hopper O/L flange above EL(+) 3.5m, separate platform shall be provided for maintenance of ash handling equipment below ESP hopper level, with a clear headroom of 2.1m below ESP hopper flange/platform and clearance of 2.5 m (min.) shall be maintained from ESP area paving level. The Vacuum pump and other ash handling system equipment shall be located outside the ESP envelope and preferably below the inlet funnel of ESP. 1.10.00 Adequate RCC paving to be provided around the equipment to facilitate handling with mobile cranes.			
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SUB-SECTION – G-06

PRE-COMMISSIONING & COMMISSIONING

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
1.00.00	GENERAL			
1.01.00	The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.			
1.02.00	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.			
1.03.00	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
2.00.00	TESTING / COMMISSIONING PROCEDURES			
	The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 18 months before the actual commissioning of the equipments / systems for review and approval of employer.			
	The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions.			
	An indicative list of Testing / Commissioning procedures/schedules and Standard Checklists and the details regarding the contents of testing/commissioning are enclosed as annexure at the end of this sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor.			
	i) Annexure-I : Standard Checklist of items			
	ii) Annexure-II : Testing / Commissioning Procedure/schedules			
	iii) Annexure-III : Commissioning procedures requiring approval of Employer.			
	iv) Annexure – IV : Demonstration/Acceptance test procedures during Commissioning/Initial operation			
	v) Annexure – V : Brief write up on Contents of Testing / Commissioning Procedures			
	Procedure/schedules shall be approved by the employer.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00	PRECOMMISSIONING & COMMISSIONING ACTIVITIES			
3.01.00	General The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
3.02.00	PRE-COMMISSIONING ACTIVITIES/TESTS:			
	Steam Generator			
3.02.01	Hydraulic Testing of Pressure Parts On completion of installation of the Steam Generator pressure parts and high pressure boiler external piping & non boiler external piping a hydraulic test in accordance with the requirements of the Indian Boiler Regulations, shall be performed by the Contractor. However, making use of valves/control valves supplied by others and installed on the contractor's piping system during hydraulic testing shall be subjected to the acceptance of respective valve supplier otherwise hydraulic cap/blanking arrangement as required shall be used. The procedure adopted for hydraulic test and preservation shall have the prior approval of the Employer. The detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished by the contractor and it shall be discussed and finalized during detailed engineering stage. The water for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the Steam Generator and high pressure external piping shall be suitably drained and preserved. All blank flanges, removable plugs, temporary valves, pipes & fittings, spools, other accessories and services required for carrying out hydraulic testing of boiler external pipings & non boiler external pipings and boiler & its pressure parts shall be furnished by the Contractor. The pressurization equipment including water piping and any chemicals for preservation, needed for the above test shall also be furnished by the Contractor. Any defect noticed during the testing shall be rectified and the unit shall be retested by the Contractor. In the case of branch connections/ tap-off piping (in others scope) from contractor's scope of piping are not ready or not erected at the time of hydrostatic testing of piping in contractor's scope, then the contractor to supply/use necessary blanking arrangement as required at these tap-off /branch connections. The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the Project Manager.			
3.02.02	Air & Gas Tightness Test After completion of installation of furnace tubes and/or inner skin casing wherever applicable ducts and air heaters, and before commencement of application of thermal insulation a test shall be performed on the Steam Generator by the contractor to prove or to establish the tightness of the erected equipments from the outlet of FD fan through Steam Generator to the stack. Such test shall be done, as far as possible, with all mountings like soot blowers etc. installed in position. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running FD Fan / PA Fan / Temporary blower, as the case may be, is adopted. The contractor may adopt any other better method of testing.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.02.03	All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their air/gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted without necessity of FD / PA fans. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.				
	Chemical Cleaning of Pressure Parts				
	The Contractor shall perform thorough and efficient cleaning operations of all the internal parts of the boiler, like economiser, water wall / evaporator, separator, feed water line, piping, start-up recirculation lines and associated piping and all other pressure parts and associated high pressure piping covered under these specifications (except those portions which are to be steam blown).				
	The cleaning operation shall consist of De-mineralised (DM) water flushing, the chemical cleaning using acids like hydrofluoric acid or as recommended by the manufacturer, DM water rinsing, DM water flushing, nitrogen capping etc. Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall have the approval of the Employer.				
	The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid/chemical transfer and acid/chemical circulating pumps complete with drive motors, acid storage and acid/chemical mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process. All equipment required for chemical cleaning of Steam Generator shall be supplied by the contractor.				
	The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager and which would comply with the norms of the State Pollution Control Board. This includes construction of suitable neutralization pit, channels, disposal equipments etc.				
	The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations. The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water.				
	The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or filling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Employer. The Contractor shall furnish a detailed procedure for boiler preservation during detailed engineering for Employer's approval.				
All equipment needed for such preservation including the nitrogen cylinders, interconnecting piping and any regulating equipment for N2 cap and other preservatives shall be provided by the Contractor for the Steam Generator and the same shall also become the property of the Employer after completion of the chemical cleaning.					
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.04	The Contractor shall provide adequate safety and protective equipment for all his employees and ensure that they are worn at all times of danger. Specialized treatment equipment (such as required for first aid when using hydrofluoric acid/chemical) must be provided at the place of handling acid/chemical. An acid/chemical cleaning report and log of each cleaning must be provided by the Contractor to the Employer, immediately after the cleaning operation.			
	Dry Preservation of non-drainable portion during shutdown to be provided.			
	Steam Blowing			
	Steam blowing of complete Superheaters, Reheaters and various boiler external piping and non boiler external piping shall be carried out by the Contractor as per requirements/scope of work (indicated in Part-A & Part-B, Section-VI) of this specification. Temporary materials as required for steam blowing of these piping systems shall be supplied by the contractor.			
	Steam blowing of contractor's scope of piping systems shall be performed without valves/control valves supplied in steam blowing circuit otherwise valve supplier's acceptance to include these valves for steam blowing operation is to be submitted by the contractor. Based on the above the Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for approval.			
	The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for steam blowing, which in any case shall meet the steam turbine-generator requirements.			
	The systems which should be ready and operational before steam blowing shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing.			
	For equipments/components installed on high pressure external piping, such as various thermo-wells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor.			
	Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor.			
	In the case of branch connections/ tap-off piping are not ready or not erected at the time of steam blowing operation then the contractor to supply/use necessary blanking arrangement as required at these tap-off / branch connections.			
It will be the responsibility of the Contractor to operate the Steam Generator and its accessories equipment to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure. The Contractor shall make adequate provisions for temporary enhancement of fuel oil firing capacity of the steam generators by changing oil gun tips etc. as may be required so as to be able to conduct complete steam blowing operation by oil firing alone. All necessary precautions to avoid fires and cold end corrosion of Air preheater, during such oil firing at enhanced SG loads, shall be taken by the Contractor.				
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	The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including: (i) Services of test/operating personnel/supervisors. (ii) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing. (iii) Extending all cooperation for interface engineering of equipments/components of temporary system required for steam blowing operation. (iv) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalizing the details of temporary system for steam blowing. For the steam blowing operation, steam conditions like pressure, temperature etc. at the Steam Generator outlet shall be so selected that a minimum cleaning ratio/ disturbance factor of more than 1.4 is achieved. A cycle of heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc. The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point.			
3.02.05	SCR SYSTEM			
	Complete pre-commissioning work including tests of facilities such as pressure drop test of SCR system and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.			
3.02.06	ESP			
	Complete pre-commissioning work including tests of facilities such as air and gas tightness tests of ESP, pressure drop test of ESP, gas distribution test of ESPs etc. and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.			
3.02.07	FGD System			
3.02.07.01	Air and Gas Tightness Test			
	After completion of installation of Booster fans (if required), ducts & absorber, and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing. All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on			
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3.02.07.02 3.02.08 3.03.00 3.03.01 3.03.02 3.03.03	temporary basis and shall be taken back after successful completion of air / gas tightness test. All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor. Any other pre-commissioning activity such as floating of safety valves etc. as considered essential for readiness of facilities for commencement of commissioning activities shall also be undertaken by the Contractor. Demonstration/Acceptance tests during Commissioning/Initial Operation The following tests shall be demonstrated during commissioning for which the bidder has to furnish the procedure and get the approval of the employer: Unit Load Ramp rate capability test: Demonstration of $\pm 3\%$ per minute ramp rate for 50% to 100% load range and minimum $\pm 1\%$ per minute below 50% load to minimum boiler once through load, maintaining the parameters within prescribed limits as defined in closed loop control system requirements (Refer Functional Guarantee Chapter). Start-up, Loading, Unloading and Shutdown Capabilities (For Turbine Generator) (i) Unit Start Up Start-up time (upto full load), and loading capabilities for the Turbine Generator together for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) as indicated by the Contractor in the offer and accepted by the EMPLOYER shall be demonstrated, ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc. are within design limits. (ii) Sudden Total Loss of External Load On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity. The same shall be demonstrated. Further, the provisions of Part-B, Section-VI, shall also be complied with. (iii) Steam Metal Temperature Mismatch Limitation The steam-metal temperature differential for cold, warm and hot start up, loading / unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Employer. Turbine Generator Set Capability The steam turbine generator unit shall be capable of delivering at generator terminals the output as indicated by the BIDDER in the heat balances submitted along with his bid, under the following condition. (a) Maximum continuous output at generator terminals corresponding to both strings of HP heaters out of service, under rated steam conditions, at condenser pressure of
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3.03.04	89 mmHg(Abs) and 3% make-up & Aux. Steam requirement tapped from CRH, generating not less than the rated output OR output corresponding to design BMCR heat duty, whichever is less without overstressing turbine components. NOTE: While conducting the tests of (a) above the condenser pressure measurement shall be done at 300mm above the top row of condenser tubes . Turbine Auxiliaries (i) H.P./L.P. Bypass Capabilities The HP & LP Bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions: (a) Generator circuit breaker opening. (b) HP - IP stop valves closing due to turbine tripping. (c) Sudden reduction in demand to house load. Under all these conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the EMPLOYER. The same shall be demonstrated. (ii) Steam Condensing Plant for main turbine (a) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads. (b) Oxygen content in condensate, at hotwell outlet, shall not exceed 0.015 CC per litre over the entire load range and shall be determined according to calorimetric Indigo - Carmine method. (c) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system. (d) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under EMCR conditions. (e) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall not be less than specified elsewhere. Correction curves for establishing the capacity at site conditions shall also be furnished. (f) The air and vapour mixture from air cooling zone of condenser shall be 4.17 deg.C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished. (g) Condenser on load tube cleaning system shall be made ready before commercial operation of the plant. Life of sponge rubber balls & Number of			
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	balls lost during 336 hours of continuous operation of COLTCS shall be demonstrated by the bidder. (iii) Feed water heaters & Deaerator (a) TTD's and DCA's of feed water heaters in line with 800 MW TMCR heat balance shall be demonstrated. (b) Dissolved O₂ content in Deaerator effluent at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/ litre determined as per ASTM-D-5543-09 or Indigo Carmine method. (c) Difference between saturation temperature of steam entering the deaerator and temperature of feed water leaving deaerator. (iv) Condensate Extraction Pumps The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated. (v) Drip Pumps (if envisaged) The vibration and noise level shall be demonstrated. (vi) Boiler feed pumps (a) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated as per specification requirements. (b) Cold start up / hot start up of the unit using TDBFP with motive steam from auxiliary steam header. (vii) Turbine hall and other EOT Crane: Over load test, travel & hoist speed checks etc., shall be demonstrated as per IS: 3177 (latest edition).			
3.03.05	Balance Pumps, Blowers, Fans, Compressors and rotating equipment. a) The vibration, noise level and parallel operation, wherever applicable, of the pumps, blowers, fans, compressors and rotating equipment shall be demonstrated. b) Pumps, blowers, fans, compressors and rotating equipment shall be capable of delivering flow and head corresponding to design point as specified.			
3.03.06	Balancing of Coal/Primary air flow Contractor shall balance the primary air as well as coal flows in the pulverised fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulveriser does not exceed 5% of average flows. The above balancing shall be checked by the Contractor by carrying out both clean air test and dirty air test (using dirty pitot tubes).			
3.03.07	Demonstration of boiler operation, rate of change of load and sudden load change withstand capability			
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3.03.08	Refer Sub section-A-02 and A-03 ,Part-B (Mechanical), Section VI of Technical Specification. Steam Temperature Imbalance The Contractor shall demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 deg C under all loads including transients.			
3.03.09	No fuel oil support shall be required above 40% BMCR Contractor shall demonstrate that oil support for flame stabilization shall not be required beyond 40% of BMCR load when firing the coals from the range identified. The Contractor shall demonstrate that with any combination of mills/ adjacent mills in service (to Employer's choice) the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% BMCR loads.			
3.03.10	Capabilities of all drives After completion of installation of drives, contractor shall demonstrate the capability of all drives as specified elsewhere in Section VI Part B of Technical Specifications.			
3.03.11	Margin on Fans After completion of installation of fan drives, Fans, inlet and outlet ducting, measuring equipments etc. contractor shall demonstrate the margin on seal air fans, primary fans, Forced draft fans and induced draft fans as specified elsewhere in Section VI Part B of Technical Specifications.			
3.03.12	Cold Air Velocity Test (CAVT) A CAVT shall be conducted on each Steam Generator during commissioning before its initial operation to establish the average cold air velocity and the velocity distribution at minimum three predetermined sections (Employer's Choice) of steam generator. The data obtained from the CAVT will be used to compute the actual flue gas velocities as well as their distribution at the test sections during actual operation by correlating the CAVT data with the test/computed data from Thermal Performance Test as per Clauses 1.03.04 (iii) sub section-IV, Section-VI- Part-A. Should the CAVT results after this correlation with TPT data indicate actual localized high flue gas velocity zones/ mal-distribution of gas flow and/or flue gas laming, suitably designed stainless steel screens at required SG cross sections shall be provided by the Contractor to bring the deviation of the localized gas velocity within $\pm 20\%$ of average gas velocity specified. Through this test the Contractor shall also demonstrate the compliance with the specification requirements regarding the maximum allowable flue gas velocities at various sections of the Steam Generator, refer sub-sectdion-A-03, Part-B of Technical Specifications. The detailed CAVT procedure shall be to Employer's approved. The Contractor shall submit a detailed CAVT report and the computations of actual velocities after correlating CAVT data with TPT data to the Employer for approval.			
3.03.13	Capabilities of firing of 30% imported coal Contractor shall demonstrate the capability of Steam generator and its auxiliaries to operate at rated parameters safely and on sustained basis at TMCR load while firing range of Indian coal(s) as specified in Table-1(A), Annexure-IV-2 ,sub section-IB ,Part-A of Section-VI blended with imported coal up o 30% by weight specified in Table-4, Annexure-IV-4, sub			
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	section-IB ,Part-A, Section-VI. Such demonstration shall be for 72 hours of continuous operation			
3.03.13 a)	Performance characteristic of fans (PA/FD/ID fan capacity, head developed, etc.)			
3.03.14	Passenger & good elevators for steam generator – overload tests, travel and hoist speed checks.			
3.03.15	ESP Air in Leakage			
	Contractor shall demonstrate that ESP air in leakage shall be limited to 1% of the total gas flow under guarantee point condition.			
3.03.16	Pressure Drop Across ESP			
	Contractor shall demonstrate that the maximum flue gas pressure drop across the ESP under specified guarantee point condition shall not exceed 20 mmwc.			
3.03.17	FGD System			
	(i) Performance characteristics of fans (capacity, head developed, etc.) and margins on fans in case Booster Fan, as specified in Part-B of technical specification, is provided by the Contractor.			
	(ii) Capabilities of all drives (Refer Part B of Technical Specifications)			
	(iii) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.			
3.03.18	Unit startup/shutdown demonstration as per combined startup curves for cold, warm and hot conditions.			
3.03.19	Fire Detection and Protection System			
	a) Following shall be demonstrated at Site:			
	i) Vibration & Noise level of fire water pumps.			
	ii) Performance test of each of systems such as Hydrant, HVW Spray, MVW Spray, Foam Injection system, Inert gas extinguishing system, fire detection and alarm system, Fire extinguishers and Fire monitors as per the design parameters/ standards/TAC.			
	iii) Parallel Operation, vibration & noise level of the fire water pumps and diesel engines.			
	b) All tests as required by the TAC.			
3.04.00	Pre-commissioning & Commissioning activities requiring approval of the employer:			
	(a) Hydraulic Test for STG integral piping, heat exchangers, condenser tubes & condenser, equipment cooling water system pipes and associated equipment etc. shall be done. The hydraulic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out. All equipment needed for the tests shall be furnished by the Contractor.			
	(b) Oil flushing of lube oil system, control & jacking oil system, etc. for turbines shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor.			
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	(c) High Pressure/Low Pressure (HP/LP) bypass tests, vacuum tightness test as per approved procedures shall be done by the Contractor after arranging & lining up of all the necessary equipment by him. (d) Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator, Low pressure piping, Power cycle piping & other piping in the scope of the Contractor shall be done by the Contractor. (e) Steam blowing & chemical cleaning, as applicable of integral piping of CEP sets & other piping in the scope of the Contractor shall be done by the Contractor. (f) All tests and activities pertaining to the CEP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification. (g) Steam blowing & chemical cleaning, as applicable of integral piping of Drip Pump sets & other piping (if applicable) shall be done by the Contractor. (h) All tests and activities pertaining to the Drip Pump and its drive (if applicable) as per manufacturer's recommendations and as given in the chapter and covered in the specification. (i) Steam blowing & chemical cleaning, as applicable of integral piping of the Heaters & other components shall be done by the Contractor. (j) All tests and activities pertaining to the Heater as per manufacturer's recommendations and as given in the chapter and covered in the specification. (k) Oil flushing of lube oil system, control & jacking oil system, for BFP sets shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor. (l) Steam blowing & chemical cleaning, as applicable of integral piping of BFP sets & other piping shall be done by the Contractor. (m) All tests and activities pertaining to the BFP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification. (n) Hydraulic Test for all low and high pressure piping, equipment cooling water system pipes and associated equipment etc. shall be done as per statutory requirement and specified elsewhere shall be carried out. All equipment needed for the tests shall be furnished by the Contractor. (o) All tests and activities pertaining to the Generator and Excitation as per manufacturer's recommendations and covered in the specification. (p) All tests and activities pertaining to the Generator Auxiliaries viz Primary water system, Seal oil system, Gas system etc., as per manufacturer's recommendations and covered in the specification. (q) Any other pre-commissioning checks/ tests and activities as described below and also those mutually agreed between the Contractor & the Employer shall be undertaken.		
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3.05.00	COMMISSIONING OF FACILITIES General Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities. Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence. The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer. The Contractor shall furnish requisite no. of copies of procedures and list of start up, pre-commissioning, commissioning and initial operation tests for Employer's approval. The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be. Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.			
3.05.01	The Commissioning tests/checks shall specifically include but will not be limited to following: (a) Checks on the operation of all controls of isolating gas and air dampers. (b) Checks on operation of all fans and all rotating equipment to ascertain level of noise and vibration. (c) Test running of all pumps. (d) Checks on operation of all air heaters and adjustment of seals, if necessary when each heater is upto its working temperature. (e) Checks on operation of all soot blowers and retraction gear and the sequences control. (f) Check run on the Pulverised Fuel (P.F.) Mills including clean air flow test. (g) Standard commissioning tests and procedures as per Contractor's practice for Steam Generator, SCR System, FGD System and other equipment / auxiliaries. (h) Checks on operation of all individual control loops in the Steam Generator control loops in the Steam Generator control system including SCR & FGD System. (i) Checks on inter-relation between each control loop in the Steam Generator control system including SCR & FGD system. Checks on inter-relation between each control loop in the turbine generator control system. (j) Checks on correct functioning of the Burner Management System (BMS).			
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3.05.02	(k)	Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.		
	(l)	Tests on Control & Instrumentation (C&I) Equipments:		
	LIST OF TEST / ACTIVITIES TO BE PERFORMED ON TG & AUXILIARY (but not limited to folowing)			
	A)	COMMISSIONING TESTS/CHECKS		
	1.	Test running of all pumps		
	2.	Condenser vacuum test, feed water heater operational tests for establishing correct cascaded flow, heater water levels etc. & checking of all parameters as per approved heat balance diagrams.		
	3.	Test for HP/LP bypass valves operation & their control system.		
	4.	Test for operation of governing control system for turbines.		
	5.	Standard commissioning tests and procedures as per Contractor's practice for steam turbine generator and other equipment / auxiliaries within the Contractor's scope of work.		
	6.	Checks on operation of all individual control loops in the turbine generator control system.		
	7.	Checks on correct functioning of the Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).		
	8.	Standard commissioning tests and procedures as per Contractor's practice for CEP and other equipment / auxiliaries within the Contractor's scope of work.		
	9.	Checks on operation of all individual control loops in the CEP control system.		
	10.	Standard commissioning tests and procedures as per Contractor's practice for Drip Pump (if applicable) and other equipment / auxiliaries within the Contractor's scope of work.		
	11.	Checks on operation of all individual control loops in the Drip Pump control (if applicable) system.		
	12.	Feed water heater operational test for establishing correct cascaded flow, heater water levels and checking of all parameters as per approved heat balance diagram.		
	13.	standard commissioning tests and procedures as per contractor's practice for heaters and de-aerator and other equipment/auxiliaries within the contractor's scope of work.		
	14.	Checks on operation of all individual control loops in the heater and deaerator control system.		
	15.	Test for operation of governing control system for BFP turbines.		
	16.	Standard commissioning tests and procedures as per Contractor's practice for BFP and other equipment / auxiliaries within the Contractor's scope of work.		
	17.	Checks on operation of all individual control loops in the BFP control system.		
	18.	Checks on correct functioning of the BFP Turbine for Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).		
	19.	Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.		
	20.	Checks on operation of all rotating equipments to ascertain level of noise and vibration		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	21.	Checks on operation of all static equipments to ascertain level of noise and vibration		
	22.	Standard commissioning tests and procedures as per manufacturer's practice for Generator, Excitation and its auxiliaries within the Contractor's scope of work.		
3.06.00	Balance of Plant equipment & systems			
	All pre-commissioning tests & activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.			
4.00.00	INITIAL OPERATION			
	Upon completion of system checking/tests and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.			
5.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
6.00.00	The Contractor shall conduct the comprehensive guarantee tests on the Steam Generator in co-ordination with the Steam Generator to establish the functional guarantee values at stipulated conditions as per Sub-section-IV, Part-A, Section-VI.			
7.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
8.00.00	COMMISSIONING SPARES			
8.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.			
8.02.00	These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.			
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	ANNEXURE-I			
	<u>STANDARD CHECKLIST</u>			
	This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor.			
	<u>MECHANICAL</u>			
	<u>VALVES</u>			
	1. Manually Operated Valve			
	2. Electrically Operated Valve			
	3. Pneumatically Actuated Valve			
	4. Hydraulically Actuated Valve			
	5. Safety Valve			
	6. Electromatic Relief Valve			
	7. Steam Trap			
	8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS)			
	9. Control Valve			
	10. Relief Valve			
	11. Differential Pressure Regulating Valve			
	12. One spare EOTV for steam blowing			
	<u>TANKS & PRESSURE VESSELS</u>			
	1. Tanks (metal) up to 20 M ³			
	2. Tanks (Large Storage)			
	3. Pressure Vessel (Below 17 bars)			
	4. Air Receiver			
	5. Pressure Vessel – Access Door			
	<u>PUMPS</u>			
	1. Pump-Low Pressure Centrifugal (Motor driven)			
	2. Pump-Up to 350HP			
	3. Pump-Sump installation			
	4. Gear Pump/Screw pump			
	<u>PIPE WORK SYSTEM</u>			
	1. Steam services			
	2. Water services			
	3. Oil / Fire Resistant fluid system			
	4. Air services (Compressor)			
	5. High pressure services			
	6. Constant load support			
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	7. Spring supports 8. PF Coal 9. Hangers and other Supports STRAINER AND FILTER 1. Strainer / Filter Basket Type 2. Strainer Rotary (Low Pressure) 3. Filter & Strainers Centrifugal Separators 4. Filter & Strainer Y-Type 5. Filter & Strainer (Plate Type) 6. Purifier 7. Filter – Compressed Air Line HEAT EXCHANGER 1. Heat Exchanger (General) 2. Heat Exchanger – Oil / Water 3. Rotary Air Heater FANS & COMPRESSORS 1. Fans –Non-Pressure Lubricated 2. Fans – Axial Flow pressure Lubricated 3. Compressors-General DAMPERS & GATES 1. Manually Operated Damper 2. Pneumatically Operated Damper 3. Electrically Operated Damper 4. Manually Operated Gates 5. Pneumatically Operated Gate 6. Electrically Operated Gate DUCT WORK 1. Boiler Flue Ducting 2. Expansion Joints 3. Observation & Access Door CRANES AND ELEVATORS 1. Auxiliary Overhead Crane 2. Travel Support Structure for Crane 3. Long Travel & Cross Traverse Motion of Crane 4. Main Aux. Hoist Motion (Crane) 5. Crane Electric Hoist		
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	<u>POWER TRNAMISSION</u> 1. Power Transmission Gear Box 2. Bearings 3. Fluid Couplings <u>BOILER & AUX.SYSTEM</u> 1. Soot Blower Long Retractable 2. Wall Deslagger/Soot Blower 3. Bottom Ash Hopper 4. Fly Ash Hopper 5. Lubricator –Compressed Air Lines 6. Wind Box Assembly 7. Mixer / Stirrer 8. Compressed Air Breathing Apparatus 9. Oil Burner 10. Ignitors 11. Scanner 12. Manual Lubricators 13. Air Motor 14. Driers-Non Regenerative /Regenerative 15. Coal Bunker <u>ELELCTRICAL</u> 1. D.C. Motor 2. HV Squirrel Cage Induction Motor 3. 415 V Squirrel Cage Induction Motor 4. Motor Operated Actuators 5. Soot Blower (Deslagger) 6. Soot Blower (Long Retractable) 7. Soot Blower (Air Heater) 8. Aux. Control and Relay Panel Desk <u>CONTROL & INSTRUMENTATION</u> 1. Conductivity Measuring Equipment Including Test Procedures 2. pH Analyser Including Test procedure 3. Level Switch (Float Actuated) 4. Level Switch (Displacer Actuated) 5. Transmitter (Float Operated Pneumatic Output including Testing procedures 6. Level indicator (Float/Pulley Type)			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	7. Local Temperature Indicator Including Test Procedure 8. Resistance Thermometer Element Including Test procedure 9. Thermocouple Element and Connecting Cable 10. Thermocouple and Resistance Thermometer Convertor/Transmitter Including Test Procedures 11. Temperature Switch Including Test Procedure 12. Cold Junction Boxes 13. O₂Analyser 14. O₂ in Hydrogen including Test procedures 15. Pressure and Vacuum Switch Including Test procedures 16. Differential Pressure Transmitter including Test Procedures 17. Differential pressure switch including Test procedures 18. Flow indicator (Variable Area) 19. Orifice plate 20. Flow Switch 21. Nozzle 22. Flow indicator (Float Operated) Including Test Procedure 23. Venturi (Fluid) 24. Flow Switch (Magnetic Type) 25. Limit Switches 26. Position Measurement & Indication Including Test procedures 27. Vibration Measurement 28. Digital Indicator 29. Moving Coil Indicator Including Test Procedures 30. Recorder Including Test procedure 31. Flame Scanner 32. Electrical Auto Manual Control Station 33. Push Button Module 34. Test Procedure for Electronic Modules of DDCMIS 35. Thermo Control Valve 36. Test procedure for Adjustment of Modulating Controller-PID Term 37. Test Procedure Indicating Controller-Electrical Input & Pneumatic Output		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-06 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES-ANNEXURE-I	PAGE 4 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS																																					
	ANNEXURE-II																																					
	COMMISSIONING PROCEDURES																																					
	Following is an indicative list of equipments / systems for which Testing / Commissioning procedures are to be submitted. The actual list will depend on the equipment / system being supplied by the Contractor.																																					
	<table><tr><th>S. No</th><th>DESCRIPTION</th></tr><tr><td>1.</td><td>ID Fan</td></tr><tr><td>2.</td><td>FD Fan</td></tr><tr><td>3.</td><td>PA Fan</td></tr><tr><td>4.</td><td>Air Heater</td></tr><tr><td>5.</td><td>Scanner Air Fans</td></tr><tr><td>6.</td><td>Fuel Firing System</td></tr><tr><td>7.</td><td>Milling System</td></tr><tr><td>8.</td><td>Soot Blower System</td></tr><tr><td>9.</td><td>Aux. Steam System</td></tr><tr><td>10.</td><td>Mill Reject Handling System</td></tr><tr><td>11.</td><td>HP Bypass System</td></tr><tr><td>12.</td><td>S.A.D.C. and its control</td></tr><tr><td>13.</td><td>Boiler Chemical Analysis Equipment</td></tr><tr><td>14.</td><td>SH / RH Spray system</td></tr><tr><td>15.</td><td>Chemical Dosing System</td></tr><tr><td>16.</td><td>Boiler Air and Gas System -Interlock Operation</td></tr></table>				S. No	DESCRIPTION	1.	ID Fan	2.	FD Fan	3.	PA Fan	4.	Air Heater	5.	Scanner Air Fans	6.	Fuel Firing System	7.	Milling System	8.	Soot Blower System	9.	Aux. Steam System	10.	Mill Reject Handling System	11.	HP Bypass System	12.	S.A.D.C. and its control	13.	Boiler Chemical Analysis Equipment	14.	SH / RH Spray system	15.	Chemical Dosing System	16.	Boiler Air and Gas System -Interlock Operation
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																				
	ANNEXURE-III COMMISSIONING PROCEDURES REQUIRING APPROVAL OF EMPLOYER <table><tr><th>S.NO.</th><th>DESCRIPTION</th></tr><tr><td>1.</td><td>Boiler Hydraulic Test and Preservation</td></tr><tr><td>2.</td><td>Boiler Chemical Cleaning</td></tr><tr><td>3.</td><td>Air and Gas Tightness Test of Furnace, Ducts etc.</td></tr><tr><td>4.</td><td>Steam Blowing of Boiler including Interconnecting Pipe Lines of Boiler, Turbine, Aux. Steam Header and Steam Supply lines.</td></tr><tr><td>5.</td><td>Steam Blowing and Oil Flushing of Fuel Oil System</td></tr><tr><td>6.</td><td>Clean Air Flow Test of Coal Pipes</td></tr><tr><td>7.</td><td>Oil Flushing of Lub Oil System of Rotary Equipments</td></tr><tr><td>8.</td><td>Cold Air Velocity Test</td></tr><tr><td>9.</td><td>Flushing of HP Bypass system oil lines</td></tr></table>				S.NO.	DESCRIPTION	1.	Boiler Hydraulic Test and Preservation	2.	Boiler Chemical Cleaning	3.	Air and Gas Tightness Test of Furnace, Ducts etc.	4.	Steam Blowing of Boiler including Interconnecting Pipe Lines of Boiler, Turbine, Aux. Steam Header and Steam Supply lines.	5.	Steam Blowing and Oil Flushing of Fuel Oil System	6.	Clean Air Flow Test of Coal Pipes	7.	Oil Flushing of Lub Oil System of Rotary Equipments	8.	Cold Air Velocity Test	9.	Flushing of HP Bypass system oil lines
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-06 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES-ANNEXURE-III	PAGE 1 OF 1																					

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ANNEXURE-IV Demonstration/Acceptance tests during Commissioning/Initial Operation The following tests shall be demonstrated during commissioning for which the bidder has to furnish the procedure and get the approval of the employer: 1. Balance Pumps, Blowers, Fans, Compressors and rotating equipment. 2. Balancing of Coal/Primary air flow 3. Demonstration of boiler operation, rate of change of load and sudden load change withstand capability 4. Steam Temperature Imbalance 5. No fuel oil support shall be required above 40% BMCR 6. Capability of all drives 7. Margin on Fans 8. Cold Air Velocity Test (CAVT)			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	ANNEXURE-IV SUB-SECTION- G-06 PRE-COMM. & COMM. ACTIVITIES	PAGE 1 OF 1	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	-ANNEXURE-V BRIEF WRITE UP ON THE CONTENTS OF TESTING / COMMISSIONING PROCEDURE Testing / Commissioning Procedure is required to be of a standard format in order to maintain consistency of presentation, content and reporting. These should contain the following sections to make the document a self contained one. 1. Plant Details / Design data 2. Objective 3. Proposal 4. Services Required 5. Safety Precautions 6. Emergency Procedures 7. State of the Plant (Status in respect of erection completion of Mech, Elect and C&I items) 8. Method 9. Completion / Acceptance Criteria 10. Appendix • Result • Log sheet • Drawing etc.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-06 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES-ANNEXURE-V	PAGE 1 OF 1	

SUB-SECTION – G-07

MDL AND DATA REQUIREMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	Master Drawing List (MDL) This part describes tentative Master Drawing List (MDL). The submission schedules of drawings shall be finalized based on project schedule.			
2.00.00	Engineering Drawing Review Methodology: To reduce engineering cycle time and no. of drawings in approval category, following Engineering Drawing Review Methodology shall be adopted: a. Auto-archive of drawings: Contractor shall certify the following statement in all auto archive drawings. “We confirm that this document meets all the contract requirements including safety and statutory requirements and facilitate ease of operation and maintenance. In case any deviation is found, the Contractor shall carry out all required changes/ modifications without any cost implications to NTPC. In addition, Penalty on account of non-compliance of contract specification as deemed fit by the Employer shall be recovered. b. Endorsement of drawings: NTPC will select base for endorsement of drawings and submit list of drawings to Contractor for endorsement. The list shall be finalized after discussion with Contractor. After agreement, the approved drawings shall be taken out from DREAMS for endorsement and stamped applicable for LARA STPP STAGE-II. c. Dedicated Contractor and NTPC engineering team shall be identified. d. Wherever input data is not available for preparation of drawing, latest similar projects input data (with not to exceed data) will be used for further engineering. e. Cluster of drawings: The drawings will be identified in different clusters for submission/approval purpose depending upon the requirement at site. The submission schedule shall be decided based on proposed L2 network. The L2 network will be agreed upon with Contractor before NOA. f. Latest approved drawing of earlier projects shall be the base for Rev 0 of Lara-II project drawings. g. After Rev 0 comments, the drawing will be locked in the system. Contractor will review the Rev 0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to NTPC as an agenda point for TCM. TCM shall be conducted with Contractor on non-agreed comments of CRS. h. System will not allow Contractor to submit approval category drawings before the scheduled submission date. However, documents may be unlocked on case to case basis. i. Based on resolution of all comments and agreements, the document will be approved in TCM itself. The contractor will revise the document based on the resolutions and certify that all the resolutions has been taken care of. j. Based on this certification, the document will be opened and submitted by contractor in the system for approval as Rev 01 within 10 days of TCM.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION G-07 MDL	PAGE 1 OF 2

CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	Tentative Master Drawing List			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION G-07 MDL	PAGE 2 OF 2

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Data requirement in GAD, Cross section, Scheme, Sizing calculation, datasheet, additional data specific to the equipment etc			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 1 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL REQUIREMENTS			
1.00.01	This part describes the technical information and data to be furnished by the Bidder for the equipment and services described in Section-VI.			
1.00.02	The Bidder shall ensure that all information, data, performance curves, technical literature (catalogues) and drawings furnished fully describe all equipment/systems covered and fully meet the requirements of the technical specifications.			
1.00.03	The Employer reserves the right to ask for further details regarding technical features, application particulars, performance, past experience for similar applications or any other information as may be required to fully satisfy himself regarding suitability, quality, reliability and full compliance with this specification for all equipment and systems offered by the Bidder.			
1.00.04	Bidder shall be required to furnish all additional data about the equipment/system being supplied, even if such details are not specified in this section.			
2.00.00	Data Requirements			
2.01.00	Data to be necessarily included in General Arrangement Drawing of respective equipments: 1. Design and Test code 2. Make/Manufacturer 3. Model/Type 4. Equipment Rating/ Basic design data 5. Equipment quantity 6. Thermal/Mechanical/operational/Performance data as applicable 7. Construction data 8. Part Lists 9. MOC 10. Bill of materials (BOM) 11. Different dimensions 12. Vibration and Sound data 13. Nozzle schedule/Connection list (if applicable) 14. Allowable Force and Moments of Nozzle (if applicable) 15. Different Loads to be considered for foundation design 16. Surface preparation and painting schedule 17. Major elevations/levels 18. Weight of equipment (Empty/operating/full weight), Max weight for maintenance/Erection, Shipping dimensions (size, weight) 19. Special/Standard notes (if any)			
2.02.00	Cross-sectional Drawing Data requirement: 1. Bill of Materials 2. Different dimensions 3. Different Clearances 4. Model Number (if applicable) 5. Design and testing code 6. Special/Standard notes (if any)			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 2 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.03.00	P&ID / Scheme/Write-up data requirement: 1. Design pressure/temperature/flow/Velocity 2. Operating pressure/temperature/flow/Velocity 3. Line size/thickness 4. KKS TAG nos 5. MOC 6. Scope & Terminal Points 7. Special/Standard notes (if any) 8. In write-up, description of each equipment shall accompany set point, rated parameters/size (as per applicability), permissive, interlock, protection, any curves for variable set point, calculation for variable set point etc.				
2.04.00	Sizing calculation 1. Design/Sizing criteria/Design Parameters 2. Codes/Standards 3. Thermal/Hydraulic/ Mechanical calculation 4. Special/Standard notes (if any) 5. Sizing related Heat Balance diagrams				
2.05.00	Datasheet 1. All the required information shall be compiled from GAD, Cross-sectional drawing, Scheme, Write-up, Sizing document etc and any specific data for a particular equipment which is necessarily to be furnished shall be incorporated in the datasheet of the equipment. 2. Following minimum data shall be included in datasheet for respective equipment mentioned below: a. Steam turbine: 1. Details of turbine modules 2. Rating & Capabilities 3. Turbine expansion lines/diagrams as called in Sub-Section-A-07, Part-B, Section-VI of specification clearly marking pressure, temperature, mass flow, specific volume and enthalpy at various points. 4. Characteristic Curves for First stage pressure vs MW load & steam flow for constant pressure and variable pressure Regimes 5. Thermal kit data for heat balance computation 6. Campbell diagrams (typical) for blading proposed, clearly indicating the resonant points and the operating frequency range (Ref. clause 1.05.00 (a), Sub-Section-A-07, Part-B, Section-VI. 7. Life expenditure curves for TG set 8. Temporary speed rise values (To be duly supported by detailed calculations bringing out clearly all the input data correlation considered and results) and Volume of steam entrained 9. Write up on criteria for back end loading of the turbine. Also furnish complete technical data alongwith LP exhaust area, Last stage blade height, max. steam				
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 3 OF 8	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC				
	flow under VWO condition through LP annulus area, actual back end loading, design back end loading etc (Refer clause 1.06.00 (c), Sub-Section-A-07, Part-B, Section-VI). 10. Whether turbine is designed for overpressure operation. 11. furnish % over-pressure capability of the turbine generator under VWO condition and the corresponding continuous output and steam flow with rated steam temperature & 77 mm Hg Condenser pressure (Furnish Heat Balance Diagram) % 12. Maximum flow through LP turbine (Indicate pressure, Temp. & Wetness & condition of operation) and design back pressure 13. Number of uncontrolled extraction points 14. Operating frequency range for turbine and Limitations on number of hours of operation if any at frequency beyond this range 15. Maximum vibration level on any of the bearings of TG set 16. Maximum noise level of Main TG set and Auxiliaries including HP/LP 17. Type of blading (Impulse /Reaction) 18. Type of governing (throttle/nozzle/combined with auto change over facility) 19. Number of turbine cylinders 20. Module number and details (attach dimensioned drawings, experience details, operational feedback etc.) 21. Maximum HP exhaust pressure expected and allowable 22. Maximum permissible steam metal temperature differential during cold/warm/hot start-up, loading/unlading/shutdown/Normal operation 23. Maximum reheat steam pressure at intermediate pressure turbine inlet 24. Steam pressure drop in the reheater circuit 25. Turbine exhaust pressure 26. No-load steam flow through turbine 27. Make-up to heat cycle (at condenser hotwell) 28. Exhaust steam parameters to condenser (at condenser design conditions) 29. Enthalpy at turbine exhaust 30. Dryness fraction and max allowed dryness fraction 31. Design conditions for Extraction steam at Turbine Extraction point 32. Extraction Steam (Flow/enthalpy/pressure/temperature) to Low Pressure Feed Water Heater(s)/HP heaters/Deaerators <tr><td colspan="2">LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B</td><td>SUB-SECTION-G-07 MDL DATA REQUIREMENTS</td><td>PAGE 4 OF 8</td></tr>	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 4 OF 8
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 4 OF 8		

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	33. Extraction Steam (Flow/enthalpy/pressure/temperature) from Cold Reheat Line to Boiler Feed pump drive turbine at low load 34. LP turbine exhaust (Flow/enthalpy/pressure/temperature) before mixing with BFPT exhaust steam 35. Change over of steam source from IP-LP cross over to alternate steam source for boiler feed pump drive turbine during normal plant operation 36. Critical speeds for turbine bladed rotors (State for individual rotors& for combined rotor) 37. Combined critical speeds of TG set 38. Does any turbine rotor pass through critical speed coming up to rated speed? If so, what shaft and at what speed? 39. Type of turning gear and KW rating of motor (if motorised turning gear is used) 40. Turning speed 41. Is the turbine designed for full arc admission during start-up? 42. Moisture at LP last stage under normal steam conditions and with all extractions open for boiler feed pump drive turbines 43. Maximum allowable temperature at LP turbine exhaust hood 44. Temperature of exhaust hood at which spray will be initiated 45. Minimum stable load for operation of TG set at Continuous without exhaust hood spray/ With time limitation/ Continuous with exhaust hood spray 46. Coast - down time to turning gear speed standstill condition after Turbine Trip-out with Vacuum and With Vacuum broken 47. Total quantity of spray water required For Exhaust Hood Spray and Other flash Boxes 48. Thermal Kit Data 49. Losses considered in heat balance computations a. Turbine mechanical loss including bearing friction but excluding power consumed by shaft driven driven MOP b. Turbine windage losses c. Turbine Exhaust losses d. Generator losses e. Generator mechanical losses (including bearing friction losses) f. Power consumed by main oil pump g. Power consumed by other integral auxiliary services for the turbine generator (with list of auxiliaries)			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 5 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	h. Total losses and power consumption considered for arriving at Pg for guaranteed heat rate consumption (Also indicate if all the items at serial numbers (a) to (g) considered for computation) 50. Main steam pressure at inlet to strainer/ stop valve/first stage pressure of HPT 51. Gland leakage coefficients 52. Mode of governing (Nozzle/Throttle/ combined) 53. Dead band of the governor 54. Percentage regulation and its range of adjustability 55. On-full load throw-off: a.Temporary speed rise (TSR) b.Permanent speed rise c.Time taken to reach steady state d.Overall response time of the governor from the moment of full load throw off to the moment of full closing of HP and Interceptor governor valves 56. Range of adjustability of speeder gear 57. Material of Construction 58. Construction Features a. Number and type of cylinders b. Number of Stages c. Number of rows and blades of HP/IP/LP integrally shrouded d. Number of rows of blades unshrouded of IP/LP (indicate whether free standing or with lacing wires) e. First stage diameter f. Length of longest blade g. Tip diameter of largest wheel h. Pitch circle diameter of largest wheel i. Maximum peripheral velocity of largest wheel j. LP turbine last two stages details (Blade height/ Root diameter/ Pitch diameter/ Tip diameter) (Furnish velocity triangles clearly indicating inlet and outlet angles of blades and various velocity sectors) k. Modulus of section (Z) for critical sections including root, pcd & tip sections l. Steam bending stresses at the above critical sections m. Reaction at root, pitch circle diameter and tip		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS
			PAGE 6 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	n. Leaving velocity at the exit of last stage blades o. Safe design bending stress of last stage blades p. Actual bending stress (duly supported by detailed calculations bringing out clearly all input data, correlation considered and results) q. Method of vibration test on LP stages r. LP exhaust annulus area s. Design back end loading t. Back end loading under EMCR/ VWO/ VWO+Over pressure/HP heaters out u. Method of moisture removal in the last stage v. Type of blade protection against moisture erosion w. Details substantiating the superiority of the proposed arrangement (if other than as called for in specification) x. Number of low pressure stages protected against moisture erosion y. Area of blades protected against moisture erosion z. Exhaust area at condenser neck aa. Pressure drop between LP exhaust and condenser top row tubes bb. Main steam and reheat stop & control valves nos/type cc. Strainers nos/type/ Mesh size/strainer element & body material dd. Bearings for turbine and generator- Nos/Type/Material/Radial clearances/bearing pressure/max temp permissible/ Mean coefficient of friction between journal and bearing/ Total load on the bearing/ Kilowatt loss per bearing ee. Shaft gland packing type/ adjustment method/whether replaceable or not ff. Method of mounting blades on rotor gg. Method of fastening shroud hh. Method of securing the fixed blades to the casing ii. Is turbine flange heating envisaged? jj. Is bolt heating envisaged? kk. Minimum Fixed Blade/moving Blade, Axial& Radial Clearances (Furnish clearance diagram & leakage rates as per specification) for HP/IP/LP cylinder ll. Shaft Glands type/nos/Normal running axial/radial clearance mm. Type of shaft coupling			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 7 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	59. Vacuum Breaker Valve number/make/type 60. Insulation details for turbine 61. Design Ramp rate (% per Minute) capability of Steam Generator and Steam Turbine Generator separately.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-G-07 MDL DATA REQUIREMENTS	PAGE 8 OF 8

SUB-SECTION–A-01

EQUIPMENT SIZING CRITERIA

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																													
1.00.00	STEAM GENERATOR AND AUXILIARIES The design/specifications/sizing of various plants/systems/equipment offered for Steam Generator(s) & Auxiliaries shall comply with the requirements detailed hereinafter:																															
1.01.00	Steam Generator(s) Type and Other Features																															
1.01.01	Type The Steam Generator shall be of single pass (Tower type) or two pass type using either spiral wall (inclined) or vertical plain / rifled type water wall tubing.																															
1.01.02	Other Features of Steam Generator Design The Steam Generator shall be direct pulverized coal fired, top supported, single reheat, radiant, dry bottom, with balance draft furnace and shall be suitable for outdoor installation. The evaporator of Steam Generator shall be once-through type suitable for variable pressure operation from sub-critical to supercritical pressure range.																															
1.02.00	Boiler Parameters Steam Generator shall be designed to cater to duty requirements/rating specified below:- <table><thead><tr><th colspan="2">DESCRIPTION</th><th colspan="2">RATED PARAMETERS</th></tr></thead><tbody><tr><td colspan="2">i) Steam Flow at Superheater outlet:</td><td colspan="2">Steam Flow at superheater outlet at Boiler Maximum Continuous Rating (BMCR) conditions, with rated steam parameters shall be 102% of the turbine VWO steam flow requirement</td></tr><tr><td colspan="4">ii) Steam Temperature at BMCR:</td></tr><tr><td>a) At Superheater (SH) outlet</td><td>:</td><td colspan="2">To achieve turbine throttle main steam temperature as indicated in clause 2.01.02 of this Sub-section. The steam temperature at superheater outlet shall be atleast 3°C higher than the rated main steam temperature at HP turbine inlet.</td></tr><tr><td>b) At Reheater (RH) outlet</td><td>:</td><td colspan="2">To achieve reheat steam temperature at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section. The steam temperature at Reheater outlet shall be atleast 3°C higher than the rated main steam temperature at IP turbine inlet.</td></tr><tr><td>iii) Feed water temperature at Economizer inlet</td><td>:</td><td colspan="2">Please refer clause 2.01.02 of this sub-section.</td></tr><tr><td>iv) Steam Pressure at superheater outlet at BMCR:</td><td>:</td><td colspan="2">To achieve Turbine throttle steam pressure as indicated in clause 2.01.02 of this Sub-section. Steam pressure at super heater Outlet shall not be more than 9 Kg / cm² higher than the rated main steam</td></tr></tbody></table>				DESCRIPTION		RATED PARAMETERS		i) Steam Flow at Superheater outlet:		Steam Flow at superheater outlet at Boiler Maximum Continuous Rating (BMCR) conditions, with rated steam parameters shall be 102% of the turbine VWO steam flow requirement		ii) Steam Temperature at BMCR:				a) At Superheater (SH) outlet	:	To achieve turbine throttle main steam temperature as indicated in clause 2.01.02 of this Sub-section. The steam temperature at superheater outlet shall be atleast 3°C higher than the rated main steam temperature at HP turbine inlet.		b) At Reheater (RH) outlet	:	To achieve reheat steam temperature at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section. The steam temperature at Reheater outlet shall be atleast 3°C higher than the rated main steam temperature at IP turbine inlet.		iii) Feed water temperature at Economizer inlet	:	Please refer clause 2.01.02 of this sub-section.		iv) Steam Pressure at superheater outlet at BMCR:	:	To achieve Turbine throttle steam pressure as indicated in clause 2.01.02 of this Sub-section. Steam pressure at super heater Outlet shall not be more than 9 Kg / cm ² higher than the rated main steam	
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iii) Feed water temperature at Economizer inlet	:	Please refer clause 2.01.02 of this sub-section.																														
iv) Steam Pressure at superheater outlet at BMCR:	:	To achieve Turbine throttle steam pressure as indicated in clause 2.01.02 of this Sub-section. Steam pressure at super heater Outlet shall not be more than 9 Kg / cm ² higher than the rated main steam																														
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																												
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.02.01 1.02.02 1.03.00 1.03.01	v) Pressure drop in Reheaters Including cold and hot Reheater Piping under all operating conditions : pressure at HP turbine inlet. To be optimized by the bidder Steam Generator Control range : 50% TMCR to 100% BMCR Under the above control range, the steam temperatures at SH & RH outlets shall be maintained at their rated values Boiler Design Optimization for Performance The Bidder shall size each heat transfer bank and select their disposition along the gas path in the radiant and convective zone so that steam temperatures are maintained at stipulated levels within the control range with minimum spray water and minimum metal temperatures. To this effect, the Bidder shall provide design basis the segmentation of heat duty among different heating segments viz. economizer, water walls, different super-heater segments and reheater segments for ensuring required steam generator performance under all operating conditions. The Bidder shall also furnish a steam temperature plot to indicate heat pick up in different heat transfer banks. The plot will include spray water and metal temperatures at different sections along the gas path for clean tube and dirty tube conditions. Further the considerations for thermo-hydraulic design of the evaporator and mechanical design of the water walls as well as selections pertaining to the offtake point to separator and the location of intermediate headers (if applicable) shall be clearly de-fined and brought out in the Technical datasheet. These shall include the limiting values of degree of superheat of steam (at minimum circulation flow and other loads), tube to tube temperature differentials at the evaporator outlet, tube (thickness/inner diameter/roughness) selection, furnace heat flux considerations and the cyclic loading and start-stop requirement that are specified in part-B sub-section A-01 of the technical specification. Fuel i) Primary fuel 100% Coal ii) Cold Start up / Black Start LDO to cater to 30 % BMCR requirements of Steam Generators without any coal firing Minimum Load without Oil Support Minimum Load without Oil Support for Flame Stabilization when firing any coal from the range of coals (design/worst/best/adequacy/ 30 % imported coal by weight blended with Indian coals) 40% BMCR requirements a) Capacity of LDO burners for load carrying purpose 30% BMCR		
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		
	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.04.00	Boiler Operation i) Mode : Suitable for variable pressure operation from subcritical to supercritical pressure range ii) Startup : The steam generator shall also be capable of start-up without HP-LP by-pass system in service iii) Load Throw Off : In case of sudden load throw-off, in worst case from 100% BMCR, the Steam Generator shall be capable of automatically bringing down the steam generating capacity to match with HP-LP bypass capacity iv) Frequency Variation : The equipment and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz. unless otherwise specified v) In line with the plant operating capability requirement indicated in sub-section G-01, the steam generator shall be designed for variable pressure operation. Thermal design of steam generator and the selection of material of pressure parts shall be suitable for variable pressure operation modes. The Steam Generators shall be designed for minimum rate of loading/unloading mentioned below without compromising on design life of pressure parts: a) Step Load Change : Minimum $\pm 10\%$ b) Ramp Rate : Minimum $\pm 1\%$ per minute (below 50% load to minimum boiler once through load) Minimum $\pm 3\%$ per minute (50% to 100% load) Bidder shall clearly bring out in his offer the maximum rates of loading/ unloading achievable with Steam Generator offered and the corresponding limiting variations ($\pm\%$) of boiler parameters such as Oxygen in flue gas, SH/RH steam temp., furnace draft, etc. Steam Generator shall be so designed such that during ramping, maximum metal temperature shall not exceed the design metal temperature of the material for the boiler pressure parts. Specific care shall be taken in the design of the water walls for load ramping conditions. vii) Rapid Load Change in downward direction : In case of external disturbances or equipment malfunction the system shall stabilize itself through proven concepts and controls and within the recommendations of National Fire Protection Association, USA, NFPA Latest Edition			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 3 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.00	Component sizing/Design Criteria		
1.05.01	Furnace/evaporator/waterwalls shall comply with following requirements at 100% BMCR and HP Heaters out conditions for the range of specified coals, under most stringent combination of conditions		
i)	Net Heat Input (NHI)/Plan area (Maximum) of furnace	4.75 x10 ⁶ kcal/hr/m ²	
ii)	Heat Liberation rate	106920 kcal/hr/m ³ (Maximum)	
iii)	Burner Zone Heat Release Rate (BZHRR)	1.9 x 10 ⁶ kcal/hr/M ² (Maximum)	
iv)	Maximum FEGT (MHVT value)	60 deg.C below Minimum IDT of ash.	
v)	Heat Input per burner(*)	650 X10 ⁵ kCal/Hr (Maximum)	
vi)	Furnace Cooling Factor	1.9 x 10 ⁵ kcal/hr/M ² (Maximum)	
vii)	Furnace residence time(**)	2.0 sec. (Minimum)	
viii)	No. of burner elevation being fed from one mill	1 (Maximum)	
ix)	Pressure withstanding capability	± 660 mmwc (Minimum) at 67% yield strength or Maximum conceivable head of fans, whichever is higher.	
x)	Furnace / Evaporator shall be designed for variable pressure operation over minimum load with separator running dry to 100% BMCR load range		
xi)	Maximum average flue gas Velocity before Gas flow changes direction (For velocity calculation , excess air shall be considered as 25% at Economizer outlet	10 m/sec. (The maximum localized velocities across the cross- section shall not exceed 12m/ sec.)	
xii)	Limiting Parameters for Steam Generator Design The Steam Generator design shall comply with the following limiting parameters with 'design coal' firing, under stipulated ambient air condition i.e. 27 degree Celsius temperature and 60 % relative humidity:		
a)	Excess air at economizer outlet at 100 %TMCR load	: 20% (minimum)	
b)	Flue gas Exit Temperature at Air Pre-heater outlet (corrected) at 100% TMCR load	: 125 deg.C (minimum)	
c)	Heat Loss due to un-burnt carbon in ash at all loads	: 1% (minimum)	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 4 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	Bidder to note that no credit shall be given in the bid evaluation or in the evaluation of the results of the guarantee tests or performance predictions etc. if the values considered by the Bidder for parameters as specified at clause no 1.05.01 xii) of this chapter above are lower than those specified in this clause. However, the Bidder shall also indicate in their bid proposal the minimum excess air & unburnt carbon loss at which unit can be operated on sustained basis meeting all other specification requirements. NOTE: Definition(s) of acronyms/terms for the above are as given at the end of this clause 1.05.00. (*) Minimum number of coal pulverisers to be provided for each steam generator shall not be less than Eight (8) (**) Selected Furnace Residence time by the Contractor shall be "COAL SPECIFIC". Definitions of Acronyms/Terms used in clause no. 1.05 .01 CLAUSE 1.05.01 (i)"NHI/FURNACE PLAN AREA" (a) Net Heat Input (NHI) or heat available in furnace is obtained by considering the GCV of the fuel minus the radiation losses, loss due to unburnt combustible, moisture in air & fuels, latent heat of moisture in fuel & that formed by combustion of H₂ in the fuel plus the sensible heat of combustion air (Primary plus Secondary air), all above 27⁰C. (b) Furnace Plan Area is the product of Furnace Width and Depth. CLAUSE 1.05.01 (iii) "BURNER ZONE HEAT RELEASE RATE" (BZHRR) Burner Zone is defined as the centre line distances between the Top and Bottom burner plus 3.05 meters of furnace height. Further, heat input is the input from coal. CLAUSE 1.05.01 (iv) "FEGT (MHVT)" (c) FEGT is the Furnace Exit Gas Temperature in degree Celsius. (d) MHVT Value is the flue gas temperature as measured by a Multi Shielded High Velocity Thermocouple (MHVT). CONTRACTOR TO NOTE: Furnace exit plane shall be defined as the plane, vertical for two pass Steam Generator and horizontal for single pass (tower type) Steam Generator, above the furnace nose tip or the plane beyond which the transverse tube pitching is less than 600 mm whichever is positioned first in the flue gas flow path. Further, all the predicted/guaranteed gas temperature including FEGT indicated by the Contractor shall be the actual MHVT value and not the HVT values. CLAUSE 1.05.01(vi) "FURNACE COOLING FACTOR" Furnace Cooling Factor in Kcal/hr/sq.m., is the ratio of NHI (Cl. 1.05.01 (i)) or heat released and available and Effective Projected Radiant Heat Absorbing Surface (EPRS).		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 5 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.02	For arriving at Furnace Cooling Factor the calculated EPRS shall be reduced by at least 10% to account for deterioration of furnace walls surface condition due to fouling/slugging etc. CLAUSE 1.05.01(vii) "FURNACE RESIDENCE TIME" Furnace Residence Time shall be defined as the residence time of the fuel particles from center line of the top elevation coal burners to the furnace exit plane. For the purpose of residence time the exit plane shall be defined as the horizontal plane at the furnace nose tip for two pass boiler & the horizontal plane at the entry to the radiant superheater/ reheater for single pass/ tower type boiler. Further, Furnace Residence Time shall be calculated by dividing the furnace volume between the center line of top coal burner and furnace exit plane by the flue gas volume at mean gas temperature in the above furnace volume			
	DESIGN OF PRESSURE PARTS (a) The design of all pressure parts (tubes, headers, separators, vessels etc.) shall be as per Indian Boiler Regulations (IBR) or other international codes with the approval of the Employer. It is however, the responsibility of the Contractor to get various calculations and other technical documentations approved by the statutory authorities in the state and country of location of the plant. (b) Design pressure of the Steam Generator pressure parts shall be atleast 1.05 times the maximum operating pressure, or as required by IBR/ASME, whichever is higher. (c) The thickness of the pressure parts (steam and water tubes/headers, separators, pressure vessels etc.) shall be calculated using IBR formulae/factor of safety etc. (and not as per codes/formulae acceptable to IBR). Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes. For this purpose appropriate thinning allowance shall be considered by the Contractor while calculating the thickness of the bends. Additional erosion allowance on the calculated tube thickness shall be provided at specified locations as specified by the Employer in this specification. (d) The working fluid temperature to be considered for design of pressure part tubes starting from water wall bottom ring header upto and including the water wall outlet headers shall be arrived by adding an additional margin of minimum 40°C to the maximum predicted/expected fluid temperature in these pressure parts. The working fluid temperature to be considered for design of pressure parts starting from downstream of water wall outlet headers upto first stage of superheater attemperation shall be arrived by adding an additional margin of minimum 15 deg C to the maximum predicted/expected fluid temperature in these pressure parts. The margins as per IBR and other codes shall be taken over and above the working fluid temperatures so arrived. For the other pressure parts where no design margin is specified in the IBR and the above specified 40 °C or 15°C margin is not applicable, the working fluid temperature to be considered for design of pressure parts shall be arrived at by adding following margin to the maximum predicted/expected fluid temperature in these pressure parts: i) 5 °C for inlet headers and its connecting tubes, pipes downstream and upstream of attemperators and other pipes in pressure parts. ii) 15°C for outlet headers and their connecting tubes except at final super heater and final reheater outlet. iii) For final super heater and final reheater outlet a margin of 5°C shall be taken.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 6 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																			
	(e) Materials for Steam Generator Components The material used for Steam Generator components i.e. boiler pressure parts including boiler tubing, headers, separators, piping, vessels, valves & fittings etc. and other components shall be equal to or better than the following unless specified otherwise: <table><tr><th></th><th>Design Metal Temperature</th><th>Material</th></tr><tr><td>(i)</td><td>Upto & including 400 degree Celsius</td><td>Carbon steel to ASME SA-106 Gr. B/C or SA 210 Gr. C or approved equivalent.</td></tr><tr><td>(ii)</td><td>Upto & including 550 degree Celsius</td><td>Alloy steel to ASME SA-335: P-11/P-12/P-22 ASME SA213:T-11/T-12/T-22/T23/ or approved equivalent.</td></tr><tr><td>(iii)</td><td>Upto & including 601 degree Celsius</td><td>Alloy steel ASME SA-335/213:P-91/T-91 or approved equivalent.</td></tr><tr><td>(iv)</td><td>Upto & including 610 degree Celsius (*)</td><td>Alloy steel ASME SA-335/213:P-92/T-92 or approved equivalent.</td></tr><tr><td>(v)</td><td>Upto & above 610 degree Celsius</td><td>Austenitic stainless steel, SA-213 UNS S30432 Shot Peened, TP347H FG or approved equivalent.</td></tr></table> * Note: (i) Bidder at his discretion can use ASME SA-335/213:P-92/T92 or approved equivalent material for the components which are outside the flue gas path for Superheater, Reheater tubes & headers and Interconnecting Piping. In case ASME SA-213:T-92 is used for terminal tubes (i.e. from header to coil) for ease of welding, then such tubes can also be used beyond design metal temperature of 610 °C and the metal temperature of T-92 will be limited to 620 Deg. C. If the Bidder offers Hot Reheat Steam Temperature (HRH) Temperature in the Specified range i.e. up to 610 deg C, Alloy Steel ASME SA -335/213 Gr.P-92 or equivalent can be used for HRH headers, up to & including 620 degree Celsius. (ii) Use of T91 tubes for the pressure parts in the heated region of the boiler shall be limited to fluid temperature of 530°C.		Design Metal Temperature	Material	(i)	Upto & including 400 degree Celsius	Carbon steel to ASME SA-106 Gr. B/C or SA 210 Gr. C or approved equivalent.	(ii)	Upto & including 550 degree Celsius	Alloy steel to ASME SA-335: P-11/P-12/P-22 ASME SA213:T-11/T-12/T-22/T23/ or approved equivalent.	(iii)	Upto & including 601 degree Celsius	Alloy steel ASME SA-335/213:P-91/T-91 or approved equivalent.	(iv)	Upto & including 610 degree Celsius (*)	Alloy steel ASME SA-335/213:P-92/T-92 or approved equivalent.	(v)	Upto & above 610 degree Celsius	Austenitic stainless steel, SA-213 UNS S30432 Shot Peened, TP347H FG or approved equivalent.		
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1.05.03	STEAM SEPERATOR(S)																				
	(i) Design Code IBR (ii) Design Temperature Max. fluid temperature plus 40°C (Min.) (iii) Design Pressure Atleast 1.05 times the maximum operating pressure, or as required by IBR/ASME, whichever is higher.																				
1.05.04	Superheater(s) and Reheater(s) shall be designed, suitably sectionalized and positioned to																				
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 7 OF 101																		

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1.05.05	comply with the following, for the specified load(s), coal(s) and for normal, upset, most adverse and other operating conditions (refer as specified at clause no 1.00.00 of Sub Section-A-02 also)			
	Parameter	Requirement		
	(1) Rated Steam Temperature			
	a) At Super heater outlet	To achieve turbine throttle main steam temp. as indicated in clause 2.01.02 of this Sub-section		
	b) At Reheater outlet	To achieve reheat steam temp at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section		
	Note: The control system for SG shall be able to maintain SH/RH outlet temperatures within ± 5°C of above values over complete control range of Steam Generators with the range of specified coals.			
	(2) Maximum average flue gas velocity in section/tube banks with transverse tube pitching 600 mm or less and with 20% excess air at economizer outlet	10 m/sec. (The maximum localized velocities across the cross- section shall not exceed 12m/ sec.)		
	(3) Maximum allowable tube metal skin temperature	40 degree Celsius below oxidation limit for the tube metal.		
	(4) SH/RH outlet steam temperature characteristic below control range	(i) As close as possible to each other. (ii) Minimum drop from rated steam temperature.		
	(5) Means of Temperature Control			
(a) SUPER HEATERS	Spray Water attemperation, (utilising water tapped off from downstream side of HP heaters or intermediate banks of economizer or Economizer outlet). Tapping of spray water upstream of top HP heater is not allowed.			
(b) REHEATERS*	Tilting of burners/gas biasing/gas recirculation (gas to be tapped off after ID fans), spray water attemperation (utilising water tapped off from interstage of BFP)			
*Note : In case gas recirculation system is offered for reheat temperature control, minimum 2x100% gas recirculation fans with atleast 20% margin on flow and 44% margin on head over calculated maximum requirement of fan flow and head respectively shall be provided for each Steam Generator.				
ECONOMISERS				
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 8 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC															
	Economizer design shall conform to the following criteria/requirements under all condition of operation and for the complete range of specified fuels.																		
	CRITERIA		REQUIREMENT																
	(i)	Economizer Type	Non-steaming type with parallel cross flow or counter flow arrangement.																
	(ii)	Approach Temperature within control range	17°C (minimum)																
	(iii)	Maximum average flue gas velocity through the Economizer tube banks, with 20% excess air at Economizer outlet.	10 m/sec. (The maximum localized velocities across the cross-section shall not exceed 12 M/sec)																
	(iv)	Economizer tube thickness	i) Provide erosion allowance of 1mm (minimum) in addition to thickness calculated as per IBR formulae. ii) Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes calculated in the manner described at (i) above. For this purpose appropriate thinning allowance shall be considered by the contractor while calculating the thickness of the bends.																
	(v)	Maximum allowable tube metal skin temperature	Oxidation limit for the tube metal.																
	(vi)	Maximum depth of tube banks/sections in the direction of gas flow:	2 Meters or maximum soot blowing radius, whichever is lower.																
1.05.06	Regenerative Air Pre-heaters (RAPH)																		
1.05.06.01	Regenerative Air Pre-heaters (for Bisector type RAPH)																		
	Air pre-heaters shall be sized / designed to cater to following requirements:																		
	<table><tr><th>DESCRIPTION</th><th colspan="2">BISECTOR TYPE</th></tr><tr><td></td><th>Primary Air Preheater (PAPH)</th><th>Secondary Air Preheater (SAPH)</th></tr><tr><td>1. No. of air preheaters per Steam Generator</td><td>Two</td><td>Two</td></tr><tr><td>2. Sizing shall be based on following criteria, all conditions considered to be occurring together:</td><td></td><td></td></tr><tr><td>i) Design ambient air</td><td>30°C* & 60% RH</td><td>30 °C* & 60% RH</td></tr></table>				DESCRIPTION	BISECTOR TYPE			Primary Air Preheater (PAPH)	Secondary Air Preheater (SAPH)	1. No. of air preheaters per Steam Generator	Two	Two	2. Sizing shall be based on following criteria, all conditions considered to be occurring together:			i) Design ambient air	30°C* & 60% RH	30 °C* & 60% RH
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA															
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CLAUSE NO.	TECHNICAL REQUIREMENTS																													
1.05.06.02	<table><tr><td>temperature & humidity*</td><td></td><td></td></tr><tr><td>ii) Type of coal firing</td><td>Worst coal, with max. moisture.</td><td>Worst coal, with max. moisture.</td></tr><tr><td>iii) Air temperature rise across Air preheater</td><td>Adequate to achieve the required coal/air mixture temperature at burner inlet at all loads and for complete range of specified coals.</td><td>Adequate to achieve the required secondary air temperature for stable combustion at all loads and for complete range of specified coals.</td></tr><tr><td>iv) Load Range</td><td colspan="2">a) 60% TMCR with Design/Best/worst coal and maximum moisture, whichever gives maximum flow with one set of PAPH & SAPH b) 100% TMCR with Design/Best/worst coal and maximum moisture whichever gives maximum flow with both sets of PAPH & SAPH</td></tr><tr><td>v) Minimum average cold-end metal temperature at 100% BMCR (with SCAPHs out of service)</td><td>76°C</td><td>76°C</td></tr><tr><td>3. AH flue gas exit temperature (corrected) at 100% TMCR (800 MW unit load) with design Coal</td><td>125°C</td><td>125°C</td></tr><tr><td>4. Min. flue gas exit temperature (for complete range of specified fuels)</td><td>5°C above acid dew point of flue gas</td><td>5°C above acid dew point of flue gas</td></tr><tr><td>5. Air Leakage (at 100% TMCR i.e. 800 MW unit load for complete range of coals)</td><td colspan="2">Less than 10% of the Flue gas weight entering airheater.</td></tr><tr><td>6. Rotational speed for drive selection</td><td>1 r.p.m. or actual offered whichever is higher</td><td>1 r.p.m. or actual offered whichever is higher</td></tr></table>			temperature & humidity*			ii) Type of coal firing	Worst coal, with max. moisture.	Worst coal, with max. moisture.	iii) Air temperature rise across Air preheater	Adequate to achieve the required coal/air mixture temperature at burner inlet at all loads and for complete range of specified coals.	Adequate to achieve the required secondary air temperature for stable combustion at all loads and for complete range of specified coals.	iv) Load Range	a) 60% TMCR with Design/Best/worst coal and maximum moisture, whichever gives maximum flow with one set of PAPH & SAPH b) 100% TMCR with Design/Best/worst coal and maximum moisture whichever gives maximum flow with both sets of PAPH & SAPH		v) Minimum average cold-end metal temperature at 100% BMCR (with SCAPHs out of service)	76°C	76°C	3. AH flue gas exit temperature (corrected) at 100% TMCR (800 MW unit load) with design Coal	125°C	125°C	4. Min. flue gas exit temperature (for complete range of specified fuels)	5°C above acid dew point of flue gas	5°C above acid dew point of flue gas	5. Air Leakage (at 100% TMCR i.e. 800 MW unit load for complete range of coals)	Less than 10% of the Flue gas weight entering airheater.		6. Rotational speed for drive selection	1 r.p.m. or actual offered whichever is higher	1 r.p.m. or actual offered whichever is higher
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	*Note: The specified ambient temperature shall be considered for APH sizing. For evaluation & guarantee purpose the limiting values in indicated in clause 1.01.03.02, Sub-Section-IV, Part A & clause 1.05.01 xii), Sub-Section-A-01, Part B, Section-VI shall apply.																													
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	i) Design ambient air temperature & humidity**	30 °C** & 60% RH		
	ii) Type of coal firing	Worst coal, with max. moisture.		
	iii) Air temperature rise across Air preheater	Adequate to achieve the required coal/air mixture temperature at burner inlet at all loads and for complete range of specified coals.		
	iv) Load Range	a) 60% TMCR with worst coal and maximum moisture with one set of RAPH in service b) 100% TMCR with worst coal and maximum moisture with both sets of RAPH in service		
	v) Minimum average cold-end metal temperature at 100% BMCR (with SCAPHs out of service)	76°C		
	3. AH flue gas exit temperature (corrected) at 100% TMCR (800 MW unit load) with design coal	125°C		
	4. Min. flue gas exit temperature (for complete range of specified fuels)	5°C above acid dew point of flue gas		
	5. Air Leakage (at 100% TMCR i.e. 800 MW unit load for complete range of coals)	Less than 10% of the Flue gas weight entering airheater.		
	6. Rotational speed for drive selection	1 r.p.m. or actual offered whichever is higher		
	1.05.06.03	**Note: The specified ambient temperature shall be considered for APH sizing. For evaluation & guarantee purpose the limiting values in indicated in clause 1.01.03.02, Sub-Section-IV, Part A & clause 1.05.01 xii), Sub-Section-A-01, Part B, Section-VI shall apply. For meeting the requirements of rated coal/air mixture temperatures at burner inlet at part load operations of steam generator with coals of excessive moisture and under conditions of low ambient temperatures the Contractor may, if required, size economiser bypass duct incase of bisector airpreheater along with necessary dampers, expansion joints, structures etc, and provide sufficient tempering air reserve incase of Trisector airpreheater accordingly. Even in case of sizing of economiser bypass or sufficient tempering air reserve is provided by the Contractor due to above requirement, the sizing of air preheaters shall ensure that the rated mill outlet temperatures are achieved, for complete range of specified coals, from 100% TMCR (800 MW) to 100% BMCR loads with economiser by pass closed and without reducing tempering air reserve. Further, the bidder shall indicate the quantity of tempering air reserve considered for Trisector air preheater design for loads 100% TMCR (800 MW) to 100% BMCR loads for complete range of specified coals.		
1.05.07	Steam Coil Air Preheater(SCAPH)			
1.05.07.01	SCAPH shall be designed / sized to increase the air heaters inlet air temperature based on following criteria:			
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	SI. No.	DESCRIPTION	Primary SCAPH *		Secondary SCAPH
	(i)	Design ambient air temp.	6°C		6°C
		(Temperature rise across fan shall not be considered for sizing of SCAPH)			
	(ii)	Number of SCAPHs	One (1) for each PA fan		One (1) for each FD fan
	(iii)	Type of coal firing	Worst coal		Best coal
	(iv)	Air temperature at SCAPH outlet			
		(a) At 100% BMCR	27°C (Min.)		27°C (Min.)
		(b) At 30% BMCR	100°C (Min.)		100°C (Min.)
	(v)	Air temperature at the inlet of each Air Preheater	To keep average metal temp. (Cold end) at least 76 °C with coal firing and 100 °C with oil firing.		
	* In case Bidder offers Tri-sector RAPH, Bidder at his option may or may not provide the SCAPH in primary air side if bidder can meet the specification requirement of preventing cold end corrosion with sizing of SCAPH in secondary air side. Bidder will furnish the relevant details, calculations, curves etc. along with his offer establishing the same.				
1.05.07.02	Design SCAPH and connected air ducts to handle flows corresponding to 60% TMCR loads with one of the two streams working without any undue noise/vibration.				
1.05.08	Pulverizer				
1.05.08.01	Pulverizer Type:				
	Bidder may offer any one of the types of pulverizers indicated below:				
	Classification		Type		
	(i)	Vertical Spindle	Bowl Mill Roller Mill or Approved equivalent		
	Above mills should have minimum three nos. of rollers. Differential pressure across mill bowl should not be more than 425 mm water column.				
1.05.08.02	Sizing of Coal Pulverisers				
	Selection, sizing and total number of Coal pulverisers to be provided for each Steam Generator shall confirm to following stipulations:				
	DESCRIPTION		CRITERIA TO BE SATISFIED		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC										
1.05.08.03	(i)	Number of mills for each Steam Generator	Adequate to achieve 100% TMCR for all specified coal(s) and all operating conditions, but not less than Eight (08) mills.										
	(ii)	Number of standby mills											
	(a)	At 100% of TMCR, (800 MW unit load) worst coal firing	One										
	(b)	At 100% BMCR worst coal firing	Nil										
	(c)	At 100% BMCR design coal firing	One										
	(iii)	Sizing of coal pulverizers confirming to clause 1.05.08.02 (i) &(ii) above shall be under following conditions all occurring simultaneously:											
	(a)	Maximum permissible Mill loading for deciding mill capacity (selection of mill type/model) complying with requirements at clause 12.05.08.02 above	90% of the mill loading achievable corresponding to the near worn out conditions of mill grinding rolls/balls/tyres etc. whichever is less. This condition shall be complied for the range of specified coals including the adequacy range of coals.										
	(b)	Unburnt carbon loss to be considered at various steam generator loads, for sizing/ selection of coal pulverizers	1% or actual expected value, whichever is higher										
	(c)	Rated Pulverized coal fineness* at rated capacity of the pulverizer, not less than	75% thru 200 mesh (75 microns) and 99% thru 50 mesh (300 microns)										
	(d)	Input coal size	Upto 50 mm										
	Note: * To be demonstrated at site for each mill by coal sampling as per ISO 9931 & with grinding elements within the guaranteed wear life of respective wear element.												
	Minimum Guaranteed Life of Coal Pulverizer Wear Parts												
	The guaranteed life of different mill components in "equivalent hours" of continuous mill operation at its rated capacity, while firing the specified range of coals and meeting the requirements as specified at clause no 1.03.00 of this Sub-Section and without requiring any in between repair or replacement shall be as under:												
	<table><thead><tr><th>ITEM</th><th>MINIMUM LIFE IN EQUIVALENT HOURS</th></tr></thead><tbody><tr><td>(1) Seals</td><td>20000</td></tr><tr><td>(2) Grinding elements (Rolls/Balls and Rings/Race)</td><td>8000 [See note (a) below]</td></tr><tr><td>(3) Mill discharge valves</td><td>15000</td></tr><tr><td>(4) Classifier cone and</td><td>25000</td></tr></tbody></table>			ITEM	MINIMUM LIFE IN EQUIVALENT HOURS	(1) Seals	20000	(2) Grinding elements (Rolls/Balls and Rings/Race)	8000 [See note (a) below]	(3) Mill discharge valves	15000	(4) Classifier cone and	25000
	ITEM	MINIMUM LIFE IN EQUIVALENT HOURS											
(1) Seals	20000												
(2) Grinding elements (Rolls/Balls and Rings/Race)	8000 [See note (a) below]												
(3) Mill discharge valves	15000												
(4) Classifier cone and	25000												
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	other items lined with Ceramic material (as applicable) (5) Classifier vane (as applicable) 25000 Note : (a) The YGP index for the specified coal is indicated in Project Information, Sub-section-I-B, Part-A, Section-VI of Technical specification when measured as per BS Standard BS-1016 Part-111. The Bidder shall furnish a curve alongwith his offer indicating the variation in guaranteed wear life with variation in YGP index of coal fired. Separate curves for different wear elements of mill shall be furnished e.g. for grinding rolls, grinding rings, clearly indicating its relationship with YGP index of coal. The curve shall be subject to Employer's approval.			
1.05.09	PULVERISED COAL PIPES			
1.05.09.01	Fuel air mixture velocity in coal pipes - minimum - 15 m/sec and maximum - 28 m/sec.			
	The coal air mixture velocity in the coal pipes shall not be lower than the critical fallout velocity under all conditions of mill operation from start up of boiler onward.			
1.05.09.02	The pipes shall be designed for an explosion pressures of 3.5 kg/cm ² (min.).			
1.05.09.03	Maximum permissible design stress shall be yield or 0.2% proof stress.			
1.05.09.04	The piping system shall be designed for a continuous operating temperature of 110 degree Celsius (minimum).			
1.05.09.05	Ceramic material specification: Alumina content of not less than 90% and guaranteed life 25000 Hrs (minimum).			
1.05.10	Raw Coal Feeders			
1.05.10.01	Each mill shall be fed with coal by an independent coal feeder.			
1.05.10.02	Provide the following minimum features in the RC feeder(s), in addition to complying with all the stipulations of NFPA (latest edition).			
	(i) Feeder Type	:	Gravimetric, belt type with minimum size of 36"	
	(ii) Raw Coal Feeder Sizing	:	1.2 times maximum capacity of coal pulverizer.	
	(iii) Environment Withstand capability	:	(a) Ambient temperature 70°C (min.)	
			(b) Explosion pressure: 3.5 Kg/cm ² (min.)	
			(c) Other environmental conditions	
	(iv) Feeder Accuracy	:		
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1.05.11 1.05.11.01 1.05.11.02	(a) Weighing Accuracy at works: ± 0.5%.			
	(b) Repeatability : 0.1%			
	(c) Shall have in-built facility for calibration			
	(v) System shall be capable of tolerating large supply voltage variation.			
	(vi) All site equipment shall be suitable for 70°C ambient temperature and other environment conditions envisaged.			
	PRIMARY AIR FANS			
	Fan Design			
	(a) Type of Fan : Two stage, constant speed, variable pitch, axial type.			
	(b) No. of fans : Two			
	(c) Type of fan blade : Stream lined/Aerofoil bladed type, designed to withstand high bending and axial load.			
(d) Fan suction : From atmosphere				
(e) Fan rotational speed : 1500 (max)				
Fan Sizing Criteria				
(a) Each fan shall be rated to meet requirement of 60% BMCR load (one stream in operation) with following conditions all occurring together.				
(1) Worst coal firing with maximum moisture content.				
(2) Power supply frequency - 49 Hz.				
(3) Ambient air temp. - 50 degree Celsius & RH 60%.				
(4) Air-heater primary air-in-leakage of 15% of flue gas flow entering in case of a Bi-sector APH (OR) primary air-in-leakage of 10% of flue gas flow entering in case of a Tri-sector APH (OR) guaranteed whichever is higher.				
(b) In any case the margins on flow & pressure shall not be less than 25% and 30% respectively over the calculated values at 100% BMCR condition. Above margin shall be under conditions indicated below all occurring together:				
(1) Worst coal firing with maximum moisture content.				
(2) Power supply frequency - 50 Hz.				
(3) Ambient air temp. - 50 degree Celsius & RH 60%.				
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1.05.12	(4) Air-heater primary air-in-leakage of 15% of flue gas flow entering in case of a Bi-sector APH (OR) primary air-in-leakage of 10% of flue gas flow entering in case of a Tri-sector APH (OR) guaranteed whichever is higher.			
	(5) All mills including standby mill shall be in service.			
	Note to 1.05.11.02 (a) & (b):			
	PA fans shall have a minimum stall margin of 10% over the Design duty points.			
	Motor Rating; Motor rating at 50 deg.C ambient temperature not less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5Hz to 51.5Hz and motor not to be overloaded during any mode of operations of driven equipment.			
1.05.12	Seal Air Fans			
	(a)	Type of Fan	:	Centrifugal,
	(b)	No. of fans	:	Two (2)x100% common for all the pulverizers of one Steam Generator unit
	(c)	Margin	:	a) On Flow - 25% b) On Pressure- 30%
	Above margins shall be based on an ambient temperature of 50 degree Celsius, relative humidity of 60 % and system leakages with mill operation at maximum duty.			
	(d)	Fan rotational speed	:	1500 (max) under test block condition
	Motor Rating; Motor rating at 50 deg.C ambient temperature not less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5Hz to 51.5Hz and motor not to be overloaded during any mode of operations of driven equipment.			
1.05.13	DRAFT PLANT			
1.05.13.01	The forced draft (F.D.) and induced draft (I.D.) fans shall be capable of maintaining balance draft conditions in the furnace over the entire load range with any one or both F.D. fans and any one or both I.D. fans in operation while firing the specified range of fuels.			
1.05.13.02	Fan Sizing Criteria			
	FD & ID fans shall be sized such that they satisfy the criteria stipulated below.			
	S.N.	Description	FD Fans	ID Fans
	1	Type of fans	Constant speed, axial type	Two stage, Constant speed, axial type.
	2	No. of fans per unit	Two	Two
	3	Fan sizing criteria with all the following conditions	Each fan to be sized for 60% TMCR load (one stream in operation) calculated taking into account	
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	S.N.	Description	FD Fans	ID Fans	
		occurring together :	following factors occurring together:		
	(i)	Type of coal firing	Design / Best / Worst whichever gives maximum FD fan air requirement	Design / Best / Worst whichever gives maximum flue gas flow.	
	(ii)	Power supply frequency	49 Hz	49 Hz	
	(iii)	Excess air	20% over the Stoichiometric air	20% over the Stoichiometric air	
	(iv)	Fan inlet air/flue gas temperature	50°C with 60% relative humidity	Gas temperature corresponding to 50°C ambient temperature and 60% relative humidity	
	(v)	Air-heater air-in-leakage	Secondary air-in-leakage of min.10% of flue gas flow entering Bi-sector APH (OR) actual guaranteed value whichever is higher. For Tri-sector APH, actual guaranteed value of leakage will be considered for fan sizing.	Based on min. 15% of flue gas flow entering PAPH and 10% of flue gas flow entering SAPH in case of Bi- sector APH (OR) 12% of flue gas flow entering Tri-sector APH (OR) actual guaranteed value whichever is higher.	
	(vi)	Pressure drop through SCR System	Not applicable	100 mm WC or actual whichever is higher	
	(vii)	Pressure drop through ESP	Not applicable	25 mm WC or actual whichever is higher	
	(viii)	Pressure drop through FGD System	Not applicable	150mm WC or actual whichever is higher(Alternately, separate booster fans for FGD system may be provided. if pressure drop through FGD system exceeds 150 mm WC. In such case, specified pressure drop through FGD system shall not be considered for sizing of ID fan.)	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.13.03	S.N.	Description	FD Fans	ID Fans
	(ix)	Air in leakage	Not applicable	1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts
	(x)	Pressure required at chimney inlet	Not applicable	+ 40 mm WC (In case separate booster fans for FGD system are provided, ID fans shall be sized for minimum +10 mm WC of pressure requirement at chimney inlet for any FGD bypass operation.)
	The fans shall also fulfill following sizing criteria in addition to those mentioned at Clause 1.05.13.02 above		Each fan to be sized for 50% TMCR flow calculated taking into following conditions occurring together.	
	(i)	Margin over 100% TMCR flow	20%	20%
	(ii)	Margin over 100% TMCR pressure requirement	44% Further for booster fan sizing, bidder to consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%. For bubbling type Absorber, Bidder shall consider choking/ blockage of 10% sparger tubes while calculating the head requirements of fan.	44% Further for booster fan sizing, bidder to consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%. For bubbling type Absorber, Bidder shall consider choking/ blockage of 10% sparger tubes while calculating the head requirements of fan.
	(iii)	Type of coal firing	Design / Worst / Best coal whichever gives maximum FD fan flow	Design/Worst/Best coal whichever gives maximum flue gas flow
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	S.N.	Description	FD Fans	ID Fans	
	(iv)	Power supply frequency	50 Hz	50 Hz	
	(v)	Excess air at economizer outlet	20% over stoichiometric air requirement	20% over stoichiometric air requirement	
	(vi)	Fan inlet air/flue gas temperature	50°C and 60%	150°C or actual gas temperature corresponding to 50°C ambient and 60% relative humidity, whichever is higher	
	(vii)	Air-heater air-in-leakage	Secondary air-in-leakage of Min. 10% of flue gas flow entering Bi-sector APH (OR) actual guaranteed value whichever is higher. For Tri-sector APH, actual guaranteed value of leakage will be considered for fan sizing.	Based on min. 15% of flue gas flow entering PAPH and 10% of flue gas flow entering SAPH in case of Bi-sector APH (OR) 12% of flue gas flow entering Tri-sector APH (OR) actual guaranteed value whichever is higher.	
	(viii)	Pressure drop through SCR System	Not applicable	100mm WC or actual whichever is higher	
	(ix)	Pressure drop through ESP	Not applicable	25 mm WC or actual whichever is higher	
	(x)	Pressure drop through FGD System	Not applicable	150 mm WC or actual whichever is higher (Alternately, separate booster fans for FGD system may be provided with flow and pressure margins as per (i) and (ii) above). , if pressure drop through FGD system exceeds 150 mm WC. In such case, specified pressure drop through FGD system shall not be considered for sizing of ID fan.)	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.05.14 1.05.14.01	S.N.	Description	FD Fans	ID Fans
	(xi)	Air in leakage	Not applicable	1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts
	(xiii)	Pressure required at chimney inlet	Not applicable	+40 mm WC (In case separate booster fans for FGD system are provided, ID fans shall be sized for mini-mum +10 mm WC of pressure requirement at chimney inlet for any FGD bypass operation.)
	(xiv)	Air & flue gas control	Blade pitch	Blade pitch
<u>Note to 1.05.13.02 & 1.05.13.03:</u> ID/FD fan shall have a minimum stall margin of 10% over the Design duty points. Motor Rating; The maximum continuous motor rating corresponding to maximum cooling water temperature to cooler inlet or the motor rating at 50 deg C ambient temperature (as applicable) not less than the maximum load demand of driven equipment at its entire range of operation at frequency variations from 47.5 Hz to 51.5 Hz and motor not to be overloaded during any mode of operations of the driven equipment. Duct Work Sizing Criteria: (a) Allowable velocities in the duct work. (1) Maximum air velocity shall be 16 m/sec. (2) Maximum gas velocity shall be 13m/sec except flue gas duct from ESP outlet to chimney inlet. (3) Maximum Flue gas velocity from ESP out-let to chimney inlet shall be 15 m/sec. The contractor shall select the flue gas velocities, within the specified limits, especially between boiler outlet to ESP such that the ash accumulations at part/low loads (corresponding to requirements specified in part-A-01 and anywhere else in the specifications) are minimized. The flue gas flow & ash accumulation patterns at such part/low loads shall be studied based on the CFD/Physical model test (PMT) of ducts & ESP as part of this contract. The same along with contractor's experience of similar cases (boiler/coal& ash type etc.) shall be used for selecting the final gas velocities by the contractor.				
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1.05.15	(b)	The velocities in the ducts shall not exceed the above limits under the following conditions, all occurring together:		
	(1)	Design/best/Worst coal firing at 100% BMCR load whichever gives maximum flow.		
	(2)	20% excess air over and above the stoichiometric air at economizer inlet.		
	(3)	For bisector air preheater, air heater air in leakage 10% of flue gas flow at inlet of secondary air preheater and 15% of flue gas flow at inlet of primary air preheater or actual guaranteed whichever is higher.		
	In case of trisector air preheater, for flue gas duct sizing air heater air in leakage 12 % of flue gas flow at inlet of air preheater or actual guaranteed whichever is higher.			
	For Secondary and Primary air duct sizing from respective fan discharge to air preheater, actual guaranteed value of air heater secondary air-in-leakage and 10% of flue gas flow as air heater primary air-in-leakage at inlet of air preheater respectively or actual guaranteed whichever is higher.			
	(4)	Design ambient temperature of 50degree Celsius and 60 % RH.		
	The size of interconnecting duct shall not be less than the individual ducts that these connect.			
	Coal burner design:			
	(a)	Turn down ratio of coal firing system 3:1 (min.).		
1.05.16	(b)	The coal burner design shall ensure a steady log mean density of coal air mixture distribution as it enters the combustion zone without allowing the coal dust to settle down.		
	(c)	The burner design shall minimize erosion.		
	(d)	The burner shall be designed to ensure smooth variation in the fuel flow without affecting the air fuel ratio.		
	(e)	The air/fuel ratio around the burner shall be optimized to ensure low emission of NOx. Total NOx emission from the unit at SCR inlet shall not be more than 325 mg/Nm3 at 6% Oxygen (O2) content on dry gas basis (from thermal as well as fuel) from 40% to 100% TMCR load condition for the entire range of coals specified.		
	(f)	Burners shall be provided with centralized automatic control with flame scanner and safety protection.		
1.05.16.01	Fuel oil preparation and Firing system:			
	The Fuel oil preparation and firing system shall be sized based on following criteria.			
	Description	Requirement		
		LDO Firing		
	(i) Purpose of fuel oil firing	Initial start up, Coal flame stabilization at low load To facilitate black start of unit,		
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1.05.16.02	(ii)	Type of fuel oil	Light Diesel Oil (As per characteristics given in per given in Table-1, Annexure-IV-1 Sub-Section-IB, Part-A of Section-VI
	(iii)	Oil firing system capacity	To cater to 30% BMCR requirements of Steam Generators without any coal firing*.
	(iv)	No. of independent oil firing streams	1 (Catering to requirements of steam generators)
	* To arrive at 30%BMCR requirements for sizing of LDO/HSD, value corresponding to 30% of 100% Q fired at BMCR worst coal to be considered.		
	Oil Burners/Burner Components		
	(a)	Type - Air atomized to be able to operate together with pumping system offered for LDO	
	(b)	Burner tips shall be provided as per following table:	
		Description	LDO Firing System
	(i)	Type of burner	Air atomized (air to be from compressed air system)
	(ii)	Burner cooling medium	Air
(iii)	Burner tip material	Resistant to corrosion due to fuel oils containing sodium, vanadium, sulphur, chloride etc.	
(iv)	Minimum life of burner tips, before needing any maintenance replacements	16000 hours	
(v)	Hardness of atomizer (The hardness to be retained even at 400°C)	Minimum vickers hardness number of 400	
(vi)	Type of oil igniters	High Energy Arc Igniters	
vii)	Oil burner turndown	3:1	
1.05.17	THERMAL INSULATION, LAGGING, CLADDING & REFRACTORIES		
	Thermal Insulation shall be designed based on criteria mentioned in separate chapter on Thermal insulation.		
1.05.18	BLOW DOWN SYSTEM		
1.05.18.01	The atmospheric flash tank shall be sized to receive following:		
	i) Maximum possible start up recirculation & drain flow under all possible normal,		
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	abnormal, upset, accidental conditions and even with startup recirculation pump out of service. ii) All drains from Steam Generator such as drains from water wall headers, attemperators headers, SCAPH drains, soot blowers drains, superheater, reheater etc. iii) Alternate drains from main steam lines, CRH lines, HRH lines, as required. iv) Any other drains from High Pressure piping. For sizing, combination of all the above occurring simultaneously to be considered. Atmospheric tank shall be located at suitable level in the Steam Generator area.																	
1.05.18.02	Drain receiving vessel shall be sized to receive drains from atmospheric tank and shall have storage for atleast 10 minutes of maximum possible start up recirculation & drain flow under all possible normal, abnormal, upset, accidental conditions with startup recirculation pump in operation.																	
1.05.18.03	2X50% condensate transfer pumps to be provided. For arriving the size of pump all drains as indicated in clause 1.05.18.01 shall be considered. This pump shall be used to transfer condensate from receiving vessel to main condenser either directly or through condenser flash tank located in TG area.																	
1.05.19	SCR SYSTEM SIZING CRITERIA (In case Bidder opts for SCR System alone) The SCR System shall be designed to comply with the requirements stipulated in the table below:																	
1.05.19.01	SCR System Sizing shall comply the following:																	
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA															
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CLAUSE NO.	TECHNICAL REQUIREMENTS																		
			future																
	5.	Flue Gas maximum velocity through SCR reactor (m/s)	Maximum 5 m/sec																
	6.	Minimum Catalyst volume per reactor per layer (m³) with plugging margin	150																
	7.	Minimum Chemical life of the catalyst (Hrs)	16,000																
	8.	Minimum Mechanical life of the catalyst (Hrs)	60,000																
	9.	Minimum Plugging of the catalyst face surface to be considered for catalyst volume (%)	15																
	10.	SCR casing thickness	6mm (min)																
	11.	SCR Supporting Structure	Considering additional load of following: i) Ash accumulation of 150mm height above each catalyst layer including future layer ii) Each layer plugged with 50% ash including future layer iii) Ash hopper completely filled with Ash																
	1.05.19.02	The SCR System shall be designed to comply with the requirements stipulated under 'Guarantee point and design point' in the table below: <table><tr><th>Description</th><th>Guarantee Point</th><th>Design Point</th></tr><tr><td>Type of Coal</td><td>Design Coal</td><td>Range of coal as specified in the specification</td></tr><tr><td>Ambient air</td><td>27 Deg C</td><td>6 Deg to 50 Deg C</td></tr><tr><td>Boiler Load</td><td>100% TMCR</td><td>40% TMCR to BMCR</td></tr><tr><td>NOx at SCR Inlet (mg/Nm³ at 6% O₂ on dry basis, keeping ammonia slip within the maximum limit)</td><td>Limited to 500 (shall be increased from actual level by adjustment of air staging and other</td><td>500</td></tr></table>			Description	Guarantee Point	Design Point	Type of Coal	Design Coal	Range of coal as specified in the specification	Ambient air	27 Deg C	6 Deg to 50 Deg C	Boiler Load	100% TMCR	40% TMCR to BMCR	NOx at SCR Inlet (mg/Nm³ at 6% O₂ on dry basis, keeping ammonia slip within the maximum limit)	Limited to 500 (shall be increased from actual level by adjustment of air staging and other	500
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																
		PAGE 24 OF 101																	

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
1.05.19.03		measures)	
	SCR efficiency for control of NOx Emission (%) (keeping ammonia slip within the maximum limit)	92	80 (after 16000 operational hours)
	Inlet Dust Burden (g/Nm3 at 6% O2 on dry gas volume basis)	80	80
	SO2 to SO3 oxidation (%)	<1	<1
	Max Flue Gas pressure drop across SCR System (mmwc)	To be guaranteed	100 or as per bidder's adopted SCR system design or actual, whichever is higher.
	Ammonia Slip after last catalyst layer (ppmat 6% O2 on dry basis)	< 3	< 2.5
	Minimum ammonia Consumption in Kg/Hr	To be guaranteed	1.05 Normalized Stoichiometric Ratio(NSR)
	Components of the SCR System shall be designed to comply with the requirements stipulated in the table below:		
	i)Catalyst module		
	Catalyst Type	Plate Type	
Catalyst pitch	Minimum 7mm		
Catalyst substrate thickness & material	Minimum 0.3 mm, Stainless steel		
Finished Catalyst plate thickness	Min 0.7 mm		
No. of sublayers in each catalyst module	Maximum 2 sublayer is permitted		
Height of catalyst module (maximum) (mm)	1400		
ii) Flue Gas Duct inlet and outlet			
Flue gas velocity at BMCR with 20%excess	Max 13 m/sec with Design/Worst/Best coal whichever gives maximum flue gas		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC								
1.05.19.04	<table><tr><td>air at economizer outlet</td><td>flow and operating temperature corresponding to 50deg C ambient temperature and 60% RH</td></tr><tr><td>Duct plate thickness</td><td>Min 6 mm</td></tr><tr><td>Economiser bypass duct sizing</td><td>Adequate to maintain required flue gas temperature at SCR inlet corresponding to design point for the operation of SCR system in the load range of 40% TMCR to BMCR</td></tr><tr><td>SCR bypass duct capacity</td><td>Flue gas flow corresponding to BMCR load with 20 % excess air. Other considerations same as those considered for SCR flue gas inlet and outlet duct.</td></tr></table>		air at economizer outlet	flow and operating temperature corresponding to 50deg C ambient temperature and 60% RH	Duct plate thickness	Min 6 mm	Economiser bypass duct sizing	Adequate to maintain required flue gas temperature at SCR inlet corresponding to design point for the operation of SCR system in the load range of 40% TMCR to BMCR	SCR bypass duct capacity	Flue gas flow corresponding to BMCR load with 20 % excess air. Other considerations same as those considered for SCR flue gas inlet and outlet duct.	
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	SCR bypass duct capacity	Flue gas flow corresponding to BMCR load with 20 % excess air. Other considerations same as those considered for SCR flue gas inlet and outlet duct.									
	Ammonia Unloading, Storage & Handling System (Common for all two units):										
	This system shall be designed for considering the condition indicated under design point of SCR system.										
	i) Ammonia Storage Tank										
	No. of tanks	Two (02), Cylindrical, Horizontal									
	Storage capacity of each tank	Catering the requirement of two (02) reactor SCR System for one (01) steam generator under design condition meeting 14 day requirement.									
	Fraction of vapor/Liquid	15%/85%									
	Corrosion Allowance	Min 3 mm									
	Design Pressure & temperature	Min 23 kg/cm ² & -20 to 50 Deg C									
	Operating Range	30% to 85% of the tank volume									
	ii) Ammonia Unloading system										
	No of unloading Compressors	Two (02)									
	Capacity of each compressor	Min 1100 LPM, Reciprocating, oil free type									
Discharge pressure	Min 20 bar or as per system requirement considering 44% margin, whichever is										
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 26 OF 101								

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
		higher	
	iii) Ammonia vaporizer system		
	Total No. of vaporizer	Three (03)	
	Design capacity of each vaporizer	475 kg/Hr or the system requirement of SCR System for one (01) steam generator under design condition considering 20% margin, whichever is higher	
	No. of warm Glycol/Water/Glycol-Water circulation pumps per vaporizer & capacity	Two (02). One pump capacity to take care of one vaporizer with margin 20% in flow and 44% in pressure	
	Glycol/Water/Glycol-Water heater		
	Type	Tube and Shell type	
	Heating media	Steam	
	Heating capacity	Considering added margin of 20 deg C over the process requirement.	
	iv) Ammonia Forwarding system		
	a) Forwarding Pumps (If Applicable)		
	Type of pump	Leak proof and without seal type	
	No. of pumps	2	
	Capacity of each pump	Catering the requirement of SCR System for two (02) steam generators under design condition	
	b) Accumulators		
	No. of accumulators	Three (03)	
	Capacity of each accumulator for handling ammonia	Min 3 m ³	
	v) Waste Ammonia Collection, Dilution and Disposal System		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 27 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
1.05.19.05	a) Waste Ammonia Collection, Dilution			
	No. of waste ammonia dilution tank	One (01)		
	Storage capacity of dilution tank (minimum) (m ³)	10		
	Service fluid	NH ₃ contaminated water		
	Temperature	80 deg C		
	b) Dyke for collection of ammonia			
	No. of dyke	One(1) around storage tank		
	Storage capacity of dyke (m ³)	Equivalent to one storage tank capacity		
	c) Waste Water Collection System			
	No. of waste water retaining basin	One (01)		
	Storage capacity of retaining basin (m ³)	Ten (10)		
	No. of waste water disposal pump	Two (02)		
	Capacity of each waste water disposal pump (minimum) (m ³ /hr)	30 or the system requirement considering 20% margin, whichever is higher		
	Pressure	As per system requirement plus 44% margin		
	Note : In case the discharge from PRV's and blow-out of the loading arms are connected to the waste ammonia dilution tank instead of boiler chimney, waste ammonia dilution tank and retaining basin shall be sized considering maximum discharge of ammonia at any moment of time			
	<u>Dilution Air System (For Each unit)</u>			
	i) Dilution Air fans (if applicable)			
	No. of dilution air fans per unit	Two (02)		
	Type of fan	Centrifugal		
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 28 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
1.05.19 (option)	Capacity of each fan	Catering the requirement of two(02) reactor of SCR System for one (01) steam generator under design condition																		
	Fan inlet air temperature (°C)	50°C with 60% relative humidity																		
	Margin over rated flow (%)	25																		
	Margin over rated discharge pressure (%)	30																		
	ii) Dilution air heater (if applicable)																			
	No. & Type	Two (2) & Electrical																		
	Flow	Each heater flow equivalent to capacity of one dilution air fan/ inlet duct																		
	Heating capacity	Considering minimum inlet air temperature 6 DegC to 50 deg or process requirement whichever is higher.																		
	Hybrid (SCR+SNCR) System Sizing Criteria (In case Bidder opts Hybrid system in place of SCR system alone)																			
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																														
	<table><tr><td>6.</td><td>Minimum Catalyst volume per reactor per layer (m³) with plugging margin</td><td>112.5</td></tr><tr><td>7.</td><td>Minimum Chemical life of the catalyst (Hrs)</td><td>16,000</td></tr><tr><td>8.</td><td>Minimum Mechanical life of the catalyst (Hrs)</td><td>60,000</td></tr><tr><td>9.</td><td>Minimum Plugging of the catalyst face surface to be considered for catalyst volume (%)</td><td>15</td></tr><tr><td>10.</td><td>SCR casing thickness</td><td>6mm (min)</td></tr><tr><td>11.</td><td>SCR Supporting Structure</td><td>Considering additional load of following: i) Ash accumulation of 150mm height above each catalyst layer including future layer ii) Each layer plugged with 50% ash including future layer iii) Ash hopper completely filled with Ash</td></tr></table>			6.	Minimum Catalyst volume per reactor per layer (m ³) with plugging margin	112.5	7.	Minimum Chemical life of the catalyst (Hrs)	16,000	8.	Minimum Mechanical life of the catalyst (Hrs)	60,000	9.	Minimum Plugging of the catalyst face surface to be considered for catalyst volume (%)	15	10.	SCR casing thickness	6mm (min)	11.	SCR Supporting Structure	Considering additional load of following: i) Ash accumulation of 150mm height above each catalyst layer including future layer ii) Each layer plugged with 50% ash including future layer iii) Ash hopper completely filled with Ash												
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 30 OF 101																														

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC																																																																												
	Solid Urea Consumption rate in Kg/hr		To be guaranteed																																																																													
	C) Components of the SNCR of Hybrid System shall be designed to comply with the requirements stipulated in the table below (Separate for each unit): SNCR system shall be sized to meet the overall efficiency requirement of Hybrid system along with SCR system at guarantee and design point conditions. <table><tr><td colspan="4">i) Dilution Water Module</td></tr><tr><td colspan="2">No. of Pumps</td><td colspan="2">Two (02)</td></tr><tr><td colspan="2">Capacity of each pump</td><td colspan="2">System Requirement of one unit at design condition + 20% margin</td></tr><tr><td colspan="2">Head</td><td colspan="2">System requirement of one unit at design condition + 44% margin</td></tr><tr><td colspan="4">ii) Metering Module</td></tr><tr><td colspan="2">Redundancy in aqueous urea and dilution water stream</td><td colspan="2">100%</td></tr><tr><td colspan="2">Capacity of each aqueous urea and dilution water stream</td><td colspan="2">System Requirement of one unit at design condition + 20% margin</td></tr><tr><td colspan="4">iii) Distribution Module (If Applicable)</td></tr><tr><td colspan="2">No. of distribution system module</td><td colspan="2">For each elevation</td></tr><tr><td colspan="2">Capacity</td><td colspan="2">As per system requirement + 20% margin</td></tr><tr><td colspan="4">iv) Injectors and its piping</td></tr><tr><td colspan="2">Total no. of injectors</td><td colspan="2">As per the efficiency requirement of system at guarantee and design condition +20% margin for plugging</td></tr></table> D) Components of the SCR of Hybrid System shall be designed to comply with the requirements stipulated in the table below (Separate for each unit): <table><tr><td colspan="4">i) Urea to ammonia convertor</td></tr><tr><td colspan="2">No. of Urea to ammonia convertor</td><td colspan="2">One (01) for each unit</td></tr><tr><td colspan="2">Ammonia production rate of each Urea to ammonia convertor</td><td colspan="2">Ammonia requirement for SCR of hybrid system of each steam generator under design condition plus 20% margin</td></tr><tr><td colspan="2">Heating system</td><td colspan="2">Electrical/ steam</td></tr><tr><td colspan="2">Heating system capacity</td><td colspan="2">i) Minimum ambient temperature to required temperature plus 25 deg C ii) Flow – Max capacity of urea to ammonia convertor iii) Loss of heat from various surfaces in worst condition</td></tr><tr><td colspan="4">ii) Dilution Air fans</td></tr><tr><td colspan="2">No. of dilution air fans per unit</td><td colspan="2">Two (02)</td></tr></table>				i) Dilution Water Module				No. of Pumps		Two (02)		Capacity of each pump		System Requirement of one unit at design condition + 20% margin		Head		System requirement of one unit at design condition + 44% margin		ii) Metering Module				Redundancy in aqueous urea and dilution water stream		100%		Capacity of each aqueous urea and dilution water stream		System Requirement of one unit at design condition + 20% margin		iii) Distribution Module (If Applicable)				No. of distribution system module		For each elevation		Capacity		As per system requirement + 20% margin		iv) Injectors and its piping				Total no. of injectors		As per the efficiency requirement of system at guarantee and design condition +20% margin for plugging		i) Urea to ammonia convertor				No. of Urea to ammonia convertor		One (01) for each unit		Ammonia production rate of each Urea to ammonia convertor		Ammonia requirement for SCR of hybrid system of each steam generator under design condition plus 20% margin		Heating system		Electrical/ steam		Heating system capacity		i) Minimum ambient temperature to required temperature plus 25 deg C ii) Flow – Max capacity of urea to ammonia convertor iii) Loss of heat from various surfaces in worst condition		ii) Dilution Air fans				No. of dilution air fans per unit		Two (02)	
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	<table><tr><td>Type of fan</td><td>Centrifugal</td></tr><tr><td>Capacity of each fan</td><td>Catering the requirement of two(02) reactor of SCR System for one (01) steam generator under design condition</td></tr><tr><td>Fan inlet air temperature</td><td>50°C with 60% relative humidity</td></tr><tr><td>Margin over rated flow (%)</td><td>25</td></tr><tr><td>Margin over rated discharge pressure (%)</td><td>30</td></tr><tr><td colspan="2">iii) Dilution air heater</td></tr><tr><td>No. & Type</td><td>Two (2) & Electrical / Steam Heated</td></tr><tr><td>Air Flow rate</td><td>Each heater flow equivalent to capacity of one dilution air fan/ inlet duct</td></tr><tr><td>Heating capacity</td><td>Refer D (i) above</td></tr><tr><td colspan="2">iv)Catalyst module</td></tr><tr><td>Catalyst Type</td><td>Plate Type</td></tr><tr><td>Catalyst pitch</td><td>Minimum 7mm</td></tr><tr><td>Catalyst substrate thickness & material</td><td>Minimum 0.3 mm, Stainless steel</td></tr><tr><td>Finished Catalyst plate thickness</td><td>Min 0.7 mm</td></tr><tr><td>No. of sub layers in each catalyst module</td><td>Maximum 2 sub layer is permitted</td></tr><tr><td>Height of catalyst module (maximum) (mm)</td><td>1300</td></tr><tr><td colspan="2">v)Flue Gas Duct inlet and outlet</td></tr><tr><td>Flue gas velocity at BMCR with 25% excess air at economizer outlet</td><td>Max 13 m/sec with Design/Worst/Best coal whichever gives maximum flue gas flow and operating temperature corresponding to 50deg C ambient temperature and 60% RH</td></tr><tr><td>Duct plate thickness</td><td>Min 6 mm</td></tr><tr><td>Economiser bypass duct sizing</td><td>Adequate to maintain required flue gas temperature at SCR inlet corresponding to design point for the operation of SCR system in the load range of 40% TMCR to BMCR</td></tr><tr><td>SCR bypass duct capacity</td><td>Flue gas flow corresponding to BMCR load with 25% excess air</td></tr></table>			Type of fan	Centrifugal	Capacity of each fan	Catering the requirement of two(02) reactor of SCR System for one (01) steam generator under design condition	Fan inlet air temperature	50°C with 60% relative humidity	Margin over rated flow (%)	25	Margin over rated discharge pressure (%)	30	iii) Dilution air heater		No. & Type	Two (2) & Electrical / Steam Heated	Air Flow rate	Each heater flow equivalent to capacity of one dilution air fan/ inlet duct	Heating capacity	Refer D (i) above	iv)Catalyst module		Catalyst Type	Plate Type	Catalyst pitch	Minimum 7mm	Catalyst substrate thickness & material	Minimum 0.3 mm, Stainless steel	Finished Catalyst plate thickness	Min 0.7 mm	No. of sub layers in each catalyst module	Maximum 2 sub layer is permitted	Height of catalyst module (maximum) (mm)	1300	v)Flue Gas Duct inlet and outlet		Flue gas velocity at BMCR with 25% excess air at economizer outlet	Max 13 m/sec with Design/Worst/Best coal whichever gives maximum flue gas flow and operating temperature corresponding to 50deg C ambient temperature and 60% RH	Duct plate thickness	Min 6 mm	Economiser bypass duct sizing	Adequate to maintain required flue gas temperature at SCR inlet corresponding to design point for the operation of SCR system in the load range of 40% TMCR to BMCR	SCR bypass duct capacity	Flue gas flow corresponding to BMCR load with 25% excess air
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	<u>E) Urea Unloading, Storage, Handling & Preparation System for Hybrid System (Common for all two units)</u> This system shall be designed for considering the condition indicated under design point of Hybrid System. <table><tr><td colspan="2">i) Dry urea unloading hopper and Unloading Screw Conveyor</td></tr><tr><td>No. of Urea unloading hoppers</td><td>Two (02), Pyramidal or conical type</td></tr><tr><td>Storage capacity of each hopper (minimum)</td><td>4000 Kg of dry urea</td></tr><tr><td>No. of unloading screw conveyor</td><td>Two (02)</td></tr><tr><td>Capacity of unloading screw conveyor (minimum) (T/hr)</td><td>25</td></tr><tr><td colspan="2">ii)Dry urea storage silo</td></tr></table>			i) Dry urea unloading hopper and Unloading Screw Conveyor		No. of Urea unloading hoppers	Two (02), Pyramidal or conical type	Storage capacity of each hopper (minimum)	4000 Kg of dry urea	No. of unloading screw conveyor	Two (02)	Capacity of unloading screw conveyor (minimum) (T/hr)	25	ii)Dry urea storage silo																															
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 32 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	No of dry urea storage silo	Two (02)	
	Storage capacity of each dry urea storage silo	Catering the requirement of hybrid system for two (02) steam generator under design condition meeting one (01) day requirement.	
	Fraction of silo volume used for storage (maximum)	90%	
	iii) Transfer Screw Conveyor (if applicable)		
	No. of Screw conveyors	Two (02)	
	Capacity of transfer screw conveyor (minimum) (T/hr)	50	
	iv) Dehumidification module		
	No. of Dehumidification module	Two (02)	
	Discharge capacity of each Dehumidification module	As per system requirement plus 20% margin	
	Discharge pressure of each Dehumidification module	As per system requirement plus 44% margin	
	v) Solutionizing (mixing of urea and water) tank		
	No. of solutionizing tank	Two (02)	
	Solutionizing capacity of each tank (minimum) (m ³)	100	
	Fraction of tank volume used for solutionizing (maximum)	90%	
	Electric immersion heaters	Considering added margin of 20 °C over the process requirement.	
	vi) Solutionizing transfer and recirculation pump		
	No. of Solutionizing transfer and recirculation pump for each solutionizing tank	Two (02)	
	Discharge capacity of each pump	As per system requirement plus 20% margin	
	Discharge pressure of each pump	As per system requirement plus 44% margin	
	Fluid handling temperature (minimum) (°C)	Considering added margin of 20 °C over the process requirement.	
	vii) Aqueous urea storage tanks		
	No. of aqueous urea storage tanks	Three (03)	
	Storage Capacity of each aqueous urea storage tanks (minimum) (m ³)	375 m ³ or the system requirement of hybrid system for two (02) steam generator under design condition meeting fourteen (14) days requirement, whichever is higher	
	Fraction of tank volume used for storage (maximum)	95%	
	No. of recirculation pump for each aqueous urea storage tank	Two (02)	
	Capacity of each recirculation pump (m ³ /hr)	Adequate to recirculate each tank	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 33 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.20		storage capacity in one (01) hour.		
	Pad heater or heat tracing (if applicable)	Considering added margin of 20 °C over the process requirement.		
	viii) Waste Urea collection and Disposal System			
	a) Dyke for collection of aqueous urea			
	No. of dyke	One (01) around aqueous urea storage tank		
	Storage capacity of dyke (m³)	Equivalent to one aqueous urea storage tank capacity		
	b) Waste Water Collection System			
	No. of waste water retaining basin	One (01)		
	Storage capacity of retaining basin (m³)	Ten (10)		
	No. of waste water disposal pump	Two (02)		
	Capacity of each waste water disposal pump (minimum) (m³/hr)	30 or the system requirement considering 20% margin, whichever is higher		
	Pressure	As per system requirement plus 44% margin		
	ix) Urea circulation/ transfer pump			
	No. of pumps	Two (02)		
	Discharge capacity of each pump	As per system requirement for two units at design condition plus 20% margin		
	Discharge pressure of each pump	As per system requirement for two units at design condition plus 44% margin		
	x) Dilution water storage tank and dilution water transfer pump			
	No. of dilution water storage tank	One (01)		
	Storage Capacity of dilution water storage tank (minimum) (m³)	System requirement of hybrid system for two (02) steam generator under design condition meeting twelve (12) hours requirement		
	Fraction of tank volume used for storage (maximum)	90%		
	No. of dilution water transfer pump	Two (02)		
	Discharge capacity of each pump	As per system requirement for two units at design condition plus 20% margin		
	Discharge pressure of each pump	As per system requirement for two units at design condition plus 44% margin		
	Note:- Sizing of DM water system including tank and pump, Compressor system, Electrical switchgear, transformer etc shall be increased considering the requirement of hybrid system.			
	ESP SIZING CRITERIA			
	(A) Electrostatic Precipitator Design Data			
	The Electrostatic Precipitator(s) shall be designed to comply with the requirements stipulated under 'Guarantee point and design point' in the table below:			
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 34 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS																																											
	<table><tr><th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr><tr><td>1</td><td>Boiler Load in MW (e)</td><td>TMCR</td><td>VWO</td></tr><tr><td>2</td><td>Type of Coal</td><td>Design coal</td><td>Worst coal (max. ash coal from range)</td></tr><tr><td>3</td><td>Ambient air condition</td><td>27 degree Celsius temp. and 60% RH</td><td>45 degree Celsius temp. and 60% RH</td></tr><tr><td>4</td><td>Gas flow per ESP at the ESP inlet when firing respective coal (m³/sec)</td><td>To be worked out by Bidder when firing the specified design coal at 100% TMCR (800 MW unit load) considering 25% excess air at economiser Outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.</td><td>To be worked out by Bidder when firing the specified worst coal (with max. ash) at VWO considering 25% excess air at economiser outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.</td></tr><tr><td>5</td><td>Gas temperature at ESP inlet (deg. C)</td><td>125 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher</td><td>145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher</td></tr><tr><td>6</td><td>Inlet Dust Burden (gms/Nm³)</td><td>To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP While firing specified design coal</td><td>To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP, While firing specified worst coal with maximum ash</td></tr><tr><td>7</td><td>No. of series electrical fields out of operation</td><td>Nil</td><td>ONE(One field in all passes)</td></tr><tr><td>8</td><td>ESP Dust Collection Efficiency (%)</td><td>To be worked out by Bidder to limit ODB to 17 mg/Nm³ (maximum) at ESP outlet before FGD system inlet</td><td>To be worked out by Bidder to limit ODB to 50 mg/Nm³ (maximum) at ESP outlet before FGD system inlet</td></tr><tr><td>9</td><td>Minimum specific collection area</td><td>285</td><td>-</td></tr></table>				Sl. No	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	TMCR	VWO	2	Type of Coal	Design coal	Worst coal (max. ash coal from range)	3	Ambient air condition	27 degree Celsius temp. and 60% RH	45 degree Celsius temp. and 60% RH	4	Gas flow per ESP at the ESP inlet when firing respective coal (m ³ /sec)	To be worked out by Bidder when firing the specified design coal at 100% TMCR (800 MW unit load) considering 25% excess air at economiser Outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal (with max. ash) at VWO considering 25% excess air at economiser outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.	5	Gas temperature at ESP inlet (deg. C)	125 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher	145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher	6	Inlet Dust Burden (gms/Nm ³)	To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP While firing specified design coal	To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP, While firing specified worst coal with maximum ash	7	No. of series electrical fields out of operation	Nil	ONE(One field in all passes)	8	ESP Dust Collection Efficiency (%)	To be worked out by Bidder to limit ODB to 17 mg/Nm ³ (maximum) at ESP outlet before FGD system inlet	To be worked out by Bidder to limit ODB to 50 mg/Nm ³ (maximum) at ESP outlet before FGD system inlet	9	Minimum specific collection area	285	-
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 35 OF 101																																								

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																				
	(m²/m³/sec) <table><tr><td>10</td><td>Maximum flue gas velocity through the ESP (M/sec)</td><td>1.0</td><td>1.0</td></tr><tr><td>11</td><td>Treatment time of the flue gases in seconds</td><td>20 (min.)</td><td>20 (min.)</td></tr><tr><td>12</td><td colspan="3">Refer 13 b) below</td></tr><tr><td>13</td><td colspan="3">Other design parameters:</td></tr><tr><td>a)</td><td>Minimum Aspect Ratio</td><td>1.5</td><td>1.5</td></tr><tr><td>b)</td><td>Design internal pressure at 67% yield strength (mm wc)</td><td>± 660</td><td>± 660</td></tr><tr><td>c)</td><td>Precipitator mechanical Design temperature (deg.C)</td><td>200</td><td>200</td></tr><tr><td>d)</td><td>Short temp excursion temperature (for approx. thirty (30) minutes at a time) (deg. C)</td><td>300</td><td>300</td></tr><tr><td>e)</td><td>Ambient temperature (deg.C) for ESP design</td><td>50 deg.C</td><td>50 deg.C</td></tr><tr><td>f)</td><td>Minimum no. of T/R sets per stream per series electrical field</td><td>One (1)</td><td>One (1)</td></tr><tr><td>g)</td><td>Maximum collection area served by one T/R set (M2)</td><td>4000</td><td>4000</td></tr><tr><td>h)</td><td>Minimum no. of bus sections per T/R set</td><td>One (1)</td><td>One (1)</td></tr><tr><td>i)</td><td>Minimum dust hopper storage capacity (upto the maximum trip level based on design point conditions while</td><td>Eight (8)</td><td>Eight (8)</td></tr></table>				10	Maximum flue gas velocity through the ESP (M/sec)	1.0	1.0	11	Treatment time of the flue gases in seconds	20 (min.)	20 (min.)	12	Refer 13 b) below			13	Other design parameters:			a)	Minimum Aspect Ratio	1.5	1.5	b)	Design internal pressure at 67% yield strength (mm wc)	± 660	± 660	c)	Precipitator mechanical Design temperature (deg.C)	200	200	d)	Short temp excursion temperature (for approx. thirty (30) minutes at a time) (deg. C)	300	300	e)	Ambient temperature (deg.C) for ESP design	50 deg.C	50 deg.C	f)	Minimum no. of T/R sets per stream per series electrical field	One (1)	One (1)	g)	Maximum collection area served by one T/R set (M2)	4000	4000	h)	Minimum no. of bus sections per T/R set	One (1)	One (1)	i)	Minimum dust hopper storage capacity (upto the maximum trip level based on design point conditions while	Eight (8)	Eight (8)
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 36 OF 101																																																				

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1.05.21.01		firing worst coal with maximum ash) (in Hrs)																						
	j)	Minimum hopper valley angle to the horizontal (degrees)	Sixty Five (65)	Sixty Five (65)																				
	k)	Spacing between the collecting electrodes (Centreline to centreline-transverse to the gasflow (mm)	400	400																				
	l)	Minimum installed corona power per unit effective collection area (Watts/M2) *	17.0	17.0																				
	m)	Maximum nos. of ash hoppers	Two (2) for one TR set																					
	Note :																							
	*	The corona power shall be defined as the product of, average bus voltage and mean current divided by the collection area served by one T/R set.																						
	**	The flue gas volume in Nm³/sec shall be calculated at normal temperature and pressure.																						
	FGD SYSTEM SIZING CRITERIA																							
	The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated under 'Guarantee Point' and 'Design Point' conditions indicated below:																							
<table><tr><th>SN</th><th>Item</th><th colspan="2">Guarantee Point</th><th>Design Point</th></tr><tr><td>1</td><td>Boiler Load in MW (e)</td><td colspan="2">TMCR</td><td>VWO</td></tr><tr><td>2</td><td>Type of Coal</td><td colspan="2">Design coal</td><td>Design/Best/Worst Coal whichever give maximum sizing determining values</td></tr><tr><td>3</td><td>Ambient air condition</td><td>27degree temperature and 60% RH</td><td>Celsius</td><td>45 degree temperature and 60% RH Celsius</td></tr></table>					SN	Item	Guarantee Point		Design Point	1	Boiler Load in MW (e)	TMCR		VWO	2	Type of Coal	Design coal		Design/Best/Worst Coal whichever give maximum sizing determining values	3	Ambient air condition	27degree temperature and 60% RH	Celsius	45 degree temperature and 60% RH Celsius
SN	Item	Guarantee Point		Design Point																				
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 37 OF 101																			

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.05.21.02 1.05.21.03 1.05.22.01	SN	Item	Guarantee Point	Design Point
	4	Gas flow (M ³ /sec)	To be worked out by Bidder when firing the coal as per SN (2) above at TMCR (800 MW) load, considering 20% excess air at economizer outlet, 10% Air heater in leakage and 1% duct and 1% ESP leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal at VVO load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.
	5	Gas temperature at FGD inlet (deg. C)	125 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher	145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher
	6	Inlet SO ₂ concentration (mg/Nm ³)	To be worked out by the Bidder (based on the above conditions).	To be worked out by the Bidder (based on the above conditions).
	7.	SO ₂ Removal Efficiency	To be worked out by the Bidder to achieve SO ₂ emission in the chimney to less than 60 mg/nm ³ (6% O ₂ dry basis)	To be worked out by the Bidder to achieve SO ₂ emission in the chimney to less than 80 mg/Nm ³ (6% O ₂ dry basis)
	* SO₂ concentrations shall be measured at Absorber inlet and in chimney for the purpose of calculating removal efficiency.			
	The Flue Gas Desulphurisation (FGD) System shall also be designed to achieve SO₂ emission of less than 100 mg/Nm³ (6% O₂ dry) for the range of loads at different operating conditions and for range of coals as specified in this Sub-Section below.			
	The Flue Gas Desulphurisation System shall also be capable to limit SO₂ to less than 100 mg/Nm³ (6% O₂ dry) on sustained basis when Steam Generator is fired with upto 30% imported coal (by weight) blended with Indian coal as specified. System redundancies/ margins on equipment/ auxiliary sizing need not be available under such fuel firing condition unless specifically mentioned otherwise. However, equipments/ systems shall not exceed their safety limits under such firing, and shall not transgress in to factors of safety as per specification/ codes.			
	CHIMNEY A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system. Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a wet stack without reheating of the flue gas. In such a case the flue gas will be saturated. However, provision has also been made for isolation of the flue gas flow through the absorber and also			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 38 OF 101

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	for bypass of the absorber, to allow maintenance of the absorber with the unit in operation. In such a case flue gas will directly go to the Chimney after ID Fans through bypass duct. Single-flue or Multi-flue chimney(s) shall be provided. There shall be one flue for each unit. In addition to compliance with statutory norms, the height of the Chimney shall be such that the flue gas emission point shall adequately clear the top most accessible elevation in the plant. In any case the height of the chimney above the plant grade-level shall be at least 150 m (Two Single Flue Chimneys) or 220 m (Twin Flue Single Chimney). The Bidder shall furnish unit rates for addition and deletion in height of the chimney with respect to the height mentioned above in relevant schedule of BPS. The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation. The chimney flue liner cladding shall be made of 1.5 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 (ASTM B575, UNS N10276) alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done by explosion bonding or hot rolling to achieve the required quality as per ASTM B 898-11. Alternatively, Contractor can also provide chimney of 8 mm thick (minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness, which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening. In such a case, Contractor/Lining supplier shall provide a ten (10) year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system. Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Borosilicate Lining and insulated for Titanium/C-276 cladding irrespective of surface temperature. For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. For Borosilicate lining, the top flue liner above the roof slab shall be made of C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner. For Titanium/C-276 lining, external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner. The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc. A wet stack study shall be performed by the Contractor for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed. A wet stack model study shall consist of the following:			
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	(i) Condensation calculations (ii) Minimum 1:12 scale physical flow model for liquid collector design (iii) Computational flow model for plume downwash Analysis (iv) Physical or computational flow model for CEMS elevation flow performance Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), include the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to rain out to the ground before evaporation. The chimney liner & duct shall be designed & sized considering the following requirements as a minimum. However, minimum inside diameter of flue liner shall not be less than 8000 mm. <table><tr><th rowspan="2">SN</th><th rowspan="2">Item</th><th colspan="2">Design Point</th></tr><tr><th>Normal Operation with FGD in Operation</th><th>Operation with Bypass Operation</th></tr><tr><td>1</td><td>Boiler Load in MW</td><td>BMCR</td><td>BMCR</td></tr><tr><td>2</td><td>Type of Coal</td><td>Worst coal</td><td>Worst coal</td></tr><tr><td>3</td><td>Gas flow (M³/sec)</td><td>To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.</td><td>To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.</td></tr><tr><td>4</td><td>Gas temperature at Chimney inlet (deg. C)</td><td>To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature at FGD inlet of 145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher.</td><td>To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature of 145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher.</td></tr><tr><td>5</td><td>Pressure at chimney inlet (mmwc)</td><td>40</td><td>40</td></tr></table>				SN	Item	Design Point		Normal Operation with FGD in Operation	Operation with Bypass Operation	1	Boiler Load in MW	BMCR	BMCR	2	Type of Coal	Worst coal	Worst coal	3	Gas flow (M ³ /sec)	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	4	Gas temperature at Chimney inlet (deg. C)	To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature at FGD inlet of 145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher.	To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature of 145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher.	5	Pressure at chimney inlet (mmwc)	40	40
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	SN	Item	Design Point	
			Normal Operation with FGD in Operation	Operation with Bypass Operation
	6	SO ₂ concentration (mg/Nm ³)	To be worked out by the Bidder (based on the above conditions).	To be worked out by the Bidder (based on the above conditions).
	7	SO ₃ concentration (mg/Nm ³)	To be worked out by the Bidder	To be worked out by the Bidder
	8	Flue Gas velocity (m/s)	< 16.8 for Titanium/C-276 Lining <18.3 for Borosilicate Lining	-
	9	Short temp excursion temperature of inlet gas (for approx. thirty (30) minutes at a time) (deg. C)	-	300
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2.0.00	STEAM TURBINE AND AUXILIARIES																																						
2.01.00	Steam Turbine																																						
2.01.01	Type																																						
	The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP & separate LP casings OR combined casings for HP - IP and separate casings for LP Turbine, directly coupled with generator, suitable for indoor installation.																																						
2.01.02	Rating																																						
	The steam turbine generator unit shall conform to the following design and duty conditions:																																						
	<table><tr><td>i)</td><td>Output under Economic Maximum Continuous Rating(EMCR) at Generator terminals</td><td>800 MW</td></tr><tr><td>ii)</td><td>Turbine throttle steam pressure</td><td>270 Kg/cm² (abs)</td></tr><tr><td>iii)</td><td>Turbine throttle main steam temp</td><td>600 deg.C</td></tr><tr><td>iv)</td><td>Reheat steam temp. at turbine inlet</td><td>To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C</td></tr><tr><td>v)</td><td>Design & operational requirement including variations in rated steam temp. & pressure</td><td>Generally as per IEC 45 or otherwise specified elsewhere in the specification.</td></tr><tr><td>vi)</td><td>Pressure drop in reheat circuit i.e between H.P. turbine exhaust & IP turbine inlet.</td><td>To be optimized by the bidder</td></tr><tr><td>vii)</td><td>Condenser pressure</td><td>77 mm Hg (abs)</td></tr><tr><td>viii)</td><td>Turbine speed</td><td>3000 rpm.</td></tr><tr><td>ix)</td><td>Frequency variation range around rated frequency of 50 Hz</td><td>+3% to -5%(47.5 Hz to 51.5 Hz)</td></tr><tr><td>x)</td><td>DM water make up to thermal cycle under EMCR condition</td><td>3% of throttle steam flow.</td></tr><tr><td>xi)</td><td>Final feed water temp. at TMCR/EMCR condition</td><td>To be optimized by bidder but not less than 305 deg C</td></tr><tr><td>xii)</td><td>Turbine protection against water induction</td><td>As per ASME-TDP-1- latest edition.</td></tr></table>	i)	Output under Economic Maximum Continuous Rating(EMCR) at Generator terminals	800 MW	ii)	Turbine throttle steam pressure	270 Kg/cm ² (abs)	iii)	Turbine throttle main steam temp	600 deg.C	iv)	Reheat steam temp. at turbine inlet	To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C	v)	Design & operational requirement including variations in rated steam temp. & pressure	Generally as per IEC 45 or otherwise specified elsewhere in the specification.	vi)	Pressure drop in reheat circuit i.e between H.P. turbine exhaust & IP turbine inlet.	To be optimized by the bidder	vii)	Condenser pressure	77 mm Hg (abs)	viii)	Turbine speed	3000 rpm.	ix)	Frequency variation range around rated frequency of 50 Hz	+3% to -5%(47.5 Hz to 51.5 Hz)	x)	DM water make up to thermal cycle under EMCR condition	3% of throttle steam flow.	xi)	Final feed water temp. at TMCR/EMCR condition	To be optimized by bidder but not less than 305 deg C	xii)	Turbine protection against water induction	As per ASME-TDP-1- latest edition.		
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	The conditions corresponding to economic maximum continuous rating (EMCR) at generator terminals shall be 800 MW output under rated steam condition with 15 T/hr of steam extracted from CRH for auxiliary steam and total cycle make up of 3% of throttle steam flow and 77 mm Hg (abs) condenser pressure . The EMCR output at generator terminals shall be 800 MW plus power consumption by auxiliaries described in clause no.1.01.03.01 of Section-VI, Subsection IV" Functional Guarantee & Liquidated damages, Part-A.																																						
	Note:																																						
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2.01.03	1. "Throttle/Main Steam Conditions" means initial/main steam conditions (i.e. pressure, temperature and flow) at inlet to Main Steam Strainer. 2. "Reheat Steam Conditions" means reheat steam conditions (i.e. pressure, temperature and flow) at inlet to Reheat Steam Strainer or Reheat Steam Stop valve whichever is placed upstream in the direction of steam flow. 3. Wherever in the specification "Main Steam / Throttle Steam / Reheat Steam / Rated Steam conditions" have been mentioned, in connection with turbine / turbine cycle rating and performance guarantees, the same shall be interpreted as per above two clauses of note. 4. Wherever in the specification, words or combination of words have been used to describe output of the turbine generator set (such as power at generator terminals, output at generator terminals, unit load, TG load, TG output, unit output etc.), it shall mean electrical power output at generator terminals after deducting the power consumption by auxiliaries described in clause no 1.01.03.01 of Section-VI, Sub-section – " Functional Guarantee & Liquidated damages, Part-A. 5. Wherever in the specification, "Condenser Design Pressure", "Condenser Pressure", "Design Condenser Pressure", "Guaranteed Condenser Pressure" is indicated, the same shall mean average of all the condenser pressures. 6. Wherever in the specification Rated steam condition have been mentioned, the same shall be as follows: (i) Turbine throttle steam pressure270 Kg/cm² (abs) (ii) Turbine throttle main steam temp.600°C (iii) Reheat steam temp.To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C 7. Extent and duration of permissible variations in rated steam temperature shall be same as specified for rated steam temperature upto 566 deg C in IEC-45 even though rated steam temperature exceeds 566 deg C. 8. Wherever in the specification reheat steam temperature is mentioned, the rated reheat steam temperature at Turbine inlet shall be according to the final selected temperature by the Bidder based on the optimization. The HBDs shall corresponds to the final reheat steam temperature selected.			
	Other Features:- a) Turbine shall be capable of operating continuously with valves wide open (V.W.O.) to swallow at least 105% of EMCR steam flow to the turbine at rated main steam and reheat steam parameters and also the corresponding output shall not be less than 105% of rated load with 3% make up and 77 mm Hg (abs) condenser pressure. Bidder can offer overload valve (HP stage bypass) to meet the above specified VWO requirement, if it is a proven practice of the Turbine manufacturer. In such case VWO shall mean wide open condition of both, the turbine main control valves and the overload valves. However, if bidder offers overload valves, then bidder to ensure sufficient margin in the main turbine control valves so as to generate at least 102% of			
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	rated load at rated main steam & reheat steam parameters at condenser pressure of 77 mm Hg (abs) with 3% makeup. Load requirement beyond 102% of rated load can be met with overload valve. OLV operation shall also be envisaged for entire range of plant operation to meet the instantaneous increase in load demand. (b) The steam turbine generator unit shall be suitable for direct connection to steam generator having no inter connection with other units either on the boiler feed water side or main steam side. (c) The steam turbine shall have minimum eight uncontrolled extractions for regenerative feed heating based on optimised cycle and shall be suitable for satisfactory operation under tropical conditions. (d) The cycle will consist of minimum 3 nos. of HP heaters with extraction for top HP heater from HP turbine, one no. of deaerator and minimum 4 nos of LP heaters. (e) For Auxiliary Steam system for Turbine Generator, Steam generator and station auxiliaries, refer requirements stipulated elsewhere in the specification.			
2.01.04	TURBINE LUBRICATION OIL SYSTEM (1) Each Unit Lube Oil tank to have capacity to allow 5 to 8 oil charges per hour (at normal operating level), fitted with non-corrodable strainers, level measuring device & local indicators and necessary manholes, 2x100% duty vapour extraction fans, platforms, railings, necessary piping, supports and accessories etc. (2) Lube oil cooler 2x100% capacity oil coolers (either shell & tube type or plate type heat exchanger) with 15% margin on heat transfer surface area shall be provided for cooling the lubricating oil. The tube / plate material shall be SS316. Further the material of any other part of the lube oil cooler which is coming in contact of lube oil shall be SS316.			
2.01.05	Central Turbine Lubricating Oil Storage & Purification System Provide identical Dirty & Pure Oil tanks with capacity 1.5 times capacity of unit oil tank. Provide purification system identical to Unit purification system as specified for Main Turbine elsewhere in the specification.			
2.01.06	TURBINE CONTROL FLUID SYSTEM Control fluid purifying unit to purify atleast 2% of the total fluid charge in the system per hour on a continuous by pass basis alongwith 2x100% capacity A.C. driven purification pumps (for fluid circulation through purification system). 2x100% control fluid coolers designed as specified at clause no 2.01.04 of this chapter above and ensure all surfaces coming in contact with control fluid to be of stainless steel. 2x100% air cooled coolers are also acceptable depending upon standard practice of the manufacturer.			
2.02.00	Steam condensing plant			
2.02.01	Condenser			
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2.02.02	i)	Design, manufacturing and testing as per Heat Exchanger Institute, USA (latest edition) with proven design. The condenser shall be designed for heat load corresponding to Valve Wide Open (VWO) conditions, 0% make-up, guaranteed condenser pressure and conditions given in Clause No. 2.02.03. The value of condenser pressure to be measured at 300 mm above the top row of condenser tubes shall be demonstrated under VWO output condition 0% make-up. The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips. The grid is fitted at 300 mm above top row of tubes of condenser. Condensate temperature at all loads shall be near to the saturation temperature corresponding to condenser pressure.		
	ii)	The Condenser hotwell shall be sized for Three (3) minute storage capacity (between normal & low-low level) of total design flow with the turbine operating at VWO condition, 3% make-up, 77 mmHg (abs) condenser pressure. The low-low level of hotwell shall be at least 200 mm above the bottom of hotwell.		
	(ii)	Design for full vacuum and min. internal pressure 1.08 Kg/cm2(g). Minimum shell side design temperature 120 deg. C.		
	(iv)	Sizing of steam dumping device to accept the steam from HP-LP bypass with necessary spray water including abnormal conditions like HP heaters out of service etc.		
	(v)	Design of air removal section to cool the air and vapour mixture to atleast 4.17 deg. C below saturation temperature corresponding to 25.4 mm Hg (abs). Connections to air evacuation pumps shall be made at this section.		
	(vi)	Design for exhaust steam from steam turbine, BFP drive turbine (if applicable), HP-LP bypass system, heater drains and vents, boiler separator drains during start up, low load and abnormal conditions and other miscellaneous drains.		
	(vii)	Designed to carry flooded weight (upto 1 meter above top row of condenser tubes) for hydraulic and hydrostatic testing of condenser without installation of temporary supports or bracing.		
	Condenser air evacuation pumps			
	(i)	Each unit shall consist of 2x100% vacuum pumps per condenser with all accessories and instrumentation for condenser air evacuation.		
	(ii)	Pumps shall be sized as per latest HEI requirements. Holding capacity of each pump in free dry air at standard condition i.e. 760 mm of Hg (abs) and 21.1 deg.C and capacity during hogging operation shall not be less than as specified in the table below:		
2 x 100 % vacuum pumps per condenser		Holding operation (with condenser operating at design pressure of 1 inch (25.4 mm) of Hg (abs) and sub cooled to 4.17 degC	20 SCFM (34 m3 per hour)	
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2.02.03		<table><tr><td></td><td>below temperature corresponding to absolute suction pressure)</td><td></td></tr><tr><td></td><td>Hogging operation (at 10 inch (254 mm) of Hg (abs) condenser pressure)</td><td>500 SCFM (850 m3 per hour under standard conditions i.e. 760mm Hg (abs) and 21.1 deg. C)</td></tr></table>		below temperature corresponding to absolute suction pressure)			Hogging operation (at 10 inch (254 mm) of Hg (abs) condenser pressure)	500 SCFM (850 m3 per hour under standard conditions i.e. 760mm Hg (abs) and 21.1 deg. C)																															
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	(iii) The above holding capacity of vacuum pump shall correspond to the vacuum pump I.T.D. (Initial Temperature Difference) calculated separately for each condenser shell as below: Vacuum pump I.T.D = Saturation temperature corresponding to optimized condenser pressure for the respective condenser shell (which is considered for guaranteed condenser pressure) – specified cooling water inlet temperature to vacuum pump seal water cooler. The hogging capacity of vacuum pump shall correspond to specified cooling water inlet temperature to vacuum pump seal water cooler																																						
	Condenser and associated systems shall be designed for parameters as given below:																																						
	Design parameters for condenser and associated systems																																						
	1. Condenser Design Parameters:																																						
	<table><tr><td>(i)</td><td>Number of Passes</td><td>:</td><td>Single pass/Double pass</td></tr><tr><td>(ii)</td><td>Design cold water temp.</td><td>:</td><td>33 Deg. C</td></tr><tr><td>(iii)</td><td>Min. size (O.D) of the tube</td><td>:</td><td>22.225 mm</td></tr><tr><td>(iv)</td><td>Minimum thickness of the tube</td><td>:</td><td>22 BWG</td></tr><tr><td>(v)</td><td>Tube velocity</td><td>:</td><td>1.6 to 2.2 m/sec.</td></tr><tr><td>(vi)</td><td>Guarantee Condenser pressure</td><td>:</td><td>To be optimised by bidder but not exceeding 65 mmHg (abs).</td></tr><tr><td>(vii)</td><td>Max. tube length between tube plates</td><td>:</td><td>15 meters (Indicative)</td></tr><tr><td>(viii)</td><td>Temperature rise in circulation water across the condenser</td><td>:</td><td>to be optimised by Bidder</td></tr><tr><td>(ix)</td><td>Tube material</td><td>:</td><td>Stainless Steel as per</td></tr></table>			(i)	Number of Passes	:	Single pass/Double pass	(ii)	Design cold water temp.	:	33 Deg. C	(iii)	Min. size (O.D) of the tube	:	22.225 mm	(iv)	Minimum thickness of the tube	:	22 BWG	(v)	Tube velocity	:	1.6 to 2.2 m/sec.	(vi)	Guarantee Condenser pressure	:	To be optimised by bidder but not exceeding 65 mmHg (abs).	(vii)	Max. tube length between tube plates	:	15 meters (Indicative)	(viii)	Temperature rise in circulation water across the condenser	:	to be optimised by Bidder	(ix)	Tube material	:	Stainless Steel as per
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	ASTMA-249-TP316L (x) Cleanliness factor : 0.9 (xi) maximum and minimum circulating water temperature : 36 deg.C (max.) and 15 deg.C (min.) (xii) Condenser arrangement : Perpendicular to T.G. axis. 2. Water box design pressure : 0.1 kg/cm² (abs) and 5 kg/cm²(g) 3. Water box test pressure : 1.3 times the design pressure 4. Water box design temperature : 60 deg. C 5. Shell side design pressure : Full vacuum and 1.08 Kg/Cm² (g) 6. Minimum Shell side design temperature : 120 deg.C 7. Design parameters for expansion joints: (a) Design pressure : Vacuum(0.1 kg/cm² (abs)) and 5 kg/cm²(g) (b) Design temperature : 60 deg.C (c) Test pressure : 1.5 times the design pressure 8. Design parameters of isolating butterfly valves with actuator (a) Design pressure : Vacuum(0.1 kg/cm² (abs))and 5 kg/cm²(g) (b) Design temperature : 60 deg.C (c) Test pressure : 1.5 times the design pressure 9. Condenser air evacuation system design parameters : (a) Source of vacuum pump heat exchanger cooling water : Condenser cooling water as per analysis given else where		
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			in the specification
	(b)	Source of sealing water	: Condensate
	(c)	Source of make-up water	: Condensate
	(d)	Design pressure (cooling water side for vacuum pump heat exchanger	: Vacuum(0.1 kg/cm ² (abs)) & as per ACW System Design Pressure
	(e)	Pressure of make-up water	: CEP discharge pressure
	(f)	Maximum temperature of condenser cooling water	: 36 deg.C
	(g)	Duty code	: HEI (Latest)
	(h)	Design condenser pressure	: 25.4mm (1 inch) of Hg (abs)
	10.	Design pressure for CW piping, valves, fittings, COLTCS equipment on the CW line etc.	: Vacuum(0.1 kg/cm ² (abs)) and 5 kg/cm ² (g)
2.03.00	Feed water heating plant		
2.03.01	The plant shall be designed as per ASME Boiler & pressure vessel code, Sec-VIII, Division-I (Latest), Heat exchange Institute Standards (USA). In addition the requirements of ASME-TDP-I - latest code for turbine damage prevention shall also be taken care of. Plant shall be designed for all operating conditions including transients like sudden load throw-off, HP LP bypass coming in operation, preceding one or two heaters going out of service etc.		
2.03.02	The plant shall be suitable for operation in conjunction with the turbine. It shall be designed for raising the temperature of feed water from that in the condenser to a final feed water temperature, as optimized by the bidder but not less than 305 deg C, at the outlet of top heater at rated output with zero percent make-up and design back pressure. TTDs and DCAs of heaters shall correspond to the 100% TMCR heat rate guarantee conditions.		
2.03.03	Design with Minimum pressure drop on tube side. Velocity of water through the tubes shall be restricted to 3.05 m/sec under all operating conditions.		
2.03.04	Each of the LP heaters and drain cooler shall be capable of handling 110% of the design condensate flow from 2x50% condensate extraction pumps without undue vibration and other deleterious effects. Each of HP heaters shall be capable of handling 110% of the design flow from one BFP without undue vibration and other deleterious effects.		
2.03.05	a) LP Heater Shell side Design Pressure: Not less than Max. Extraction Steam pressure and full vacuum with minimum design pressure of 3 kg/cm ² (g).		
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2.03.06	b) HP Heater Shell side Design Pressure: Not less than max. extraction steam pressure and full vacuum. Design pressure of HP heaters taking extraction from CRH line, shall be CRH extraction pipe design pressure and full vacuum. a) LP Heater Tube side Design Pressure: CEP shut off head at maximum possible speed Of Variable Frequency Drive (VFD) and full vacuum. b) HP Heater Tube side Design Pressure: The design pressure of HP heaters' tube side shall not be less than maximum of the following: (i) 1.05 times the maximum operating pressure (including BMCR condition) at BFP discharge. (ii) Pressure required at BFP discharge under lowest spring loaded safety valve on boiler separator blowing condition. (iii) Design pressure as required by IBR/ ASME. However, pressure relief valve/ 3-way by pass valve across the HPHs shall be provided, as per the tender drawing, so that HPHs are not subjected to shut off condition. The HPHs shall be designed for full vacuum also. (d) Design for handling drains from preceding heaters for all operating conditions and emergency drains to condenser bypassing the drain cooling zone. (e) Provision of start-up and operating vents with orifices and relief valves and provision for removing non-condensable gases collecting on shell side individually to condenser. Vent orifice shall be sized to pass one half percent of TMCR extraction steam flow to respective heater under TMCR conditions. (f) Provide sentinel relief valve on tube side. Relief valve on shell side sized to pass flow from two ruptured tubes (four open ends) or 10% of water flow corresponding to VWO condition with 3% make up and 77 mmHg (abs) condenser pressure at 10% accumulation whichever is higher and set to open at heater shell design pressure.			
2.03.07	The deaerator shall be designed such that maximum oxygen content shall be 0.005 cc/litre at deaerator outlet measured as per ASTM D5543-09 or Indigo Carmine method at all operating conditions. Minimum feed water storage tank capacity shall be based on 6 (six) minutes of TMCR flow (approx.) between normal operating level and low-low level with a filling factor of 0.66. This capacity shall be exclusive of the volume of internal piping, baffles and volume of the dished end. It shall be designed for maximum incoming steam flow when none of the LP heaters are working under HP/LP bypass condition. Deaerator capacity below low-low level (BFP tripping point) shall have minimum value of 80 cubic meter (Without dished end volume). BFP tripping on NPSHa (at centerline) less than NPSHr shall be provided to avoid any damage during transient condition like sudden load throw-off i.e. turbine trip from VWO operating condition, no pegging steam is available for de-aerator or any abnormal condition arising out during plant operation. Quick measuring devices and sensors with high accuracy class and least response time shall be installed in BFP suction system for real time acquisition of NPSHa to enable instant tripping.			
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2.04.00	Size of vent orifice for one half percent of TMCR extraction steam flow to deaerator. Deaerator shall be sized for handling all incoming condensate, HP heater drains etc. Turbine hall E.O.T. cranes Two (2) number of electrically operated overhead travelling cranes with associated auxiliaries, along with electrical equipment, control & instrumentation as required and specified shall be provided in the turbine hall for erection and maintenance of turbo-generators and their auxiliaries. Each crane shall be capable of lifting at least 105% of the weight of single heaviest component/ equipment (except generator stator), including lifting beam and slings etc. (as applicable) to be handled in TG hall for erection as well as maintenance of the equipment provided in AB bay. The auxiliary hook capacity shall not be less than 20 Ton. In addition it shall also be possible to handle Generator Stator with tandem operation of two Turbine hall EOT cranes for which necessary arrangements shall be provided. In such case, the combined capacity of two EOT cranes shall not be less than 105% of weight of Generator Stator, including the weight of lifting beam with swiveling arrangement and slings.			
2.05.00	Condensate Extraction pump i) Pump sizing a) Design Capacity: Combined flow of 2x50% condensate extraction pumps to be based on 15% margin over highest Condensate flow envisaged during unit operation (excluding HP/LP by pass operation). Design Head: Corresponding to above considering 10% margin over deaerator pressure. b) Best efficiency point: Combined flow of 2x50% CEPs shall be based on TG unit EMCR and corresponding head. Best efficiency point of the selected pump shall be preferably corresponding to above point. c) Maximum Capacity: One pump capable of handling the flow and head corresponding to 65% unit load. d) Other Capabilities: - 2 pumps shall be capable of handling the flow corresponding to Unit EMCR, all HPH out, 3% m.u and worst condenser pressure. - 2 pumps shall be capable of handling the flow corresponding to HP/LP by pass operation with turbine under tripped condition as well as turbine on house load.			
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	e) NPSH Margin NPSH (R) at 3% head drop shall not be more than half the NPSH(A) at design flow with low-low hotwell level and NPSH(R) at 3% head break shall be well below NPSH(A) under all conditions. f) Suction specific speed Suction specific speed of first stage impeller not to exceed 11,000 U.S. units based on 3% head break of that impeller at design point. g) Design Pressure 1) Bowls and discharge components design pressure shall correspond to shut off head at maximum possible speed of Variable Frequency Drive (VFD) and operating specific gravity and maximum suction condition. 2) Suction components shall be designed for 8 ata and full vacuum. ii) Motor Rating: Variable frequency drive motor with maximum speed of the motor shall atleast be 5% above the highest speed determined of the pump corresponding to the condition indicated at (i) above. Motor rating at 50 deg.C ambient temperature shall not be less than the maximum load demand of its driven equipment corresponding to maximum motor speed indicated above and motor shall not be overloaded during any mode of operation of driven equipment.			
2.06.00	Boiler feed pump			
2.06.01	Pump sizing			
	(i) Turbine Driven BFP			
	1) Design capacity and design head: Combined flow of 2x50% Turbine driven boiler feed pumps to be based on 10% margin over feed flow corresponding to turbine V.W.O condition, 3% makeup, 77 mm Hg (abs) condenser pressure and corresponding head. In case continuous overpressure operation of unit is envisaged then the capability of pump for such an operation shall be verified. 2) Best efficiency point: Combined flow of 2x50% TDBFPs shall be based on TG unit EMCR and corresponding head. 3) Runout point: One TDBFP shall be capable of handling flow and head corresponding to 65 % of unit rated load. 4) Emergency point: Two Turbine driven boiler feed pumps to be capable of generating the discharge pressure not less than steam generator highest safety valve set			
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	pressure corresponding to 105% of boiler maximum continuous rating (at 0% make up). 5) Other capabilities: Combined flow of 2X50% TDBFP shall meet the following: (a) BMCR flow and head corresponding to rated steam pressure (at 3% make up). (b) Output corresponding to VWO flow, 3% makeup, worst condenser pressure. (ii) Motor Driven BFP : 1) 1x30% MDBFP shall meet all the above conditions (i.e. (i) (1) to (5) above) except that the flow of 1x30% Motor driven Boiler feed pump shall be 30% of the total flow arrived for 2x50% TDBFPs. The head developed by MDBFP shall be calculated in the same way as done for TDBFPs for all the above conditions so that TDBFPs and MDBFP can be operated in parallel. 2) The conditions corresponding to (i) (5) shall be met by MDBFP at 47.5Hz. (iii) One TDBFP and one MDBFP operating in parallel shall be able to generate flow and head corresponding to minimum 95% of unit load. (iv) Bidder may consider the following for boiler feed pump sizing. (a) Design discharge flow of each TDBFP - not less than half of 110% of VWO feed water flow. Design discharge flow of MDBFP - not less than 60% of the discharge flow of each TDBFP. (b) Bidder to consider Rated discharge flow through interstage bleed off from turbine driven feed pump for reheater attemperation to meet Boiler requirements. Rated discharge flow through interstage bleed off from MDBFP - not less than 60% of the discharge flow through interstage bleed off from TDBFP. Note : Discharge flow of main pump not to include any seal flow, warm up flow and balance drum leakage flow.			
2.06.02	Motor Rating: The maximum continuous motor rating corresponding to maximum cooling water temperature to cooler inlet not less than the maximum load demand of driven equipment at its entire range of operation at frequency variations from 47.5 Hz to 51.5 Hz and motor not to be overloaded during any mode of operations of the driven equipment.			
2.06.03	NPSH Margin (a) The ratio between NPSH (A) and NPSH (R) at 3% head drop for booster pump and main pump shall be not less than 2.5 at design point corresponding to Low-Low level of deaerator.			
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2.06.04	(b) Trip speed of TDBFP: 10% above the design speed of the feed pump. (a) Efficiency: Preferably not more than 83% (hot). However, if higher efficiency is selected then the drive power requirement shall be determined with 83% efficiency only. (b)First stage suction specific speed Not in excess of 10000 (US units) and 9500 US units based on 3% head break down of that impeller of main pump and booster pump respectively at their respective design point. (c) Casing design pressure TDH at minimum flow and operating at trip speed for TDBFP and TDH at minimum flow and maximum pump speed at 51.5 Hz for MDBFP under highest operating density plus maximum suction pressure at booster pump. d) Axial thrust Balancing drum designed to balance 95% of total pump axial thrust. Balancing disc not acceptable. e) Thrust bearing of booster pump and main pump Two times of the worst thrust from minimum speed to trip speed of TDBFP and minimum speed to maximum speed of MDBFP at all flow values from 0% to 125% and internal clearances being 100% or 200% of new clearance under which condition thrust is higher. Thrust bearing should be suitable for reverse rotation.									
2.06.05	GEAR BOXES (Applicable Code- AGMA 6011 and AGMA 6013 (Latest)) Service Factor <table><tr><td>MDBFP (combined gearing/Hydraulic coupling)</td><td>.....</td><td>1.4</td></tr><tr><td>Between turbine drive and booster pump</td><td>.....</td><td>2.0</td></tr></table>				MDBFP (combined gearing/Hydraulic coupling)		1.4	Between turbine drive and booster pump		2.0
MDBFP (combined gearing/Hydraulic coupling)		1.4								
Between turbine drive and booster pump		2.0								
2.06.06	OIL COOLERS: In case of shell and tube type oil coolers tube material shall be SS 304 and in case of plate type heat exchanger plate material shall be SS 316. Applicable code-TEMA, Pressure parts-ASME Sec VIII. 15% margin on plates shall be considered in case of plate type heat exchanger. Instrument connections alongwith temperature and pressure indicators on inlet and outlet branches of the water side and also on the shell side of each Coolers.									
2.06.07	Drive turbine Lubricating oil system Two full capacity oil coolers specified as under: (i) Rating Adequately rated with suitable fouling allowance in accordance with TEMA with necessary arrangements for changing over the cooler without interrupting the oil flow. (ii) Cooling Arrangement Cooling medium shall be demineralized water taken from closed loop cooling system. Cooling medium shall flow in tube side. (iii) Instruments Connections along with temperature and pressure indicators on inlet and outlet branches of the water side and also on the shell side of each Cooler. Adequate draining and venting of all parts of cooler. (iv) Alternatively plate type heat exchanger with 15% area margin on plates also acceptable as per standard practice of bidder. Following requirement shall also be complied with:									
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2.07.00	- Plate material shall be SS 316 and material for other component shall be compatible for the application. - Pressure part as per ASME Sec-VIII. - Thermal calculation considering fouling factor, overall heat transfer coefficient, corrosion allowance, plate thickness etc as per their standard practice shall be provided for employer's approval. - Oil reservoir with five minutes retention time. - Suitably sized hydraulic accumulators shall be provided in governing oil system to maintain system pressure, when there is a change over from one running pump to stand by oil pump. Also provision shall be made for initial air purging of the governor system. Drip pump (if offered) (a) Pump Sizing (i) Design Capacity 1x100% drip pump flow to be based on 10% margin over highest drip flow envisaged during unit operation. Design Head Corresponding to above considering 10% margin over deaerator pressure. (ii) Other Capabilities 1 pump shall be capable of handling the flow corresponding to Unit EMCR, all HP heaters out, 3% m.u. and worst condenser pressure at 47.5 Hz. (iii) NPSH Margin NPSH (R) at 3% head drop shall not be more than half the NPSH(A) at design flow with low low heater level and NPSH(R) at 3% head break shall be well below NPSH(A) under all conditions. (iv) Suction specific speed Suction specific speed of first stage impeller not to exceed 11,000 U.S. units based on 3% head break of that impeller at design point (v) Design Pressure (1) Bowls and discharge components design pressure shall correspond to shut off head at 51.5 Hz and operating specific gravity and maximum suction condition. (2) Suction components shall be designed for 8 ata and full vacuum. (b) MOTOR RATING Motor rating at 50 deg. C ambient temperature shall not be less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5 Hz to 51.5 Hz and motor shall not be over loaded during any mode of operation of driven equipment.			
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2.08.00	HP-LP STEAM TURBINE BYPASS SYSTEM The HP and LP bypass system shall be designed and capable of meeting the following requirements: (a) Ensure HP bypass aggregate capacity not less than 65% of the main steam flow at BMCR condition considering rated main steam parameters at the upstream of valves & CRH steam parameters corresponding to 60% TMCR condition on the down stream. The HP bypass system shall have minimum 2x50% capacity valves. In addition the aggregate capacity of HP Bypass valve shall be adequate to evacuate the required minimum steam flow from the boiler under various start up conditions (viz. Cold/warm/hot start up) as per combined boiler turbine start up curve. (b) LP bypass shall be designed to condition the incoming steam from re-heater corresponding to parameters resulting from operation as specified at clause no 2.08.00(a) of this chapter above to parameters matching with those of LP Turbine exhaust steam. In addition to that LP Bypass system shall be sized for maximum rise of HRH steam pressure, temperature and steam flow during transient conditions. For LP bypass valve sizing, no steam will be extracted for regenerative feed heating except for deaerator pegging at a pressure optimized by the bidder with only MDBFP in service. The capacity shall be commensurate with that of HP bypass system plus the spray water used in HP bypass. Number of LP Bypass valves shall be as per bidder's standard practice subjected to a minimum of 2 numbers. (c) Quick startup of the steam generator from cold, warm & hot conditions. (d) HP-LP bypass operation under rated steam conditions with bypass valve open to full capacity and turbine on house load (5% of rated load). (e) Provide HP bypass station spray water requirement from Boiler feed pumps discharge, either upstream or downstream of HP Heaters & LP bypass spray water requirement from condensate extraction pump discharge. Spray system to include spray water control valves, NRVs and isolating valves. (f) Ensure HP bypass designed to accept continuous spray water at temp. corresponding to all HP heaters out of service and deaerator pegged at a pressure optimized by the bidder. (g) Ensure Suitability for operations under sliding pressure mode to enable short start-up time.			
2.09.00	Other System Sizing: (a) Ensure normal make-up to cycle in the condenser hot well at 3% which at times may go upto 5%. And, the emergency make up shall be sized for 5 % BMCR, 10 % BMCR & 15 % BMCR for Min/ Normal/ Maximum flow respectively. (b) Low Load Feed Control valve (0 to 30% BMCR capacity range) in Feed regulating station (FRS) for feed water flow control , downstream of BFPs, shall be sized with maintaining a differential pressure (DP) of 5kg/cm2(abs) during unit startup upto 30% BMCR Load. (c) All the Normal drain / Emergency Drain Control valves for Feed water Heaters shall be sized considering all the transient cases (including preceding heater out of service and corresponding increase in extraction flow to that heater accordingly) and the process requirements as finalized during detailed engineering stage.			
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3.00.00	WATER SYSTEM		
3.01.00	CW Pumps		
	SN	Particulars	Requirement
	a)	Number of working CW pumps	2 X 50 % per unit
	b)	Number of Standby pumps	One (1) number (50% capacity) common for two units
	c)	Type of CW pumps	Vertical wet pit /Concrete volute/Metallic volute (with concrete encasement) with Forced water lubrication
	d)	Rated CW pump flow per unit (Design Point)	Condenser Flow + ACW flow per unit + CW blowdown flow per unit + CW Chemical treatment +any other requirement as envisaged by the bidder
	e)	Total Head of the CW pump at rated flow	Sum of static lift from minimum water level in CW pump house sump up to the centerline elevation of hot water distribution header at Cooling Tower + 110% of friction drop in the entire CW system + pressure drop across Condenser with 2 mWC margin (minimum). <u>Note:</u> For calculation of friction drop in CW pipe /duct the “C” value shall be considered as 100.
	f)	Operating Speed	Not more than 333 rpm
	g)	Type of Impeller	Closed / Semi-open
	h)	Location of Pumps	Indoor
	i)	Service of Duty	Continuous
	j)	Internal Diameter of CW pipes in CW pump discharge up to inlet to cooling tower (excluding non-encased portion of piping connected to condenser)	Design velocity not to exceed 2 m/sec
	k)	Size of Discharge Butterfly Valves & Duct interconnecting Valves	Same as that of CW discharge pipe
	l)	Size of the Pump Re-circulation Valve and pipe.	To be sized for re-circulation of about 50% capacity of one CW pump. However, in case of Volute type pumps, the sizing should be adequate to carry flow of one pump to enable Performance test at Site.
	m)	Expansion joint	Size & rating to suit the discharge head of CW pump
	n)	Maximum Water level in CW Sump	Maximum water level in Cooling tower basin i.e. FGL at cooling tower area.
	o)	Minimum Water level in CW Sump	Minimum water level in cooling tower (i.e. 1M below FGL at CT) minus drop in the CW channel.
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3.02.00	p)	Submergence to be provided for pump	Submergence to be provided for pump - As recommended by " Pump intake design" of HIS plus 1 m margin (minimum)
	q)	Sump invert level	As per HIS (Hydraulic Institute Standards)
	r)	Operating Floor level	Minimum one meter above Local Grade level.
	s)	Accessories to be provided with each pump	a) Required Instrumentation b) Anchor bolts, nuts, sleeves, and inserts to be embedded to concrete. c) Companion flanges with nuts, bolts, and gaskets, internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. e) Positioning dowels, eye bolts, lifting etc. g) Ladders, Platforms & Other Accessories
	Induced Draft Cooling Tower		
	SN	Particulars	Requirement
	a	Number of Cooling Towers	Two (2) numbers (One Number / Unit)
	b	Type of Cooling Tower	RCC Induced Draft Cooling Tower / FRP Induced Draft Cooling Tower
	c	Quantity of water to be cooled by Cooling Towers of One Unit	CW pumps flow per unit + 10% margin
	d	Heat Load (Excluding Heat of Evaporation)	As per system requirement (10% margin to be taken for CW pump flow only , however heat load to be taken as actual)
e	Design Range	Temp. rise across condenser + 1 deg C	
f	Hot Water temperature at cooling tower inlet	Design range +32 degC	
g	Design Cold water temperature at cooling tower outlet	32 Degree C	
h	Re-circulation allowance	0.8 Degree C	
i	Design ambient wet bulb temperature (WBT)	27 degree C	
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	SN	Particulars	Requirement	
	j	Design inlet wet bulb temperature	Design Ambient WBT + Recirculation allowance in degree C	
	k	Design Ambient Relative Humidity	50 %	
	l	Quality of water	Same as Circulating Water	
	m	Maximum Water level in CT Basin	Finished Ground Level (FGL)	
	n	Normal Water level in CT Basin	Maximum Level minus 0.5 M	
	o	Minimum Water level in CT Basin	Maximum Level minus 1 M	
	p	Invert level of Basin	Normal Level minus 1 M	
	q	Internal Diameter of pipes	To suit the design velocity of Maximum 2 m/sec	
	r	Size of Branch & Cell isolation Butterfly Valves (if applicable)	Same as that of pipe size	
	s	Terminal Pressure available at FGL (MWC)	as per system requirement	
	t	No of stop logs to be supplied (no by Bidder per cooling tower)	As per Civil section	
	3.03.00	ECW System for each Unit		
SN		Particulars	Design Requirement	
1		Primary (DM) Cooling Water Pumps (TG and SG separate)- Horizontal Centrifugal Pumps		
a		Quantity	3 X 50% for TG ECW system 2 X 100% or 3x50% for SG system	
b		Flow	a. For TG ECW system- Design flow required for all TG coolers b. For SG ECW system- Design flow required for	
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			all SG auxiliaries + other Station Auxiliaries (Air compressors, Mill reject, Ash Handling compressors, FGD & SCR system, any other system envisaged by the bidder) c Head As per system requirement + 10% margin on friction head 2 Secondary (Auxiliary) Cooling Water Pumps- Horizontal Centrifugal Pumps a Quantity 3 X 50% b Flow [Design flow required for TG ECW + SG secondary water requirement] c Head As per system requirement + 10% margin on friction head 3 Plate Heat Exchangers (TG and SG separate) a Quantity 3 X 50% for TG ECW system 2 X 100% or 3x50% for SG ECW system b Design secondary water inlet temperature Not less than 36 deg C c Secondary water outlet temperature Not more than the design hot water temperature at condenser outlet d Primary water outlet temperature 39 deg C (maximum) e TTD 3 deg C (maximum) f Overall fouling factor (min) (f) 0.8×10^{-4} hr m² deg C/Kcal g Overall Heat transfer coefficient [U(o)] As per Manufacturer's design h Dirty Heat transfer Coefficient [U(d)] $[1 / (1/U(o) + f)]$ i Heat transfer area (sqm) $\frac{\text{Total Heat Load (in kCal.hr)}}{U(d) \times \text{LMTD}}$ j Heat transfer area of PHE shall be selected based on maximum heat transfer rate of 6500 kCal/hr per sqm of heat transfer plate. k Frame of each plate type heat exchanger shall be able to accommodate minimum 25% extra plates. l The design pressure shall be equal to DMCW pump/ACW Pump shut off pressure (whichever is higher) with maximum suction pressure plus 5% margin 4 Self-cleaning Strainers a Quantity 2 X 100% 5 Overhead ECW (DM water) tank (separate for TG ECW system and SG ECW system) 1 X 10 cum (min.) (at 60% of the tank height) 6 Alkali dosing tank including agitator & drive (separate for TG ECW) 1 X 500 L (min.)
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		system and SG ECW system)		
	7	Complete piping, fittings, supports, valves, and specialties including instrumentation and electrical equipment as specified & required to complete the system.		
	8	Required orifices shall be provided in the primary and secondary circuit of Equipment Cooling Water system for balancing of pressure.		
3.04.00	All water systems including CW chemical treatment system shall be designed considering the total make-up water availability of 4800 m³/hr. Suitable cycles of concentration (COC) and the treatment chemicals shall be selected to achieve this objective. However, the minimum COC shall be 5.0.			
3.05.00	Auxiliary Water Systems (AWS) All the pumps shall be designed with head as per system requirement considering minimum water level +10% margin in frictional head loss. a) Raw Water System to Water PT Plant (Vertical turbine) Capacity of each Pump – As per system requirement with 5% margin. The pumps shall have rubber expansion joints with electric motor actuated discharge butterfly valve and Non return valve of required sizes. The system shall be designed with Forced water lubrication. Separate recirculation line with motor actuated butterfly valve for Raw water (PT) and Raw water (Ash) system. b) Raw Water System to Water Ash Handling Plant (Vertical turbine) Capacity of each Pump – Water required for ash handling plant without AWRS c) Makeup (Clarified water) water system to CW system Capacity of each Pump – half of the total CW make-up requirement. d) AC & Ventilation System Makeup Pumps Capacity of each Pump – To meet complete makeup requirement of AC & Ventilation systems (all AC Plants and Air-washer units) of the complete station (minimum 100 m3/hr). e) FGD Gypsum wash System Makeup Pumps Capacity of each Pump – To meet complete makeup requirement of FGD Gypsum wash requirement. f) DM Cycle make-up water System Capacity of each Pump – 100 % of Cycle makeup water requirement for one unit (minimum 150 m3/hr). g) Boiler Fill System Boiler fill system shall supply DM water to fill each Boiler for start-up or to conduct hydraulic test. Suitable tap offs shall be provided for filling of deaerators during initial stages or exigencies. Water for this shall be drawn from main DM water Storage tanks in Water Treatment Plant. Number and Capacity of Boiler Fill Pumps shall be as follows: Capacity of each Pump - Adequate capacity as per system requirement (minimum 200 Cu.m/hr). h) Service Water System Clarified water from the clarified water tank shall be used as service water. Service water pumps shall take suction from this tank and supply water to the service water pipe network. Capacity of service water pumps shall be as follows: Capacity of each Pump – as per system requirement (minimum 200 Cu.m/hr). i) Potable Water System			
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3.06.00	Potable water system shall meet the drinking water required for all the plant facilities/buildings included in Contractor's scope up to the specified terminal point. Number and Capacity of pumps shall be as follows: Capacity of potable water requirement will be 20 m3/hr (minimum) for plant j) Condensate transfer pumps To meet the condensate transfer system one (1) no of horizontal centrifugal type pump for each unit shall be provided without any standby. The capacity of each pump shall be designed considering minimum 20 % of the condensate flow and head to suit the system requirement. k) Air pre-heater wash water pumps Air pre-heater wash water pumps shall draw water from service water tank. The capacity of all the working pump(s) shall be designed considering washing of Air pre-heater(s), ESP etc. as per bidder's design and head to suit system requirement. However, minimum capacity shall not be less than 500 Cu.m/hr. Note: Requirement of water(DM, clarified and service water) for SCR system shall be taken care while sizing the above pumps.			
	Water treatment plant A. Pre-treatment system Design criteria of Pre-Treatment Plant for Circulating Water (PT-CW) & DM system (PT-DM): 1) “PT-CW” System with minimum three (3) reactor type clarifiers, one (1) number aerator (1x100%) & one (1) number stilling chamber (1x100%) (Common for all the Clarifiers), three (3) Inlet channels of RCC Construction with flow measuring element (Parshall flume), outlet Channels, Clarified Water Storage Tank, bypass channel to by-pass the clarifier(s). 2) “PT-DM” System with one (1) number reactor type clarifier (1x100%), one (1) number aerator (1x100%) & one (1) number stilling chamber (1x100%), one (1) number inlet channel of RCC Construction with flow measuring element (Parshall flume) and two (2) numbers of Gravity filters (2x100%), Gravity Filter blowers (2x100%) filtered water reservoir (twin section), pump house etc. 3) “PT-Potable” System with two (2) numbers of Gravity filters (2x100%), Gravity Filter blowers (2x100%), filtered water reservoir (twin section), pump house etc. 4) Three (3) numbers (3x100%) Filtered Water Transfer Pumps shall be provided for Ion Exchange based DM plant. In case of UF+RO+MB plant be envisaged for DM water, three (3x100%) numbers Filtered Water Supply Pumps (UF Feed Pumps) shall be provided. 5) Interconnection provision shall be provided between the clarified water outlet channels of PT-CW System with the PT-DM System to have flexibility in operation. 6) Chemical House: A common two (2) storey Chemical house of RCC construction shall be provided to install various Chemical dosing equipment, pumps, tanks, piping etc. of PT–CW & Potable, PT–DM, PT-RO plant (As applicable) : a) Lime preparation & dosing system consisting of minimum two (2) nos. of RCC lime slaking tanks, minimum three (3) nos. of lime solution Preparation			
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	tanks of RCC construction, agitators, lime slurry transfer pumps (2x100%), lime solution dosing pumps (2x100%) etc. b) Alum Solution preparation & dosing system consisting of minimum four (4) nos of Alum solution preparation tanks, agitators, alum solution dosing pumps (3W+1S) for PT-CW Clarifiers, (2x100%) for PT-DM Clarifier, (2x100%) for Lamella clarifier/tube settlers etc. c) FeCl₃ (35–45 % conc.) (in case of PT-RO) preparation & dosing system consisting of minimum two (2) nos. of dosing tanks, agitators, coagulant unloading and transfer pumps (2x100%), FeCl₃ dosing pumps (2x100%) etc. d) PE dosing system consisting of minimum two (2) nos. of dosing tanks, agitators (SS-316), dosing pumps (2x100%) (in case of PT-RO) etc. e) PAC dosing system shall consist of minimum two (2) numbers of storage cum dosing tanks, agitators, dosing pumps (2x100%), unloading pumps (2x100%) etc. f) Coagulant handling, storage, and dosage system with bulk Coagulant storage tanks (2), capacities of both tanks together shall be sized for one(1) month's storage, the tank shall be fitted with vent, drain, overflow seal pots etc., Coagulant unloading cum transfer pumps (2x100%), Coagulant preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Coagulant, Coagulant dosing pumps (2x100%). g) Coagulant aid handling, storage, and dosage system with bulk Coagulant storage for one(1) month's storage with design dose, Coagulant aid dosing pumps (2x100%), Coagulant aid preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Coagulant aid. h) Anti-scalant handling, storage, and dosage system with bulk storage for one(1) month's storage with design dose, Anti-scalant preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Anti-scalant, Anti-scalant dosing pumps (2x100%). i) Anti-oxidant handling, storage, and dosage system with bulk storage for one(1) month's storage with design, Anti-oxidant preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Anti-oxidant, Anti-oxidant dosing pumps (2x100%). j) Two (2) numbers of electrically operated mono-rail hoists each of 1 Ton capacity in chemical preparation area to handle chemicals from ground floor to first floor. k) Two (2) numbers of weighing scales at ground floor for weighing of chemicals being handled during storage and preparation.		
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	C. Liquid effluent treatment plant (LETP) 1. PT - plant clarifier sludge disposal system a). One (1) number RCC sludge pit (in 2 sections) to collect sludge from all the clarifiers of PT-CW system, PT-DM system & Lamella clarifiers/tube settlers and any other effluent connected to this sump envisaged. b). Two (2) numbers air blowers (2x100%) for the air agitation system of the sludge pit. c). Three (3) (3x50%) numbers of sludge disposal pumps. 2. Filter back wash waste disposal system a) One (1) number RCC Filter backwash waste collection pit (in 2 sections) to collect the backwash water from all the filters excluding Ultra filtration system. The filters backwash water shall be collected and recycled back to the PT-DM clarifier. b) Two (2) (2x100%) (1W+1S) numbers of backwash disposal pumps shall be provided. 3. Waste service water treatment system a) One (1) number RCC waste service water sump (WSWS) in two (2) sections shall be provided for collection of waste service water. Service water effluents and other plant effluents from various areas of the plant shall be routed to this waste service water sump. Facility shall be provided to collect free oil from these sumps to MS Oil drum and oil skimmers (2 nos.), Portable oil Centrifuge (1x100%) of suitable capacity shall be provided for reuse of oil. b) Three (3) (3x50%) numbers of Waste Service water pumps. c) Two (2) (2x100%) numbers of Lamella Clarifier/tube settlers of RCC construction of suitable capacity shall be provided to treat the total waste service water & other wastewater of the plant for reuse. d) One (1) number of RCC CMB cum Treated water tank for collection of treated water from Lamella Clarifier/tube settlers. Treated service water pumps shall be provided to transfer the treated service water to plant service water system & Ash handling system for reuse. 4. Coal handling plant run-off water treatment system a) Two (2) numbers of Coal Slurry Settling (CSSP) Ponds (minimum size of 40m x 8m x 3m deep) of RCC Construction shall be provided. b) Two (2) numbers Coagulant-aid tanks (with SS-316 agitators) of MS rubber lined construction. c) One (1) number decanted water sump of RCC Construction (2 sections) to receive decanted water from above settling ponds. d) Two (2) numbers (2x100%) Coal Decanted Water Pumps for reuse of coal decanted water in CHP dust suppression system. e) Two (2) numbers (2x50%) (2W) Clarifier Feed pumps (CSSP area).			
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	Strong base anion exchangers shall be designed for 12 hours of operation cycle followed by 4 hours regeneration period. MB unit shall be regenerated after minimum 108 hours of operation followed by regeneration period not exceeding 6 hours. b) Two (2) (2x100%) numbers of Activated carbon filters with all accessories. c) Two (2) (2x100%) Weak Cation exchangers units & Two (2) (2x100%) Strong Cation exchangers units with all accessories. d) Two (2) (2x100%) Weak Anion exchangers units & Two (2) (2x100%) Strong Anion exchangers units with all accessories. e) Two (2) (2x100%) numbers of Degasser system comprising of Degasser Towers and storage tanks, Air Blowers (2X100% per Degasser unit), three (3) (3x100%) Degassed water transfer pumps etc. f) Two (2) (2x100%) MB units along with Two (2) (2x100%) air blowers with its drives and all accessories. g) Two (2) (2x100%) Ultrafiltration (UF) polishing Units, complete with all accessories for chemical treatment inclusive of UF feed tanks (2), 3x50% UF feed pumps, 2x100% backwash pumps, 2x100% fast flush pumps (if applicable) etc. h) One (1) no. UF CIP/CEB system for chemical cleaning, CIP/CEB pumps etc. as per manufacturer's standard. i) Complete Hydrochloric acid handling, bulk acid storage tanks, measuring tank, and dosage system with three (3) bulk acid tanks, each tank sized for minimum 50 T OR capacities of all tanks together shall be sized for one month's storage, whichever is higher. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc., Two (2) no Acid measuring cum dilution tanks, one each for Cation units and MB units, 2x100% Dosing/Metering pumps with associated accessories each , two (2) (2x100%) acid unloading pumps with 50 mm dia. Heliflex hoses of 30m length. j) Complete Alkali handling, storage, and dosage system with two (2) bulk alkali tanks, each tank sized for minimum 50 T OR capacities of both tanks together shall be sized for one month's storage, whichever is higher. The tank shall be fitted with vent, drain, CO₂ absorber, overflow seal pots etc. Two (2) nos. alkali measuring cum dilution tanks with a motorized agitator, one each for each Anion units and MB units. One (1) No. alkali preparation and dilution tanks (from alkali flakes), with dissolving baskets & motorised agitators, One (1) number of activated carbon filter for alkali, One (1) number of alkali diluent water heating tank, 2x100% Metering pumps with associated accessories, two (2) (2X100%) alkali unloading pumps with 15 mm dia. Heliflex hoses of 30 m length. k) Two (2) numbers of safety shower units and two (2) number of Eye-fountains. l) Two (2) numbers of DM water storage tanks (Min. capacity 2450 m3) with all accessories with vent, drain, CO2 absorber, PVC balls, overflow, and seal pots. m)Two (2) numbers (2x100%) DM water pumps for regeneration system. n) Brine Solution Preparation Tank and Brine transfer pumps, piping and valves etc.		
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	o) Provision of hot water supply to the ACF units from the hot water tank shall be made for rejuvenation of activated carbon and the DM regeneration pumps to be sized considering above requirement in addition to required for regeneration. p) Headers shall be designed such that both DM streams can run simultaneously during exigency utilizing the stand-by pumps. 3) RO based plant DM plant (Option-II) A. Ultrafiltration (UF) system a) UF skids (2x60%) (Pressurized type), Simplex strainers (2x100%) for each stream, UF backwash pumps (2x100%) along with flushing tanks and pumps, CEB & CIP systems, UF permeate water storage tanks (2), UF permeate transfer pumps (3x50%) etc. b) 3x50% Micron Cartridge Filter (MCF). c) UF system headers shall be designed such that all the UF streams can run simultaneously utilizing the stand-by pump. B. RO system a) High Pressure (HP)-RO feed pumps (3x50%) with one(1) store standby, RO Streams/trains (3x50%) with module rack assemblies, RO Permeate transfer pumps (3x50%), sampling facilities, reject control valves, Complete system for Chemical cleaning (CIP) and Flushing system comprising of necessary tanks and pumps for RO trains/streams etc. b) Complete Degassifier system for removal of CO₂ in permeate water from RO units, consisting of minimum one (1) Degasser tower, Degasser/RO permeate water storage tank (2), Degassed Water Pumps (3x100%), RO Chemical dosing system consisting of Anti-oxidant dosing tank and pumps, Anti-scalant dosing tank and pumps etc., etc. c) Degasser Blowers for Degasser (2x100%). d) Mixed bed (MB) units (4x50%) (2W+2S) along with air blowers (2x100%) and complete regeneration system etc. e) RO system headers shall be designed such that all three RO & MB streams can run simultaneously. f) Complete Hydrochloric acid handling, bulk acid storage tanks, measuring tank, and dosage system with two (2) bulk acid tanks, each tank sized for minimum 25 T OR capacities of both the tanks together shall be sized for one month's storage with design dose. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc., Two (2) no Acid measuring cum dilution tanks, one each for pH control and regeneration of MB units, 2x100% acid dosing/metering pumps with associated accessories for pH control, 2x100% acid dosing/metering pumps with associated accessories, two (2) (2x100%) acid unloading & transfer pumps with 50 mm dia. Heliflex hoses of 30m length. g) Complete Alkali handling, storage, and dosage system with two (2) bulk alkali tanks, each tank sized for minimum 25 T OR capacities of both tanks together shall be sized for one month's storage with design dose. The tank shall be fitted		
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	with vent, drain, CO₂ absorber, overflow seal pots etc. Two (2) nos. alkali measuring cum dilution tanks with a motorized agitator, one each for each pH control and regeneration of MB units. One (1) No. alkali preparation and dilution tanks (from alkali flakes), with dissolving baskets & motorised agitators, 2x100% alkali dosing/Metering pumps with associated accessories for pH control in RO and 2x100% alkali dosing/Metering pumps with associated accessories for MB regeneration, two (2) (2X100%) alkali unloading, two (2) (2X100%) alkali transfer cum recirculation pumps with 15 mm dia. Heliflex hoses of 30 m length. h) Two (2) numbers of safety shower units and Two (2) numbers of. Eye-fountains to protect against any chemical hazard. 4) Other requirements for DM plant (Common for Option I, II) a) Two (2) numbers of DM water storage tanks with all accessories. b) Two (2) numbers (2x100%) DM water pumps for regeneration system. c) Neutralizing waste disposal system- DM plant Effluent drains, UF back wash, UF/RO cleaning chemicals etc. shall be connected to the N-Pit and shall be led suitably to Ash handling system. d) Backwash waste disposal system for DM plant - Backwash water from AC filters and fast/final rinse wastewater of DM plant shall be connected to the backwash collection pit (DM). Back wash water shall be pumped to the inlet channel of PT-DM clarifier. e) Two (2) (2x100%) numbers of backwash disposal pumps shall be provided. Two (2) numbers air blowers (2x100%) for the air agitation system of the filter backwash pit shall be provided. f) First fill of filter media for AC filters and first fill of resins for all Ion exchange units shall be provided. g) Provision of hot water supply to the ACF units from the hot water tank shall be made for rejuvenation of activated carbon and the DM regeneration pumps to be sized considering above requirement in addition to requirement for regeneration. h) Suitable MS Epoxy painted elevated access platform of permanent type to be provided for inspection of all the units like AC Filters, Ion Exchanger vessels, UF, RO skids, Hot water tank, dosing tanks, degasser tower and tank etc. i) RO Reject shall be led to Coal handling plant for reuse in dust suppression system. j) Adequate space for access and maintenance shall be provided for HP Pumps (at the end of the pump bay) and RO membrane (at the sides) of assembly. k) Two (2) numbers of portable and movable ladders with platform to be supplied for RO plant upto the highest reach. l) DM Plant shall be kept under steel shed without side wall and equipment inside the shed shall be protected against sunlight and rain. Height of the shed(s) shall be adequate to have sufficient head room for erection and maintenance. DM plant regeneration area shall be kept under steel shed.		
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3.07.00	5) Any other equipment required to meet the system requirement for complete Water-treatment plant and as envisaged by the contractor shall also be provided. 6) All wetted parts in the plant shall be constructed with suitable corrosion resistant material suiting to the fluid. 7) Facilities for maintenance of the pumps by means of mobile cranes or jib crane or gantry cranes shall be provided based on pumps layout. 8) DM Lab building along with associated equipment. 9) The unloading pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between chemical tanks to avoid any kind of mixing. Note:- Sizing of DM Plant(including tank and pump etc) shall be increased considering the requirement of SCR/SNCR system.			
	Condensate polishing plant (CPP) 1) One (1) number of Condensate Polishing unit (CPU) for each of the TG (Turbine-Generator) units, along with complete external regeneration system common for all the CPPs. 2) The Condensate Polishing unit (CPU) for each TG unit shall consist of either four (4) service vessels (4x33.33%) or three (3) service vessels (3x50%) along with emergency bypass system, resins, valves, piping etc. 3) Two (2) (2x50%) backwashable type cartridge pre-filters for each CPU shall be provided for the commissioning period, start-up period as first cleaning step as well as normal continuous operation, complete with automatically operated by-pass, associated piping, pumps (with at least one stand-by), pneumatically operated valves etc.			
3.08.0	Separation of Plant drain (effluents) from Storm water drain Arrangements shall be made that effluents and storm water do not get mixed. In general, the following philosophy shall be adopted for separation of plant drain from the storm water drain. a) Area wash water, Oil/Coal/Ash/Chemical contaminated water are considered as Plant Water. b) Plant water must be completely isolated from the Storm/Rainwater and only Plant water needs to be treated & recycled/reused for various plant use. Storm water drains will be separated out for free discharge. c) Area Pit(s)/Sump(s) shall be created broadly in the TG, Boiler, CHP transfer points, Mill & Bunker areas, ESP, Fuel oil & Fuel oil unloading areas, Chemical storage, Chemical unloading areas, transformer areas and in other cluster areas as required. d) Submersible Pumps (Capacity-2x100%) interlocked with Level control devices shall be installed in the Area Pit(s)/Sump(s) to transfer the Plant Water to Waste Service Water Sump (WSWS) located in main power house area or Water Treatment Plant			
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3.12.04	Further, the design features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed. iii) A strainer ('Y' type) be provided at upstream of deluge valve. iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock. v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors. vi) Each of the outdoor deluge valve and accessories shall be provided with housing with RCC roof. vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel through the keyboard operation of PC monitoring station when the system is selected in remote manual mode. The remote manual selection for the operation of spray system on any equipment or any zone shall also be through the monitoring station of the respective panel. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel. viii) Isolation Valves (Gate Valves with limit switches) in spray mains/headers for isolation of individual area like Switchyard, transformer yard, TG Building, Boiler, ESP & Chimney Area, CHP area, etc. shall be provided for O&M purpose.			
	Fire Detection, Alarm and Control System Design Philosophy (Fire Alarm and Detection System) i. The PLC based panel at Booster pump house shall indicate the status of each pump, system pressure, operation of hydrant and/ or spray system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS. ii. The addressable type panels at control equipment rooms shall receive signal from sensors from various areas/ equipment's of the respective units. iii. The panel at coal handling plant control room shall exhibit alarms from detection and protection from coal handling plant and all other auxiliary buildings/areas. Further, panel provided at stacker-reclaimer machines shall also be hooked-up with fire alarm panel at CHP control room for alarm purpose. iv. The central monitoring station to be located at Central Control Room shall cover the fire detection and protection system of the complete plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system. v. Alarms from all the panels shall be repeated simultaneously in repeater panel at fire station.			
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3.12.05 3.12.05.01	vi. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc. vii. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels. viii. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.			
	Total Flooding Inert Gas Extinguishing System			
	Design Philosophy (Minimum Requirements)			
	General			
	a) Complete design and all critical components / equipment like cylinder, cylinder valve assembly, hoses, check valve, actuation controls, restrictor/pressure reducer, directional/selector valve, pressure relief device/safety valve, pressure gauge, pressure switch, nozzle, etc. shall be approved and listed by UL/FM /VDS /LPCB or equivalent. Basic design parameters of inert gas extinguishing system like type of inert gas agent, extinguishing/design concentration, safety factor, discharge time, etc. shall be considered in strict accordance with NFPA-2001 (latest edition). Piping design/layout, nozzle arrangement/orientation, etc. shall confirm to UL/FM/VDS/LPCB or equivalent.			
	Agent Supply, Design Concentration, Quantity & Discharge time			
	a) System shall be designed to meet the minimum requirements of total flooding inert gas extinguishing system as per NFPA 2001. However higher concentration may be used if it is specified by the agent manufacturer/ system supplier for the area protected. b) The complete volume of the rooms including the above false ceiling shall be considered for estimation of quantity of gas and containers. When determining the gas quantity, the leakage losses from the enclosure shall be taken into account by the supplier. Further volume of re-circulating type air conditioning system & its duct work (at least up to the automatic fire dampers of the ducts) shall be considered as a part of the total volume so that the design concentration is achieved throughout the hazard area. Further gas quantity shall be adjusted for ambient pressure & temperature conditions. Bidder to provide primary supply of gas & its cylinders, along with 100% (one hundred percent) standby reserve gas quantity and cylinders for each room/area. c) However, if the system design permits provision of a common "ENGINEERED STORAGE SYSTEM" with directional valves for multiple rooms / areas of one unit, such a design is acceptable provided the total primary supply and/or reserve supply is equivalent to the requirement of largest area / room and such rooms /areas are perfectly separated from each other by means of wall / metal cladding or floor of minimum required fire rating. Such common storage system should have been listed & approved by UL/FM/VDS/LPCB or equivalent and bidder should produce documentary evidences for design and installation of such systems elsewhere in the past by them.			
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	d) In either of the case mentioned in above two clauses, both the main & reserve supply cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy changeover from the panel. Suitable selector switches be provided for “Normal /Standby “supply selection. e) The discharge time period shall be such that the design concentration is achieved within time duration specified in NFPA-2001 (latest edition/amendment) The flow calculations shall establish this criterion. f) The quality of gas shall conform to relevant design standard such as NFPA – 2001(latest edition) or as specified by listing authorities. g) Clean agent discharge test shall be done for smallest inert gas protected zone. Storage containers a) The storage cylinders offered shall be of seamless type & brand new. Welded cylinders are not permitted. b) All the storage containers shall be provided under an enclosure. It shall not be kept open to atmosphere. c) The storage containers shall be securely installed as per the listed installation manual with a provision for convenient individual servicing and container weighing. Such servicing or weighing shall be possible without shutting down the system. d) Automatic means such as check valves shall be provided to prevent gas loss if the system is operated when any containers are removed for maintenance. e) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer’s listing. f) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55 °C and shall be designed to meet the requirements in NFPA-2001. g) All cylinders shall bear the marking as detailed out in NFPA -2001 and shall be duly listed by UL / FM /VDS/LPCB or equivalent in addition to approval by Chief Controller of Explosives -INDIA. h) The storage cylinders shall have accessories such as pressure gauges/ switches, liquid level indicators (if applicable), refilling connections, relief devices (if applicable) etc. A reliable means of indication other than weighing shall be provided to determine the pressure in cylinders. i) All the pressure gauges/switches, manifold connections etc shall be easily removable for servicing / maintenance without any loss of gas. DISTRIBUTION a) Both main & reserve cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy & auto changeover. Cylinder Manifold, directional valve manifolds, Piping, fittings & pressure relieving device shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA -2001 (latest edition) or as specified by listing authorities. Material of construction for manifolds shall be as per listed design manual and shall be hydro-tested as per design manual or at 1.5 times the maximum design pressure, whichever is higher.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 74 OF 101

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	b) Discharge nozzles along with deflector shields shall be listed for the intended use including the flow characteristics and area of coverage and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc. c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply be taken from the Fire detection /alarm system panels of the respective units. Required annunciations such as “Gas released”, “Failure of automatic actuation” etc shall be exhibited in the fire alarm panel. d) Where pilot cylinders are employed for actuation of the cylinder banks, the number of pilot cylinders shall be as per the listed design manual. e) Facility for manual release of gas through push buttons be provided along with selection facility of “Auto/Manual” from the panel. f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks. g) All manual-operating devices shall be identified to the hazard they protect by fluorescent paint. h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA -2001 or as specified by listing authorities. i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant. j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system /panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL/FM/ VDS/LPCB. Design, Installation & Testing a) System design, specifications, working plans, flow calculations etc. shall be prepared in line with the NFPA-2001 or as specified by listing authorities and shall be approved by Employer. The system flow calculations shall be performed using a calculation listed or approved by UL/FM /VDS/LPCB. b) Calculation shall be provided by the designer to prove that the area is not pressurized and extinguishing capability is not affected due to provided ventilation of that area. Bidder to provide additional ventilation arrangement if required. c) After installation, the complete system shall be inspected and tested as per the recommendations of Chapter-4 & relevant Clauses of Appendix-A of NFPA-2001. Wherever testing is mentioned at a regular frequency in these chapters, the bidder shall carry out initial testing and records shall be presented to Employer for approval of the installation. d) Prior to handing over of the system to Employer, the supplier shall provide operational training to Employer’s operating personnel which shall consist of control system operation, trouble procedures, emergency procedures, safety requirements etc.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 75 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC													
3.13.00	e) The complete installation, testing, commissioning & training shall be carried out by the Contractor under the supervision of the Manufacturer/ designer at site. f) The performance test of the system shall be carried out by releasing the agent gas in a selected area and design parameters shall be measured. All equipments, refilling of gas after test, instruments etc. shall be provided by the contractor for the same.														
	SAFETY (a) All the safety requirements recommended in NFPA -2001 or as specified by listing authorities shall be incorporated in the installation by the bidder. (b) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating clearly the hazard associated with the system such as Noise, turbulence, cold temperature, physiological effects on personnel etc. (c) Apart from written warning signs, audio-visual type warning signs (i.e) hooters & strobe lights shall be provided for pre-discharge and post-discharge activity. The sounder shall have selectable tone options. (d) The gas shall be discharged after a set time delay on receiving signal from the fire detection system. The duration of the timer shall be upto a range of 0- 5 minutes (adjustable in 1 minute variation) at site after conducting test to find out the duration for evacuation of the personnel from the area. (e) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of "LOCKOUT". The status of the system lockout condition shall be annunciated audio-visually in the panel.														
	Pressure Venting Since huge quantity of gas is envisaged to be released, proper pressure relief and ventilation systems such as fans, dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided by the owner. The contractor shall submit pressure relief, venting calculations, its requirement and suggestive mode of ventilation during detailed engineering for approval.														
	AIR CONDITIONING AND VENTILATION SYSTEM <table><tr><th>Season</th><th>Dry Bulb Temp. (Deg. C)</th><th>Wet Bulb Temp. (Deg. C)</th></tr><tr><td>Summer</td><td>44</td><td>25.5</td></tr><tr><td>Monsoon</td><td>31</td><td>27.7</td></tr><tr><td>Winter</td><td>12.2</td><td>6.6</td></tr></table>	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)	Summer	44	25.5	Monsoon	31	27.7	Winter	12.2	6.6		
	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)												
Summer	44	25.5													
Monsoon	31	27.7													
Winter	12.2	6.6													
GENERAL REQUIREMENTS 1. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.															
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 76 OF 101												

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
3.13.01	2. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.			
	DESIGN PHILOSOPHY - Air conditioning system			
	1. Design ambient conditions for all air conditioning system shall be as indicated below:			
	2. All equipments of Air Conditioning system shall be designed for continuous duty.			
	3. All air conditioned areas like control room, control equipment rooms, office area in control tower , etc. shall be maintained at 24 deg. C $\pm$ (plus or minus) 1 deg. C and relative humidity of 50% $\pm$ (plus or minus) 5%.			
	4. The fresh air quantity for air-conditioned areas of ESP Control Room / AHP Control Room /FGD control room, Control Room / Control Equipment Room / UPS, Water System Control Room Building, AIS Control Room Building, etc. shall be 0.45 M3/minutes/person or 1.0 air change per hour whichever is greater. However, for areas like office area in control tower , etc. quantity of fresh air shall be minimum 1.5 air changes per hour.			
	5. Lighting load shall be one (1) Watts/Sq.feet or actual whichever is higher.			
	6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room/meeting room the same shall be one per 3 Sq.M. In the control rooms, control equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).			
	7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided. Further, FGD control room and ESP Control Room, office area in control tower , etc. where various floors are air-conditioned and no intermediate or intervening floor are left non-air-conditioned, the space above false ceiling shall be used as return air plenum.			
	8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls (with perfect partition i.e. partition both above & below false ceiling) and floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts shall be provided in control panel of A/C plant by the Contractor for further wiring upto fire alarm panels.			
	9. Soft water make up (if required) for complete air conditioning and ventilation system shall be provided by the bidder.			
	10. Design Chilled water flow shall not be less than 0.7 Cu.M/hr per TR air-conditioning load and design condensing water flow shall not be less than 1 Cu.M /hr per TR air-conditioning load.			
	11. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Water piping shall be sized for a maximum velocity of 2.0 m/sec. However, gravity flow / pump suction line shall be sized for a maximum water velocity of 1.5 m/sec.			
	12. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.			
13. Requirement of Underdeck Insulation (for A/C area)				
14. Underdeck insulation shall be provided if				
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 77 OF 101

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
3.13.02	1 No. cooling tower fan. 2 nos. AHUs for CR & CER 1 No. fresh air fan.															
	21. As per ECBC codes minimum coefficient of performance (COP) for the chiller shall be as follows (based on AHRI conditions):															
	A. COP of the water cooled chiller:															
	<table><tr><th>Sl. No.</th><th>Chiller Capacity (kW_r)</th><th>Min COP</th></tr><tr><td>01.</td><td><260</td><td>4.7</td></tr><tr><td>02.</td><td>≥ 260 & < 530 TR</td><td>4.9</td></tr><tr><td>03.</td><td>≥ 530 & < 1050 TR</td><td>5.4</td></tr></table>				Sl. No.	Chiller Capacity (kW _r)	Min COP	01.	<260	4.7	02.	≥ 260 & < 530 TR	4.9	03.	≥ 530 & < 1050 TR	5.4
	Sl. No.	Chiller Capacity (kW _r)	Min COP													
	01.	<260	4.7													
	02.	≥ 260 & < 530 TR	4.9													
	03.	≥ 530 & < 1050 TR	5.4													
	B. COP for air-cooled chillers:															
	<table><tr><th>Sl. No</th><th>Chiller Capacity (kW_r)</th><th>Min COP</th></tr><tr><td>01.</td><td>< 260</td><td>2.8</td></tr><tr><td>02.</td><td>≥260</td><td>3.0</td></tr></table>				Sl. No	Chiller Capacity (kW _r)	Min COP	01.	< 260	2.8	02.	≥260	3.0			
Sl. No	Chiller Capacity (kW _r)	Min COP														
01.	< 260	2.8														
02.	≥260	3.0														
DESIGN PHILOSOPHY – Ventilation System																
1. Minimum Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:																
<table><tr><td>i)</td><td>For all evaporative cooled areas</td><td>-</td><td>8</td></tr><tr><td>ii)</td><td>General areas</td><td>-</td><td>20</td></tr><tr><td>iii)</td><td>Hydrogen generation plant/MCC/ Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated</td><td>-</td><td>30</td></tr></table>				i)	For all evaporative cooled areas	-	8	ii)	General areas	-	20	iii)	Hydrogen generation plant/MCC/ Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated	-	30	
i)	For all evaporative cooled areas	-	8													
ii)	General areas	-	20													
iii)	Hydrogen generation plant/MCC/ Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated	-	30													
2. However in areas producing lot of heat, temperature shall be the criteria as follows:-																
a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas. b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.																
Note : (i) Dry bulb temperature during summer season is 43 degC. The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected. (ii) To calculate air quantity based on air changes per hour (ACPH) method, height of operating floor (17M) in AB Bay shall be taken as 4 meter.																
3. All ventilation systems shall operate on 100% fresh air. Fan envisaged for MCC & Switchgear rooms shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only.																
4. All the equipments of ventilation system shall be designed for continuous duty.																
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CLAUSE NO.	TECHNICAL REQUIREMENTS																								
3.14.00	5. The supply air ducts of evaporative type ventilation system shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) entry in switchgear room, cable galleries etc. The operation of these automatic dampers shall be interlocked with the fire alarm system and shall also possible from the control panel remote manually. 6. Circulating water Capacity for Air washer units shall be minimum 1 Cu.M/hr per 1000 Cu.M /hr of air flow and for UAF it shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec. 7. The air washer unit shall be designed for a maximum velocity of 2.7 m/sec and at least 90% saturation efficiency. 8. All mechanically ventilated areas shall be positively ventilated. However, Battery rooms and other fumes/odour generating areas like fuel oil pump houses, central lube oil purification room etc. shall be negatively. Type of ventilation for various buildings shall be as follows: <table><tr><th>S.No</th><th>Area</th><th>Type of Ventilation system</th></tr><tr><td>(i)</td><td>General area like pump house, compressor houses, etc.</td><td>Combination of Supply air fan & Exhaust air fans/Roof Extractor Fans</td></tr><tr><td>(ii)</td><td>MCCs and Switchgear room, Cable Vault (other than served by evaporative ventilation system), etc.</td><td>Supply air fans & Back draft dampers</td></tr><tr><td>(iii)</td><td>Battery rooms & other fumes/odour generating areas</td><td>Combination of Air Intake Louvers & Exhaust air fans</td></tr><tr><td>(iv)</td><td>Cable Galleries of TG Building, ESP Building and FGD Control Room Building</td><td>AWU/UAF systems along with back draft dampers</td></tr><tr><td>(vi)</td><td>Toilet/pantry etc.</td><td>Exhaust air fans</td></tr><tr><td>(vi)</td><td>For underground ventilation of CHP & Mill reject handling</td><td>Refer relevant clause in this sub section.</td></tr></table>				S.No	Area	Type of Ventilation system	(i)	General area like pump house, compressor houses, etc.	Combination of Supply air fan & Exhaust air fans/Roof Extractor Fans	(ii)	MCCs and Switchgear room, Cable Vault (other than served by evaporative ventilation system), etc.	Supply air fans & Back draft dampers	(iii)	Battery rooms & other fumes/odour generating areas	Combination of Air Intake Louvers & Exhaust air fans	(iv)	Cable Galleries of TG Building, ESP Building and FGD Control Room Building	AWU/UAF systems along with back draft dampers	(vi)	Toilet/pantry etc.	Exhaust air fans	(vi)	For underground ventilation of CHP & Mill reject handling	Refer relevant clause in this sub section.
	S.No	Area	Type of Ventilation system																						
	(i)	General area like pump house, compressor houses, etc.	Combination of Supply air fan & Exhaust air fans/Roof Extractor Fans																						
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	(iv)	Cable Galleries of TG Building, ESP Building and FGD Control Room Building	AWU/UAF systems along with back draft dampers																						
	(vi)	Toilet/pantry etc.	Exhaust air fans																						
	(vi)	For underground ventilation of CHP & Mill reject handling	Refer relevant clause in this sub section.																						
	9. For pumps, continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range. For fans, compressors and blowers continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand at the design duty point. However for V-belt driven fan, continuous motor rating (at 50°C ambient) shall be atleast 15% above the maximum load demand at the design duty point.																								
	10. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.																								
Compressed Air System																									

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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																												
3.14.02 3.14.02.01	The compressed air system shall consist of Instrument Air compressors & their motor drives, Air Drying (ADPs) Plants, Service Air compressors & their motor drives, air receivers for each Air compressors, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit). DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE 1. All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment. 2. The compressors and Air Drying plants shall operate under the following ambient conditions. i. Minimum temperature : 10 deg.C ii. Maximum temperature : 50 deg. C iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH iv. Height above MSL (m) : Refer Chapter “Project Information” 3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.																															
	Selection of Capacity of Air Compressor																															
	Instrument Air Compressor																															
	a) Instrument air Compressor shall be designed to meet the Instrument air requirement of all the equipments/plant/systems to be supplied by the Contractor and as well as to meet instrument air requirement of Employer’s systems /plant as follows:																															
	<table><tr><th>Sl. No.</th><th>Continuous Requirement</th><th colspan="2">Quantity (in NM³/min)</th></tr><tr><td>1.</td><td>For each Unit of Steam Generator & its auxiliaries (Continuous)</td><td colspan="2">A</td></tr><tr><td>2.</td><td>For each Unit of TG & its auxiliaries (Continuous)</td><td colspan="2">B</td></tr><tr><td>3.</td><td>Water Treatment Plant (Continuous)</td><td colspan="2">C</td></tr><tr><td>4.</td><td>For Station C&I System</td><td colspan="2">D</td></tr><tr><td>5.</td><td>For each Unit of Ash handling system, Silo Utility & its auxiliaries (Continuous)</td><td colspan="2">E</td></tr><tr><td>5.</td><td>Instrument air requirement for 1 unit (Z)</td><td>=</td><td>[1.3x1.1x(A+B+C+D+E)] NM³/min</td></tr></table>				Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)		1.	For each Unit of Steam Generator & its auxiliaries (Continuous)	A		2.	For each Unit of TG & its auxiliaries (Continuous)	B		3.	Water Treatment Plant (Continuous)	C		4.	For Station C&I System	D		5.	For each Unit of Ash handling system, Silo Utility & its auxiliaries (Continuous)	E		5.	Instrument air requirement for 1 unit (Z)	=	[1.3x1.1x(A+B+C+D+E)] NM ³ /min
	Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)																													
	1.	For each Unit of Steam Generator & its auxiliaries (Continuous)	A																													
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
3.14.02.02	6.	Total instrument air requirement for all units	=	No of units X (Z)	
	7.	Minimum Capacity of instrument air compressor	=	No of units X (Z)/N Where N=Nos. of instrument Air Compressors (working) as specified.	
	Notes: While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air, if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.				
	Service Air Compressor				
	a)	Service air Compressor shall be designed to meet the Service air requirement of all the equipments/plant/systems to be supplied by the Contractor as well as to meet service air requirement of LDO firing upto 30% BMCR and Employer's systems /plant as follows:-			
	Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)		
	1.	For each Unit Steam Generator & its auxiliaries (Continuous)	F		
	2.	For each unit TG & its auxiliaries (Continuous)	G		
	3.	Water Treatment Plant (Continuous)	H		
	4.	Service air requirement for 1 unit (Y)	=	[1.3x1.1x(F+G+H)] NM ³ /min	
5.	Total service air requirement for all units (W)	=	No of units X (Y)		
6.	Service air requirement considering atomization for LDO firing of one units at a time	=	I		
7.	Total service air requirement for all units with LDO firing of one units at a time (Z)	=	W + I		
8.	Minimum Capacity of service air compressor	=	Z/M Where M=Nos. of Service Air		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
			Compressor as specified.	
	Note: While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirement of service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of service air if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4. The Service air requirement of mill reject shall not be included while sizing the compressor capacity, as separate & dedicated compressors are to be provided for the same. General 1. The compressor capacity & discharge pressure of instrument air system and service air system shall be identical. 2. The capacity of air drying plant shall be equal to the capacity of the individual air compressors.9 The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air". 3. Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm² (g) or more as per the requirement of Contractor. 4. The discharge pressure of compressor shall be minimum 8 Kg/cm²(g). 5. The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature. 6. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C. 7. Noise level shall not exceed 85 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor and 1m horizontal distance. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. For eventual noise, from the discharge line, accessories and/or ancillary equipment which are not included, a correction factor of (+)8 dBA maximum shall be allowed for background & ambient noise. Similarly, vibration level of screw compressor shall be as per VDI-3836. However velocity vibration shall be limited to 10mm/sec (rms). Vibration level of centrifugal compressor shall be as per manufacturer standard & proven practice. 8. Parallel operation of compressors shall be possible without any undue vibration and noise. 9. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors. 10. The maximum velocity to be considered in compressed air and cooling water piping shall be as mentioned elsewhere in Subsection titled "Low Pressure Piping" in Part-B of this Technical Specification.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	11. All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.00.00	MATERIAL HANDLING			
4.01.00	Ash handling System			
4.01.01	Brief System Description			
	Ash handling system consists of the following sub systems:			
a)	Bottom Ash, Economizer, Eco outlet duct hopper (if applicable), APH, Duct hopper, SCR Hopper ash Handling System, system shall be kept ready for SCR hopper Ash Handling system			
	i) Jet pump and Water Impounded Hopper System – An intermittent system consisting of water impounded hoppers, clinker grinders, jet pumps etc.			
	OR			
	Submerged Scrapper Conveyor and dry type hopper System – A continuous system consisting of dry type Bottom Ash hoppers, submerged scrapper conveyors, clinker grinders, bottom ash slurry trench etc.			
	ii) Dewatering Bins system			
b)	Dry Fly Ash Conveying system			
	Two alternatives for pneumatic conveying system (i.e. vacuum conveying system or pressure conveying system) are specified for conveying of fly ash in dry form from ESP Hoppers to Buffer Hoppers (in vacuum conveying) or ESP Hoppers to classifier silo (in pressure conveying).			
	i) Vacuum Conveying System			
	It shall consist of liquid ring vacuum pumps, material handling valves, cast iron and MS pipes, instrument air compressor etc.			
	OR			
	ii) Pressure Conveying System			
	It shall consist of screw compressors, air lock/pump tanks, ash intake & discharge valves, CI & MS pipes, instrument air compressors etc.			
c)	Ash Water System			
	Ash water system shall consist of bottom ash HP water pumps, bottom ash LP water pumps, flushing water pump, fly ash HP water pumps etc.			
d)	Ash Disposal System			
	The bottom ash and fly ash of each unit shall be disposed in combined HCSD slurry to Ash dyke. The scope of pipeline for the package is upto plant boundary, however system sizing of HCSD pumps shall be done taking care of disposal to ash dyke.			
e)	Dry Fly Ash Transportation system			
	ESP ash from the buffer hoppers (applicable for vacuum conveying system) to classifier silos and from ash classifiers silo to fly ash storage silos by pressure transportation system shall be transported. Transportation of Ash in single stage pressure conveying shall limit to 1500 meters.			
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f)	The user industries shall take the dry fly ash from dry fly ash storage silos either in rail wagons/ closed tankers or in open tankers. The fly ash Storage Silos shall also have rail and road loading facilities.		
	Ash classifier and bagging plant		
	An ash classifier system, having a provision to segregate dry fly ash into coarse ash and fine fly ash shall be provided. The classifier shall be of proven design for similar application.		
	A mechanized ash bagging plant shall be provided for bagging of fine fly ash into 50 kg (cement) bags.		
	Broad Design Criteria		
	(A) The capacity of ash handling systems, as a percentage of maximum ash generated corresponding to firing of worst coal at BMCR, shall not be less than the following:		
	a) Fly Ash System		
	ESP ash	90% (Worst Case Considering SCR is in By-pass condition)	
	b) Bottom Ash System		
	Furnace bottom ash	25%	
Economiser ash	5%		
Economiser outlet duct hopper (if applicable)	5%		
SCR Hoppers	Bidder to indicate; (at least 5% margin over & above the design requirement)		
APH Ash	5%		
Duct Hopper Ash (if applicable)	5%		
(B)	Ash removal rate shall meet the following criteria:		
	a) Fly Ash System		
	8 hour collection shall be removed in 6 hours for ESP Ash. The conveying system shall be designed to evacuate ash generated both during normal mode and SCR Bypass mode. The ash conveying rate from ESP hoppers must be designed considering two fields out of service condition at any one time.		
	b) Bottom ash system		
i)	Intermittent jet pump system	Bottom Ash, Economizer, (APH + SCR + Duct Hopper) ash to be removed twice in a shift	
	OR		
	SSC system	Continuous removal	
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	ii)	Dewatering Bins system: Each bin shall have provision to hold bottom ash and coarse ash generated for eight hours of ash. Two chutes shall be provided from each bins along with feeding arrangement to Truck/dumpers.																
		Dewatering Bins shall be of proven design/supplier for similar applications.																
	(C)	Ash Densities:																
		<table><tr><th rowspan="2">Type of Ash</th><th colspan="2">Bulk Density (Tonnes per m³)</th><th rowspan="2">Particle density (Tonnes per m³)</th></tr><tr><th>For Calculations</th><th>Load For volume Calculations</th></tr><tr><td>Bottom Ash</td><td>1.6</td><td>0.65</td><td>2.0</td></tr><tr><td>Fly Ash</td><td>1.6</td><td>0.75</td><td>2.0</td></tr></table>			Type of Ash	Bulk Density (Tonnes per m ³)		Particle density (Tonnes per m ³)	For Calculations	Load For volume Calculations	Bottom Ash	1.6	0.65	2.0	Fly Ash	1.6	0.75	2.0
	Type of Ash	Bulk Density (Tonnes per m ³)		Particle density (Tonnes per m ³)														
		For Calculations	Load For volume Calculations															
	Bottom Ash	1.6	0.65	2.0														
	Fly Ash	1.6	0.75	2.0														
	(D)	Cooling water Requirement for Bottom ash																
		For calculating cooling water requirement, bottom ash collection rate corresponding to 15 % of total ash make, shall be considered. This is applicable only for sizing of cooling water requirement for BA hopper. For calculating the cooling water quantity the relevant factors and the formulae to be used shall be as indicated at Annexure-I.																
(E)	Bottom ash Overflow water																	
	The overflow water from the bottom ash hopper shall be led to an overflow water tank. Each overflow tank shall have an effective storage capacity of minimum ten (10) minutes of BA overflow water pump rated capacity. From overflow tank, the BA overflow water shall be pumped to minimum one (1) number settling tanks and one (1) no. surge tank, by BA overflow water pumps. The diameter and thickness of mild steel settling tanks shall be minimum 15 meters and 10 mm respectively. The total suspended solids of overflow water from settling tanks to ash water pump house should not exceed 100 ppm and the same shall be guaranteed. Should the bidder feel that the total suspended solids will be more than 100 ppm, even after settling tank and surge tank suitable chemical treatment/filtration/clarification shall be provided by the bidder before the overflow water is recycled to ash water pump house where the ash water pumps are proposed to be located.																	
(F)	Ash slurry disposal system																	
	Combined Ash slurry disposal system																	
	The ash concentration (W/W) for shall be as given below:																	
	a)	For bottom ash slurry disposal (for Jet pumps) 25% max.																
	b)	Combined Bottom ash & Fly Ash slurry disposal system in HCSD form																
		The ash concentration (W/W) shall be 60% (rated).																
	ii)	HCSD system capacity shall be designed based on the following criteria:																
		a)	Design concentration for ash slurry pumping minimum 60% by weight.															
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	b) Range of concentration shall be 55% to 65% c) HCSD pump operating range – 10% to 100% of rated flow. d) The high concentration slurry shall be disposed in disposal area such that no significant free water is released from the slurry. e) The High Concentration ash slurry disposal pump shall be positive displacement type f) Maximum slurry velocity in disposal pipe line shall be 1.9m/sec @rated duty point g) Elevation of top of ash dyke : RL 227.0 h) Maximum pumping distance – 6.0 Km or as per actual distance for the farthest disposal point in ash dyke whichever is higher.																																		
	(G)	Velocities																																	
	<table><tr><td>Minimum / Maximum Velocity in Bottom Ash/Fly Ash/ Combined Ash Slurry Lines</td><td>2.3 /2.8 (m/s)</td></tr><tr><td>Tip Speed for Centrifugal Ash Disposal Pump (Max)</td><td>1676 (m/min)</td></tr></table>				Minimum / Maximum Velocity in Bottom Ash/Fly Ash/ Combined Ash Slurry Lines	2.3 /2.8 (m/s)	Tip Speed for Centrifugal Ash Disposal Pump (Max)	1676 (m/min)																											
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	(H)	Rated flow of pumps shall be used for determining the pipe sizes. Further the following line velocities shall be considered for estimating the line sizes of water pipes and Air Pipes:																																	
	<table><tr><th>S. N.</th><th>Service</th><th colspan="3">Velocity, M/Sec</th></tr><tr><th></th><th></th><th>Pipe size below 50 mm</th><th>Pipe size of 50 to 150 mm</th><th>Pipe size of 200 mm and above</th></tr><tr><td>a)</td><td>Water pump Suction</td><td>0.6-0.9</td><td>1.2-1.5</td><td>1.2-1.5</td></tr><tr><td>b)</td><td>Water Pump Discharge</td><td>0.9-1.8</td><td>1.5-2.4</td><td>1.8-2.8</td></tr><tr><td>c)</td><td>Compressed air below 2 Kg per cm²(g)</td><td>15-20</td><td>15-20</td><td>20-30</td></tr><tr><td>d)</td><td>Compressed air, 2 Kg per cm²(g) & above</td><td>20-30</td><td>20-25</td><td>25-35</td></tr></table>					S. N.	Service	Velocity, M/Sec					Pipe size below 50 mm	Pipe size of 50 to 150 mm	Pipe size of 200 mm and above	a)	Water pump Suction	0.6-0.9	1.2-1.5	1.2-1.5	b)	Water Pump Discharge	0.9-1.8	1.5-2.4	1.8-2.8	c)	Compressed air below 2 Kg per cm ² (g)	15-20	15-20	20-30	d)	Compressed air, 2 Kg per cm ² (g) & above	20-30	20-25	25-35
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	a) Pipe Size in pump suction side shall be at least one pipe size larger than the corresponding pump discharge connection. b) The proposed sizes of the water and air pipes shall be submitted for Owner's approval. The water and air pipe supports shall be spaced as follows. <table><tr><td>Pipe size (NB)</td><td>25</td><td>50</td><td>100</td><td>150</td><td>200</td><td>300</td><td>400</td><td>500</td></tr><tr><td>Spacing meter in</td><td>2.1</td><td>3.0</td><td>4.3</td><td>5.2</td><td>5.8</td><td>7.8</td><td>8.2</td><td>9.8</td></tr></table>	Pipe size (NB)	25	50	100	150	200	300	400	500	Spacing meter in	2.1	3.0	4.3	5.2	5.8	7.8	8.2	9.8		
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(I)	Friction factor 'C' to be considered in Hazen-Williams formula:																				
	<table><tr><td>i)</td><td>Friction factor ' C ' for Bottom/Combined Ash Slurry Lines</td><td>140</td></tr><tr><td>ii)</td><td>Friction factor ' C ' for Sludge Lines</td><td>130</td></tr><tr><td>iii)</td><td>Friction factor ' C ' for Bottom Ash Over Flow Lines</td><td>100</td></tr><tr><td>iv)</td><td>Friction factor ' C ' for Water Lines</td><td>100</td></tr></table>	i)	Friction factor ' C ' for Bottom/Combined Ash Slurry Lines	140	ii)	Friction factor ' C ' for Sludge Lines	130	iii)	Friction factor ' C ' for Bottom Ash Over Flow Lines	100	iv)	Friction factor ' C ' for Water Lines	100								
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(J)	Basis for selection of capacities of various tanks/sumps - (effective Maximum pumping capacity)																				
	<table><tr><td>i)</td><td>Bottom Ash Over flow Tank</td><td>Ten (10) minutes</td></tr><tr><td>ii)</td><td>Slurry Sump (each compartment) [between High level & pump trip level]</td><td>Five (5) minutes</td></tr><tr><td>iii)</td><td>Ash Water Sump</td><td>Thirty (30) minutes</td></tr></table>	i)	Bottom Ash Over flow Tank	Ten (10) minutes	ii)	Slurry Sump (each compartment) [between High level & pump trip level]	Five (5) minutes	iii)	Ash Water Sump	Thirty (30) minutes											
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iii)	Ash Water Sump	Thirty (30) minutes																			
(K)	Ash Storage silos																				
	Three HCSD Cum Storage Silos shall be provided for both the units to receive ash from ESP Hoppers. Each HCSD Cum Storage Silos shall be of 2000 MT effective storage capacity. An additional fine ash silo of capacity 2000 Tonnes shall be provided at a separate location/adjacent to HCSD Cum Storage Silos having facility for feeding to the ash bagging plant. Storage capacity for Classifier Block Silos/Hoppers are as follows: - Fine fly ash Hopper-600 (T), Coarse Fly ash Hopper-600 (T), Classifier Silo -250 (T).																				
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4.01.03	The fly ash storage silos shall be at a pitching suitable for filling of ash into BOXN/BCCW/BTAP/BCFC wagons. (L) Buffer hopper /Intermediate surge hopper shall be sized for 30 minute storage of conveying stream capacity. Margins on equipment Margins on equipments shall be as follows:			
	S.NO.	EQUIPMENT	MARGIN	
	1.	VACUUM PUMPS	Minimum margin of 10% (percent) over the capacity determined based on ash removal rates.	
	2	CONVEYING/ TRANSPORT AIR COMPRESSORS	At least 10% (percent) margin shall be provided on compressor capacity over and above the maximum flow requirement determined based on the ash removal rates.	
	3.	BAG FILTER	Number of bags shall be sized considering 10% of the bags plugged. Air to cloth ratio taken for bag selection shall be taken as maximum 0.8m/min.	
	4.	WATER PUMPS	At least 15% (percent) margin shall be provided in the pump capacity over and above the maximum seal water/cooling water and other flow requirements.	
	5.	HCSD PUMPS	Minimum 10% margin shall be considered for ash slurry pump sizing over and above the total slurry disposal head requirement comprising the straight pipe line frictional loss and bends loss	
4.01.04	Standby arrangement for Ash handling system Ash handling system shall have the provision for following standby arrangement: Bottom Ash System - 100% standby for clinker grinders, jet pumps with independent pipelines for each jet pump. <u>Or</u> 100 % standby for submerged scrapper conveyor (SSC) and clinker grinders Fly Ash System - 100% standby for vacuum pumps, buffer hoppers. Independent vacuum air line from each buffer hopper to vacuum pump (for ESP Hoppers). - 100% standby blowers for buffer hopper and at least one no. standby blower for storage silos.			
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	ANNEXURE-I				
	GUIDELINES FOR ESTIMATING COOLING WATER QUANTITY FOR BA HOPPER				
	1.0	Formulae for calculating the make up water quantity for BA hopper			
		Heat input to BA hopper	=	Heat output to BA hopper	
		$Q_{ba} + Q_{fr}$	=	$Q_C + Q_{OW}$	
		Q_{ba}	=	$F_{ba} \times C_{ash} \times (T_1 - T_2)$	
		Q_{fr}	=	$A_{fa} \times R_f$	
		Q_C	=	$A_{fa} \times E \times C_v$	
		Q_{OW}	=	$F_W \times C_{water} \times (T_2 - T_3)$	
		Q_{ba}	=	Sensible heat of bottom ash (BTU/hr.)	
		Q_{fr}	=	Furnance radiation to BA hopper (Btu/hr.)	
		Q_C	=	Heat leaving in evaporated	
		Q_{OW}	=	Heat leaving in overflow water (Btu/lb)	
		F_{ba}	=	Collection rate of bottom ash for cooling water requirements (lb/hr) (For calculating cooling water requirement, bottom ash collection rate corresponding to 15 % of total ash generation shall be considered. This is applicable only for sizing of cooling water requirement for BA hopper.)	
		Cash	=	Specific heat of ash = 0.25 btu/lb ⁰ F	
		T ₁	=	temperature of bottom ash in hopper =1050 ⁰ C (1922 ⁰ F)	
		T ₂	=	Temp. of water to be maintained in BA hopper=60 deg. C (140 deg.F)	
		A _{fa}	=	Furnance aperture above hopper(ft ²)	
		R _f	=	Radiation rate from furnace =15,000 btu/ft ² /hr or higher as applicable to the boiler offered.	
		E	=	Evaporation rate from hopper = 15 lb/hr.ft ²	
		C _v	=	Latent heat of evaporation at140 deg.F(60 deg.C) =1014 btu/lb	
		C _{water}	=	1 Btu/lb/ ^o	
		T ₃	=	Temp. of incoming make-up water (40 deg.C or 104 deg.F)	
		F _w	=	Make up water flow in BA hopper (Lb/hr)	
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4.02.00	Coal Handling Plant			
4.02.01	Rated capacity of each stream of Coal Handling Plant shall be 2400 TPH and minimum belt width shall be 1800 mm. For Coal Handling, Belt speed of trough conveyors shall not be more than 3.4 m/s.			
4.02.02	All conveyors (except boom conveyor of S/R) shall be designed for 110% of rated capacity. The boom conveyor of S/R shall be designed for 125% of rated capacity. Rated capacity (corresponding to CHP capacity) shall be guaranteed capacity for 100% duty equipment. For 55% / 75% duty equipment rated capacity shall be guaranteed capacity. For purpose of guaranteed power consumption rated capacity shall be considered in either case.			
4.02.03	2x100 % (one working + one standby) conveying stream shall be provided in the Coal Handling Plant, except Reclaiming stream.			
4.02.04	Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient			
4.02.05	Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent International Standard. Ai value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.			
4.02.06	All mechanical, civil and structural system design shall consider: a) Simultaneous running of both conveyors at design capacity. b) Starting of one stream with other stream in standstill condition. c) Starting of one stream with other stream in operation at design capacity. d) Round the clock operation of Coal Handling Plant. e) The following aspects shall be taken care of coal/biomass i) The coal delivered to power station, shall be of size 250 mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered. Terrified Biomass shall be delivered to power station, of size 35 mm and below with fines upto 5 % and maximum moisture content 15 %. ii) HGI of coal shall be between 44 to 65. Normally, moisture content in coal vary between 12% to 15%. However, for design purposes moisture content of 20% shall be considered for both coal and limestone(if applicable). iii) Due to open cast method of mining involved, the coal may contain shale and sand stone as high as 20%. Also, occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with coal/ Limestone(if applicable). iv) The coal as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above. f) For the purpose of volumetric computation, bulk density of coal shall be taken as 800 kg/m and for biomass 600 kg/m ³ and blending ratio of Biomass with Coal is 20 % (by weight). Therefore, for calculation of belt conveyor capacity for their drives and drive motors KW requirement and sizing (volume calculations) of chute, hoppers etc., the above bulk density shall be considered. For all other purpose (viz) for stresses/load on			
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4.02.08	Gear Box Rating:			
	a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity}			
	In any case, gear box rating shall not be less than motor nameplate rating.			
	b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment}			
4.02.09	@ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues			
	Coupling			
	Not less than motor nameplate rating.			
	General practice for dust control system			
4.02.10	a. All pumps in dust suppression, portable water and service water system shall be designed for 100% capacity and with 100% standby.			
	b. Minimum 2 no. sprinkler nozzles shall be considered per each stacker reclaimer for sizing of the pumps.			
	c. For Dry Fog/Ultrafine Cold Fog dust suppression system, the transfer point shall be conveniently grouped. Each group shall be designed to feed all conveyors in the transfer point.			
	d. For service water system it shall be assumed that six valves shall be open at any point of time.			
4.02.09	Hoists			
	Drive			
	(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings			
	(ii) Other hoists including the hoists for handling take-up pulley and takeup weight			
4.02.10	Belt Scale			
	Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least (±) 0.25 percent throughout its range. Belt scale provided on Stacker Reclaimer Boom Conveyor shall have accuracy (in the horizontal position of Boom) of (±) 1 percent for the range of 20% to 120% of boom conveyor rated capacity.			
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4.02.11	Belting and Pulleys I. Coal Conveyors a) For Coal Handling Plant, Belt ratings shall be selected in such a way that there are only three (3) ratings for Nylon/Nylon belting and maximum two (2) ratings of steel cord belting. This however excludes sealing belt (for sealing slots of tripper floor) and belting of belt feeders. (Belting shall be completely interchangeable among same rating of belt.) Minimum number of plies for belting shall be four (4). Other details of belting shall be as specified elsewhere in the specification. For Pulley of Coal Handling plant, following minimum parameters shall be followed: (1.) Shell thickness : 20 mm (Min.) (2.) End disc plate thickness : 30 mm (Min.) (3.) Maximum allowable deflection of shaft at hubs : 5 Minutes (4.) Diameter: (i) All drive pulleys : 800 mm dia (min.) 1000 mm dia (min.) (In case of steel cord belts) (ii) All balance pulleys : 630 dia (min) Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters. b)Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5). These shall comprise of two (2) no. drive pulleys and three (3) no for all balance pulleys. Pulleys for belt feeder, fixed & travelling tripper, SS pulleys & S/R pulleys are not included in the above categories		
4.02.12	Stock Pile No. of days of crushed coal storage based on BMCR Design coal consumption at 100% PLF: Bidder to maximize the coal stockyard storage capacity by utilizing the available space. However, stockyard capacity in any case shall not be less than 17 days considering 800 T/cum bulk density for coal Also, in case of uni-directional stacker cum reclaimer, yard conveyor may be elevated near head end to accommodate take-up above ground Height of stockpile to be formed: 10 meters Width of each stockpile at base : 50 meters		
4.02.14	Dust Suppression System (Dry fog/Cold fog type)		
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4.02.15	(1) Operation	:	Water & air sprayed by Fogging nozzle (in case of Dry Fog)	
		:	Ultra fine spray of water by Fogging nozzle (Cold fog)	
	(2) Location of spray	:	At all coal discharge & receipt point in all transfer points & crusher house	
	(3) Capacity & Pressure	:	0.5 Kg/cm ² for water (min.) at inlet of spray head and 5.0 Kg/cm ² for air (min.)	
	Pressure at inlet of spray head (Cold Fog)	:	70 Kg/cm ² (min)	
	Stockyard Dust Suppression System			
	(1) Maximum number of nozzles	:	Two (2) Nos.	
	operating simultaneously for each stacker cum reclaimers			
	(2) Capacity & Pressure	:	500 Lpm/4.5 kg./sq cm(g)	
	of each spray nozzle			
4.02.16	Dust extraction system			
Type	:	Venturi scrubber type		
Location	:	Belt feeder after crusher & Vibrating Feeder at crusher house.		
4.02.17	Service Water System			
Service water connections are to be provided in trough conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house.				
(a.) Flow at each valve	:	5 cub.m/hr		
(b.) Minimum discharge				
Pressure at tap point	:	2 kg/sq.cm		
(c) No. of valves operated	:	6 nos.		
Simultaneously				
4.02.18	Ventilation System			
A Mechanical Ventilation System:				
Underground Areas: Minimum 15 supply air changes and minimum 7 exhaust air changes per hour.				
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4.04.03	2x100 % (one working + one standby) conveying stream shall be provided for GHP.		
4.04.04	Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient		
4.04.05	Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent International Standard. Ai value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.		
4.04.06	All mechanical, Electrical, civil and structural system design shall consider: a) Simultaneous running of both conveyors/bucket Elevators at rated capacity. b) Starting of one stream with other stream in standstill condition. c) Starting of one stream with other stream in operation at rated capacity. d) Round the clock operation of Gypsum Handling Plant. e) For volumetric computations of limestone handling system (if applicable), the bulk density of limestone shall be taken as 1400 kg/m3. However, for torque & drive requirements the density of limestone shall be taken as 1700 kg/m3. For gypsum, the bulk density shall be taken as 900 kg/m3 for volumetric computation and 1250 kg/m3 for torque and drive requirements.		
4.04.07	Drive equipment Rating Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors a) For conveyors of belt conveyor systems *110% of actual power at drive motor output shaft at specified design capacity *The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train. Gear Box Rating: 1. For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} In any case, gear box rating shall not be less than motor nameplate rating. 2. For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment} @ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues Coupling Not less than motor nameplate rating.		
4.04.09	Hoists		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC									
	<table><tr><td colspan="2">Drive</td></tr><tr><td>(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings</td><td>Motor driven for both travel & lift.</td></tr><tr><td>(iii) Other hoists including the hoists for handling takeup pulley and takeup weight</td><td>Manual for both travel & lift.</td></tr></table>				Drive		(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings	Motor driven for both travel & lift.	(iii) Other hoists including the hoists for handling takeup pulley and takeup weight	Manual for both travel & lift.		
Drive												
(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings	Motor driven for both travel & lift.											
(iii) Other hoists including the hoists for handling takeup pulley and takeup weight	Manual for both travel & lift.											
4.04.10	Belt Scale Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least ($\pm$) 0.25 percent throughout its range.											
4.04.11	Belting and Pulleys for 150 TPH rated conveying capacity (GHP) (a) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification. (c) For Pulley, following minimum parameters shall be followed: (1.) Maximum allowable deflection of shaft at hubs: 5 Minutes (2.) End disc plate thickness : 12 mm (min.) Shell plate thickness : 12 mm (min.) (3.) Diameter: (i) All drive pulleys : 630 dia (min) (ii) All balance pulleys : 500 dia (min) Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.											
4.04.12	Bulk density of limestone (if applicable) & gypsum shall be considered as follows: <table><tr><td></td><td>Limestone</td><td>Gypsum</td></tr><tr><td>a) For volumetric computation</td><td>1400 kg/m³</td><td>900 kg/m³</td></tr><tr><td>b) For load/ strength</td><td>1700 kg/m³</td><td>1250 kg/m³</td></tr></table>				Limestone	Gypsum	a) For volumetric computation	1400 kg/m ³	900 kg/m ³	b) For load/ strength	1700 kg/m ³	1250 kg/m ³
	Limestone	Gypsum										
a) For volumetric computation	1400 kg/m ³	900 kg/m ³										
b) For load/ strength	1700 kg/m ³	1250 kg/m ³										
4.04.13	The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days.											
4.04.14	Dust extraction system Type: Dry type dust extraction system Location: Truck un-loading points, Junction Towers & Silo for limestone (if applicable)											
4.04.15	Dust Suppression system Location: gypsum discharge & receipt points, Gypsum storage Shed											
4.04.16	Service Water System Service water connections are to be provided in conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house.											
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4.04.17	(a.)	Flow at each valve	:	5 cub. m/hr
	(b.)	Minimum discharge		
4.04.18		Pressure at tap point	:	2 kg/sq.cm
	(c.)	No. of valves operated	:	6 nos.
		Simultaneously		
	Ventilation System			
	A. Mechanical Ventilation System:			
	Underground Areas	Minimum 15 supply air changes and minimum 7 exhaust air changes per hour.		
	Chutes:			
	Minimum clear cross section of chute: 800 mm X 600 mm (inside both ways)			
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SUB-SECTION-A-05

FLUE GAS DESULPHURISATION SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																		
	FLUE GAS DESULPHURIZATION (FGD) SYSTEM																					
1.00.00	GENERAL The design/specifications/sizing of various plants/systems/equipment offered for Flue Gas Desulphurisation (FGD) System shall comply with the requirements detailed hereinafter along with limestone as specified in Part-A:																					
1.01.00	System Description The Flue Gas Desulphurisation (FGD) System shall be based on Wet Limestone Forced Oxidation process. The FGD system shall be installed downstream of the Induced Draft (ID) fans. The flue gas temperature may approach the economiser outlet temperature of about 300°C in case the regenerative air preheaters fails to operate. The Contractor shall take this aspect into account while designing the Flue Gas Desulphurisation (FGD) System.																					
1.02.00	Service Conditions The Steam Generators which are designed to burn pulverised coal will use LDO during startup and at low loads for warm up and flame stabilization. Further, the frequency and duration for startup and low loads operation may be quite high during the first year of unit commissioning and operation. The Steam Generator has been designed for cyclic/two shift operation. Expected numbers of Steam Generator start-ups during 25 years of design life are as follows: <table><tr><td></td><td>Type of Starts</td><td>Number of Starts</td></tr><tr><td>a.</td><td>Hot start (after 8 hours of unit shut down)</td><td>4550</td></tr><tr><td></td><td></td><td></td></tr><tr><td>b.</td><td>Warm start (after 36 hours of unit shut down)</td><td>910</td></tr><tr><td></td><td></td><td></td></tr><tr><td>c.</td><td>Cold start (after 72 hours of unit shut down)</td><td>455</td></tr></table> The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired and the expected numbers of Steam Generator start-ups while designing the FGD system.					Type of Starts	Number of Starts	a.	Hot start (after 8 hours of unit shut down)	4550				b.	Warm start (after 36 hours of unit shut down)	910				c.	Cold start (after 72 hours of unit shut down)	455
	Type of Starts	Number of Starts																				
a.	Hot start (after 8 hours of unit shut down)	4550																				
b.	Warm start (after 36 hours of unit shut down)	910																				
c.	Cold start (after 72 hours of unit shut down)	455																				
1.03.00	Design Criteria																					
1.03.01	The Flue Gas Desulphurisation (FGD) System shall be designed to meet all the conditions specified above. Representative coal and ash analysis for the expected coal and oil are given in the Technical Specification. The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated indicated in Equipment sizing Criteria in Sub-Section A-01, Part B of the Technical Specification. The values indicated for FGD sizing shall be considered as minimum design criteria. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements. The Contractor shall also furnish along with his offer the detailed calculations and data along with																					
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-A-05 (FGD)	PAGE 1 OF 26																		

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.03.02 1.03.03 1.03.04 1.03.05 1.03.06 1.03.07 1.03.08 1.03.09 1.03.10 1.03.11 1.03.12 1.03.13 1.03.14	his Bid to establish as to how the Bidder will meet the efficiency requirements both at design and guarantee point as specified in FGD sizing criteria. The FGD system shall be designed to achieve the required SO₂ capture without the use of oxalic acid or any other additives. The FGD System shall be designed so as to be in operation when Steam Generator is in operation. The wet absorber system shall be designed to maintain the required SO₂ removal. In order to be compatible to all possible modes of operation, the design of the FGD plant shall enable short start-up times, compatible with load changes in the Steam Generator and shall ensure reliable mode of continuous operation. NA The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator. Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of SO₂ emission of less than 100 mg/Nm₃ (6% O₂ dry) for the range of loads and coals. In case of failure of the SG and ancillary equipment, the FGD plant shall be brought automatically to the off-load operation without restriction by the current load case by suitable measures. In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system of Booster Fan) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. Bidder shall furnish a list of all such Auxiliaries in their bid proposal. Further, all the vital & critical valves, dampers etc. shall be designed for fail safe condition for any abnormalities, trips in the FGD system and its associated equipment/items. For details refer Part-C (GTR). Draining and flushing for the items in contact with limestone/gypsum slurry (pipes, tanks, pumps etc.) which are required even during short time outages or an emergency shutdown shall be started automatically and by remote control from the Control Room. All items or equipment which are subject to wear, abrasion or failure (e.g. nozzles, pumps, pipe work, etc.) shall be designed and installed for easy replacement, repair and maintenance. The design and the construction shall be performed so as to avoid stress corrosion cracking, galvanic or other types of corrosion. Especially when using two different alloys, appropriate measures shall be taken to avoid corrosion. This is subject to approval by the Employer. All items of equipment including flue gas ducts, expansion joints, etc. shall be designed considering thermal and mechanical strength as a function of the maximum temperature which might occur in case of a failure of any upstream equipment. NA In case distance from Limestone Grinding system and Absorber is more than 500M, Bidder shall provide the following Flushing system at intermittent locations for the limestone slurry pipeline which shall contain tank and pumps. Intermittent location distance of flushing system shall be based on their proven practice.			
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1.03.15	NA.			
1.04.00	Justification of Proposed Design			
1.04.01	All the design procedures, systems, and components proposed shall have already been adequately developed and have demonstrated good reliability under similar or more arduous conditions elsewhere.			
1.04.02	The Bidder shall submit with the offer, comprehensive information on how the L/G ratio, mass balance, spray nozzle cone angle, spray nozzle arrangement, limestone consumption etc. of the proposed design has been arrived at. The Contractor shall also submit along with the offer, a detailed write up on the proposed design features with recent design modifications, if any, and their specific advantages over the previous designs. The offered system should be designed in a manner to comply with the design & guarantee conditions (specified elsewhere) and should have good O&M features to ensure the plant sustained smooth operation for the envisaged life.			
1.05.00	Statutory Approval The engineering, design, supply and installation of FGD system and the associated auxiliaries shall comply with the applicable safety code and regulation of the locality where the system is being installed.			
1.06.00	Location & Layout Requirements			
1.06.01	The Contractor shall offer the best design to accommodate the Flue Gas Desulphurisation (FGD) System within the confines of the space available. The location of FGD System have been indicated in the General Layout Plan.			
1.07.00	Capital Overhaul of FGD System Employer envisages to carry out the capital overhaul of units once in three (3) years. The design and materials for various equipments/auxiliaries etc. shall be selected by the Contractor keeping in view the above requirement of the Employer, such that no major repairs/replacements, requiring shutdown of the unit, are needed in between the capital overhauls.			
1.08.00	Maintenance			
1.08.01	The Contractor shall provide adequate handling facilities & approach as for carrying out on-line and off-line maintenance of the FGD system and its auxiliaries. In order to carry out on-line maintenance, it shall be possible to readily disassemble, repair and reassemble the equipment supplied in the shortest period.			
1.09.00	Noise level shall be in line with the applicable codes. Following to be ensured other then as defined elsewhere in specifications: Crusher: 100 dBA.			
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2.00.00	EQUIPMENTS AND SYSTEMS SPECIFICATIONS Specified hereafter are the minimum acceptable functional requirements of the Employer, and all components, equipments and systems for the Flue Gas Desulphurisation System shall be designed to cater to these requirements. Compliance to various stipulations of the Technical Specifications, functional requirements of Employer and utilization of various parameters and their values in the specification by the Contractor shall in no way relieve the Contractor of his responsibilities to meet all guarantee requirements or of providing completely safe and reliable operating equipment/systems. The complete FGD system and the associated auxiliaries shall be designed by the standard industrial practices. Only field proven materials for similar application shall be used for the system. The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines. In the execution of the welds contractor must ensure that welding material has same corrosion resistance as the actual plate surface. Alloy to carbon steel welds must either be hidden behind a covering strip of alloy material, or be executed by a special welding procedure ensuring the same quality at the weld surface as the alloy lining. All welding which shall be in the contact with process fluids shall be executed under the supervision of the designer/manufacturer.																				
3.00.00	FLUE GAS SYSTEM																				
3.01.00	The entire flue gas system, flue gas ducts inlet to absorber and bypass duct etc. shall be designed to meet the following conditions: <table><tr><td>1.</td><td>Design internal pressure at 67% yield strength (mmwc)</td><td>+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher, at 67% of yield strength of material</td></tr><tr><td>2.</td><td>Design Inlet Gas Temperature (deg.C)</td><td>145 or as per Design Point conditions, whichever is higher</td></tr><tr><td>3.</td><td>Short temp excursion temperature of inlet gas (for approx. thirty(30) minutes at a time) (deg. C)</td><td>300</td></tr><tr><td>4.</td><td>Inlet Dust Burden in Gas (mg/Nm3)</td><td>50 to 200</td></tr><tr><td>5.</td><td>Maximum flue gas velocity through the Absorber (M/sec)</td><td>Not more than 4 m/s at Design Point Conditions (not applicable for bubbling type absorber)</td></tr><tr><td>6.</td><td>Recirculation Slurry pH</td><td>Not less than 5.5 under all operating conditions. For JBR (Jet Bubbling Reactor) technology, pH range - between 4 and 6 (Justification of the selected pH shall be provided with proven references).</td></tr></table>			1.	Design internal pressure at 67% yield strength (mmwc)	+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher, at 67% of yield strength of material	2.	Design Inlet Gas Temperature (deg.C)	145 or as per Design Point conditions, whichever is higher	3.	Short temp excursion temperature of inlet gas (for approx. thirty(30) minutes at a time) (deg. C)	300	4.	Inlet Dust Burden in Gas (mg/Nm3)	50 to 200	5.	Maximum flue gas velocity through the Absorber (M/sec)	Not more than 4 m/s at Design Point Conditions (not applicable for bubbling type absorber)	6.	Recirculation Slurry pH	Not less than 5.5 under all operating conditions. For JBR (Jet Bubbling Reactor) technology, pH range - between 4 and 6 (Justification of the selected pH shall be provided with proven references).
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3.02.00	Design																				
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3.02.01	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 16.00.00 this subsection.			
3.02.02	All ducts with operating temperature above 60°C shall be insulated in accordance with Sub-Section A-13 (Thermal Insulation), Part B, of the Technical Specification			
3.02.03	The duct layout shall ensure that there is no accumulation of acid mist on the duct floor.			
3.02.04	The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct from Absorber outlet to bypass duct & duct after by pass damper/gate to chimney inlet shall be made of cladded sheet of minimum 2 mm thickness of either Titanium (Grade 2 as per ASME SB265) or C-276 over 7 mm thick (minimum) mild steel base metal. Cladding shall be done to achieve the required quality as per ASTM B 898-11.			
3.02.05	Wherever required, expansion joints of proven design shall be provided by the Contractor in the ducts to take care of differential expansion in the system. The material chosen for expansion joints shall suitable for the duty conditions and the corrosive atmosphere of the FGD system and shall be field proven for similar applications. The expansion joints shall be guaranteed for faultless material and workmanship, for a minimum guaranteed life of not less than 20000 hrs. of operation. During Guarantee period any defects noticed in the expansion-joints due to faulty material and workmanship shall be rectified by the Contractor free of cost.			
3.03.00	Gates & Dampers			
3.03.01	Provision shall be made for facilitating operation of unit with FGD bypass. This shall also facilitate the online maintenance of absorber system and associated equipment's. The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose, Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber (in case booster fan is not provided by the bidder) and (ii) cold gas outlet from Absorber. Motor operated Guillotine gate shall also be provided by the Contractor at the outlet of each Booster fan, in case Booster fan is provided by the Contractor. The Gates shall be provided with 2x100% seal air fans. Gates at outlet to Absorber shall also be provided with 2x100 electrical heaters. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness, on flow basis, without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions.			
3.03.02	Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans & 2x100 electrical heaters shall also be provided in the by-pass duct. The design of the damper shall ensure 99.5% leak tightness, on flow basis, without seal air. The damper shall be 100% leak tight with seal air fans under the above conditions.			
3.03.02A	Bidder may provide common seal air skid for FGD Outlet guillotine gate and the bi-plane damper in the FGD bypass duct. Seal air skid (with 2x100% fans + 2x100% heater) shall be sized considering either the requirements of FGD outlet gate (when FGD loop is closed / FGD not in operation) OR for bypass damper (when bypass loop is closed / FGD under operation), whichever is higher.			
3.03.03	The design of the gates shall ensure 99.95% leak tightness without seal air on flow basis along the duct as well as from the duct to atmosphere.			
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3.03.04	The blade and other components in the gas path, of the bypass damper and gate at Absorber outlet shall be made of Carbon steel with C276 cladding of sheet of minimum thickness 1.6 mm or better material. The seals shall be made of Alloy C-276 or better material.		
3.03.03	The gates/dampers shall be controlled from the control room with auto opening of bypass damper in case of emergency. Manual gate operation should be easy for O&M.		
3.03.04	NA		
3.03.05	All gates shall be designed to withstand the operating air and flue gas temperature without distortion.		
3.03.06	All guillotine gates shall be located in horizontal duct to avoid fly ash build up when in closed position and shall be of top entry type.		
4.00.00	BOOSTER FAN (If Required):		
4.01.00	To take care of the additional pressure drop in the FGD System, Contractor at his own discretion can provide 2x60% Booster Fans. The Booster Fans shall be located downstream of the ID Fans (Induced Draft Fans) in the inlet duct to Absorber shall be capable of handling the additional pressure drop in the FGD system & ducting and maintain required chimney inlet pressure over the entire load range with any one or both Booster fans in operation in conjunction with one or both ID fan in operation while firing the specified range of fuels. Booster Fans shall be sized & designed as per the Sizing Criteria and specification requirements specified for ID Fans elsewhere in the Technical Specification. All the margins on flow & head shall be same as that considered for ID Fans.		
5.00.00	ABSORBER		
	The unit shall be provided with an independent/dedicated absorber.		
5.01.00	The contractor may offer either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry, as per Bidders/Collaborator's proven practice. Only proven system in successful operation in previous installations supplied by the contractor shall be offered. A Spray System (if offered) (i) The contractor shall provide spray system and minimum spray levels required to meet the stipulated guarantee and design requirement. The spray system (including slurry recirculation pump & nozzles) shall be sized to achieve a desired L/G ratio required to meet the guarantees SO₂ removal efficiency, with redundancies specified under this clause. (ii) In case the contractor offers an absorber with multiple levels of spray nozzles, each spray level shall be provided with independent 2x100%		
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5.02.00	pumps. Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity pump. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided. The contractor shall provide spray system / spray levels only as per his proven practice, which should be in successful operation elsewhere. (iii) The slurry recirculation pumps shall have a minimum margin of 10% of flow and head, over the actual requirement for meeting the guarantee and design point conditions. All slurry recirculation pumps including motors shall be of the same size and type. (iv) The slurry recirculation pumps shall have motor /pneumatic driven knife gate valve at pump suction and motor/pneumatic operated Butterfly Valves at discharge side as per the standard practice of bidder. In order to optimise power consumption of FGD system at part load operation, bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD). (v) The slurry recirculation pumps shall be wear-resistant and equipped with flushing devices and single mechanical seals with automatic flushing with a connection for additional manual flushing. (vi) The slurry pumps shall also comply with the requirements stipulated in Clause 9.00.00 of this sub-section. (vii) Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level. B Bubbling Type Absorber (i) In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No recirculating pump and spray header and nozzles shall be required in such case. However, 3 x 50% Gas Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping which are in contact with hot flue gas shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. Cooling Pump discharge piping and valves outside the flue gas path shall be in line with the requirements specified for slurry recirculation pumps. The Cooling Pumps shall be installed in a shed with roof sheeting (ii) The sparger and gas riser tubes shall be made of proven material which shall have a minimum life of 5 years. Minimum 10% of the number of Sparger Tubes required for one JBR to be provided as warehouse spares for the project in case JBR technology adopted by the Bidder.			
	Absorber Recirculation Tank			
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5.05.00	the gypsum slurry from the absorber with slurry solid concentration not exceeding 30%, under the following conditions, all occurring simultaneously:			
	Load	Design point		
	Flow	100% of gypsum produced at Design point condition		
	Head	As per system requirement		
	Margins	Flow -- 15%		
		Head – 20%		
	The pumps shall be designed to meet the stipulations of Clause No.8.00.00 of this Sub-Section.			
	Provision shall also be provide in the Gypsum Bleed Pumping system by provision of tap off, valves etc. for pumping the gypsum bleed to alternate source.			
	Emergency Spray System			
	An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipment’s shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. The water shall be supplied from an elevated tank (emergency water tank) installed near to the absorber. The system shall be designed to fill/refill the emergency water tank in 2 hours in case dedicated pump is used for filling of tank. The tank volume and the injection lances/nozzles shall be designed to protect the inlet duct and the lining of the absorber& absorber internals. The inlet duct shall be sloped towards the absorber.			
5.06.00	Design			
5.06.01	The design and arrangement of the absorber shall be field proven for successful long-term operation in conjunction with a coal fired power plant.			
5.06.02	The design of flue gas ducts and inlet and outlet hoods of the FGD as well as [guide vanes and baffle plates shall ensure a homogeneous flue gas flow with respect to the distributions of: (i) temperature (ii) velocity (iii) dust content (iv) slurry injection and distribution. The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct. Homogeneity shall be ensured, if the deviation from average is less than ±10%. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed.			
5.06.03	NA			
5.06.04	The absorber shell shall be designed for pressure loads, piping forces and moments, wind and seismic loads and all other loads imposed on the absorber. Bracing and reinforcement shall be adequate to prevent deflection and vibration. Internal supports for mist eliminator			
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	sections, etc. shall be designed to withstand the flooded weight of the supported section. The absorber and its structural supports shall be designed for the maximum operating loads including design positive & negative internal pressure, static head, external attachment loads (such as exerted by piping) wind load using the allowable stresses permitted by the applied standards.			
5.06.05	It shall be possible to reach the SO₂ emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service.			
5.06.06	Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber. Provision shall be made for washing of both ends of the first & second stage and the front section of the third stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the second stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. NA The ME system shall be equipped with washing and drain provisions, where drains are directed into the absorber. Washing provisions shall include external and internal piping systems with replaceable nozzles, water pressure booster pumps (if required) complete with all piping, valves, instrumentation and controls. The mist eliminator wash piping/header shall be constructed of Chlorobutyl / Bromobutyl rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same. Carbon steel pipe can be selected outside pipe up to the nozzles at Mist Eliminator casing only for the portion which is not exposed to slurry. Ease of replace ability and placement of the mist eliminator on maintenance platforms is an important requirement. The ME shall be designed to allow for efficient cleaning in process. Test ports shall be provided downstream of the mist eliminator to enable performance testing. The mist eliminator system shall be capable of withstanding high velocity spray water jets typically employed during manual cleanings. The ME shall be constructed in individual cells. The design shall safely avoid ME vibration and/or humming. Walkways shall be arranged and also measures shall be taken as appropriate to permit the internal components to be disassembled and reassembled during repairs without the necessity for time-consuming preparatory work. The headroom shall have a height of more than 2200 mm. The mist eliminator support beams shall be designed to act as maintenance walkways approximately 300 mm wide and shall allow for a minimum 500 Kg/m² load. Adequate number of viewing ports with flushing devices connected to automatically operating washing system shall be delivered at following locations: (i) upstream of 1st stage (ii) between 1st and 2nd stage (iii) downstream of 2nd stage. (iv) downstream of 3rd stage The regular flushing shall be done in a defined time sequence.			
5.06.07	The absorber oxidation tank shall be provided with an over flow line (for spray tower process) complete with sealing pot, over flow and drain line. The absorber over flow shall be taken to a sump in the absorber region, from where the slurry shall be pumped back to the absorber by			
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	a sump pump.			
5.06.08	Materials used shall be suitable for the chemistry of the absorber process and resist abrasion from any particulate contained in the incoming flue gas and from the particulate of desulphurization process.			
5.06.09	NA			
5.06.10	The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently.			
5.06.11	The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct upto absorber outlet flange) shall be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) by explosion bonding or hot rolling, having minimum 7 mm thick carbon steel as base material.			
5.06.12	The material of process equipment of flue gas desulphurization system shall be appropriate for the chloride content and pH level at which the process is to operate.			
5.06.13	All internal members shall be lined with minimum 2 mm Alloy 59/ C276. All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276.			
5.06.14	The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness.			
5.06.15	The other bridges (supports) shall be lined with minimum 2 mm Alloy 59/ C276.			
5.06.16	Lining material and technical application requirements shall be furnished by manufacturer experienced with similar FGD plants. Proof of such experience shall be provided by the Contractor.			
5.06.17	The spray headers (if provided) and air supply headers (exposed to slurry in any form) shall be made of FRP or Carbon Steel with Chlorobutyl/ Bromobutyl rubber lining (minimum 10 mm natural rubber lining), corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry). Optionally ceramic coating is also acceptable provided bidder has proven experience for the same. The slurry spraying system shall be made of material resistant to erosion and corrosion. During the lifetime of the plant, only the nozzles shall be replaced. The distribution system of the slurry shall be hydraulically optimized. The spray nozzles shall be of silicon carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The design of the spray nozzles shall be such that rapid wear, encrustation and plugging are avoided. Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules. In case of JBR technology, following shall apply: 1. Slurry spray headers shall be made of Nickel based alloy in gas cooling section. 2. Air supply header inside JBR shall be made of FRP. 3. Slurry spray nozzles in gas cooling section shall be made of SiC. Other slurry spray nozzles are made of SiC or High Alumina or equivalent having a minimum guaranteed life of 20,000 hrs. All wash and water nozzles and pipes shall be made of FRP. SiC coating shall be provided inside FRP slurry pipes."			
5.06.18	In case the absorber is equipped with several spray levels they shall be designed as follows:			
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	(i) For spray type Absorber, the last spray level upstream the mist eliminator shall be operated only in counter-flow. (ii) Depositions at downstream spray level and mist eliminator by co-flow injection of slurry shall be avoided. (iii) The spray lances shall be equipped with bars for installation of scaffolding without any offset. The spray levels shall be designed for a load of min. 500 kgf/m². (iv) A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation.			
5.06.18	The absorber shall be self-supported from the bottom to suit site conditions. Absorbers which are externally supported from the structure are also acceptable provided Bidder or its Technology Collaborator has proven experience of supplying such Absorbers which are operating for more than 5 years. The absorber shall have adequate stiffening arrangement on the external side. Internal stiffeners shall be used only where it is not possible to provide proper external stiffening with approval of employer.			
5.06.19	It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles.			
5.06.20	The spray piping, mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance.			
5.06.21	The bottom of the absorber sump shall be designed so that there will be an easy entrance (adequately sized doors) for a man with a wheelbarrow and should be full drainable easily.			
5.06.22	In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. In case Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The Screens shall be made of made of Alloy 59 /C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collaborator has proven experience).For the agitators a flushing system for start ups shall be provided.			
5.06.23	It should be possible to discharge the absorber sump into the auxiliary absorbent tank within 2 hours.			
5.06.24	At the head of the absorber two manholes shall be provided to reduce the draught of the stack during outage.			
5.06.24	Equipment's required for internal & external inspection shall be furnished by the contractor in brand new condition. List of all such items shall be furnished along with the Bid. The formation of agglomeration, deposition & caking shall be avoided with submission of procedures & safety guidelines for all probable areas.			
6.00.00	LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM			
6.01.00	A common limestone and slurry preparation system as already provisioned at Lara-I (2 x 800 MW) units shall be utilized for Lara-II (2X800MW) with suitable interconnections. For this			
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	purpose the contractor shall supply interconnection system from existing stage-I limestone slurry storage tanks with necessary pipings, fittings, supports and isolation & control valves to the stage-II absorbers. The details as shown in respective limestone grinding system P&IDs are indicative, However the scope is limited to interconnections as above.			
6.02.00	Not Used			
6.03.00	Not Used			
6.04.00	Not Used			
6.05.00	Not Used			
6.06.00	Not Used			
6.07.00	Limestone Slurry Supply Pumps& Piping			
6.07.01	2x100% centrifugal type limestone slurry pump shall be provided for each unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together.			
	(i)	Load	Design point	
	(ii)	Flow	110% of one absorber requirement with the limestone requirement at Design point.	
	(iii)	Head	As per system requirement.	
	(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)	
	(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.	
6.07.02	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.9.00.00. of this Sub-Section.			
6.07.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.			
6.07.04	Automatic flushing equipment for all lime slurry pumps and pipes shall be supplied.			
7.00.00	GYPSUM DEWATERING SYSTEM			
7.01.00	A common gypsum dewatering system for 2 x 800MW units is envisaged. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber up to less than 10% moisture. All the equipment supplied shall be proven design with previous installations for similar capacities.			
7.02.00	The Contractor shall provide 2x100% gypsum dewatering system with each stream sized to			
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	dewater 110% of the maximum gypsum produced by 2 X 800 MW units operating at Design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.			
7.03.00	Primary Dewatering Hydro-cyclones			
7.03.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by all the units operating at Design point with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters.			
7.03.02	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.			
7.03.03	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing.			
7.03.04	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.03.05	The hydro-cyclone shall be of proven design The primary hydrocyclone shall me made up of made of polyurethane ,Urethane or with replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 12mm. The liners shall have a minimum wear life of not less than 8000 hrs.			
7.04.00	Vacuum Belt Filters			
7.04.01	Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum:			
	a. Capacity	110% of gypsum produced by 2x800 MW Absorbers at Design point.		
	b. Outlet Moisture	10% max.		
	c. Gypsum Purity	90% (minimum)		
	d. Chloride content	< 100 ppm		
7.04.02	The vacuum belt filter shall be proven design in operation for similar capacities. The design, manufacture, installationand testing of Vacuum Belt Filters shall follow thelatest applicable Indian / International (ASME /EN / Japanese)Standards The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.			
7.04.03	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design.			
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7.04.04	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be single piece endless, factory or site vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.			
7.04.05	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.			
7.04.06	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.			
7.04.07	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.			
7.04.08	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.			
7.04.09	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor. The elevation of vacuum belt filter shall be suitable to discharge the gypsum cake effectively.			
7.04.10	A 2 m (min.) wide platform shall be provided around each belt filter.			
7.05.00	Vacuum System			
7.05.01	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice.			
7.05.02	Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump.			
7.05.03	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design.			
7.05.04	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.			
7.05.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.			
7.05.06	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.			
7.06.00	Filtrate System			
7.06.01	Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks or limestone			
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7.06.02	preparation tanks as the case may be.. 2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case.			
7.06.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump.			
7.07.00	Waste Water System			
7.07.01	The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones.			
7.07.02	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr. of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank.			
7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones.			
7.07.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials or replaceable rubber lining. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.07.05	The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to waste water tank. In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids con-centration in waste water up to max 10% can be acceptable. However, the required moisture content in Gypsum & required Gypsum quality shall be complied.			
7.07.06	1x100% Waste water tank shall be provided which shall be sized for 8hrs storage of waste water with all the units operating at design point and no out flow from the tank. The Waste water tank shall be complete with agitator, level transmitters etc. The Waste water collection tank shall be of Steel construction with rubber lining. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water. The material of Casing shall be rubber lined or Hi-chrome steel. The impeller shall be made of Hi-chrome steel. Shaft shall be of stainless steel 410 and shaft sleeve shall be stainless steel.			
7.07.07	All piping, valves & instrumentation shall be in the contractor's scope. Provision to correct the pH of the waste water by lime dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of			
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	the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room. Feeding of lime to bucket elevator can be manual.		
7.07.08	Contractor shall provide 2x100% Lime Neutralization tanks which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank.		
7.07.09	Contractor shall provide 2x 100% Lime Storage Silos for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of 2x800 MW at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc. Hydrated lime shall be supplied by the employer in the form of bags. For sizing purpose, bulk density of hydrated lime shall be considered as 480 kg/m ³ . For dust free operation each silo should be provided with a covering arrangement and a self-cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.		
7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope.		
7.07.11	A storage room for storing minimum one (1) month requirement of lime for all the units shall also be provided by the contractor.		
7.08.00	Auxiliary Absorbent Tank		
7.08.01	The Contractor shall provide a common auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge each absorber into the Auxiliary Absorbent tank within 2 hours up to pump trip level in both the technologies i.e. spray tower & Jet Bubbling type Further, Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.		
7.08.02	The contractor shall provide 1x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.		
7.08.03	Agitation shall be provided to prevent settlement of slurry by sufficient no. of Top entry agitators with emergency flush start system.		
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7.08.04	The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be equipped with man entry provisions doors, all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber.		
7.08.05	NA		
7.08.06	Coarse-screen(s) of suitable material at suction-side of the pumps shall be provided.		
7.09.00	Hardness of rubber lining wherever applicable (tank, pipes etc) shall be 55±5 durometer (Shore A).		
8.00.00	SLURRY PUMPS		
8.01.00	This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone slurry feed pumps and any other pump handling slurries.		
8.02.00	The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.		
8.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head.. Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps, wherever not specified. The slurry concentration in the pump shall not exceed 30% by weight .		
8.04.00	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down.		
8.05.00	In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller.		
8.06.00	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a hi- chrome casing or hi-chrome alloy lined pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.		
8.07.00	For absorber recirculation service a Silicon carbide/hi-chrome impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service.		
8.08.00	In case of Hi-chrome casing pump the Guaranteed wear life of casing shall not be less than 24000 hrs. In case of lined pump the Guaranteed wear life of liner and other wear parts of the pump shall not be less than 14000 hrs..		
8.09.00	The design of the shaft shall ensure that the critical speed is at least 20% above the operating speed of the shaft.		
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9.10.00	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.			
9.00.00	VERTICAL SUMP PUMPS			
9.01.00	Contractor shall provide sumps of adequate capacity in the each absorber area, limestone grinding area and gypsum dewatering area for containing the over flow from the respective systems. Contractor shall make arrangements for pumping the drainage water back to the respective system with 2x100% vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump.			
9.02.00	The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
9.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.			
9.04.00	The pump shall deliver the rated flow at rated head. Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps wherever not specified. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.			
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.			
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.			
10.00.00	SLURRY & PROCESS WATER TANKS			
10.01.00	All the Slurry tanks (Slurry tanks, Filtrate tank, Secondary hydro cyclone feed tank, Vacuum receiver tank, Waste water tank, Lime Neutralization tanks etc.)& Process water tanks (Process water storage tanks, Clarified water storage tanks, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with the following: Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank: Vinyl Ester based flakeglass lining/ Polymeric Epoxy of mini-mum 3 mm thickness Slurry tanks: Replaceable Chlorobutyl/Bromobutyl rubber lining of minimum 5 mm thickness The outside surface of the tanks shall be coated with paint as approved by the Employer. Coarse-screen(s) at suction-side of slurry recirculation pumps shall be provided.			
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11.00.00 11.01.00 11.02.00 11.03.00 11.04.00 11.05.00 11.06.00 11.07.00 11.08.00 11.09.00 11.10.00 11.11.00 11.12.00 11.13.00 11.14.00 12.00.00 12.01.00	AGITATORS Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc. All agitators shall be designed for continuous operation unless otherwise specified. Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type. Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc. All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion. The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials. NA To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection. NA Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly. All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally. All exposed moving parts shall be covered by guards. Side entry agitator shall be flange mounted. The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s. Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions SLURRY LINES AND VALVES Slurry pipes shall be designed to keep the velocity above the settling velocity under all			
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	operating conditions. The contractor may provide a recirculation line with motorized isolation valve / restriction orifice made of erosion resistant material for the above purpose.			
12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes size up to 400 NB made up of FRP material as per ASTM 2310 and testing as per ASTM B2583(silicon carbide coating on slurry exposed surface)if it has previous experience of providing the same. Outer surface of the pipes should be fire retardant. If it has previous experience of providing the same.			
12.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.			
12.04.00	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.			
12.05.00	Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipments etc.			
13.00.00	PROCESS WATER STORAGE TANKS & PUMPS			
13.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of 2 x 800 MW units) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of 2 x 800 MW units) along with all necessary piping, valves, control & instrumentation to feed the clarified water shall be provided by the Contractor. Process water Storage level shall be automatically controlled at operating level by controlling the water flow from the makeup water from terminal point. The two tanks shall be interconnected with an isolation valve. Contractor shall provide 2x100% Booster Pumps of required capacity & head to feed process water (clarified water) to the two (2) no. of process water storage tank designed to store 15 minutes of maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for 2x800 MW units. All the process water storage tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tank shall receive clarified water. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.			
13.02.00	2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit. A further 10% margin shall be provided over the above capacity for all the above pumps.			
13.03.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. Alternatively,			
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	Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. Each pump shall cater to maximum mist washing requirement of one unit. The capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the maximum wash water requirements of mist eliminators of the absorber. A further 10% margin shall be provided over the above capacity for all the above pumps.			
13.04.00	The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.			
13.05.00	All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS: 803, latest edition shall be provided by the Contractor. Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness or Epoxy lining minimum three coats of 150 micron thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.			
14.00.00	APPROACH AND HANDLING FACILITIES			
14.01.00	Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations specified elsewhere in this specification. Each equipment requiring maintenance (over and above as specifically mentioned) shall be provided with suitable handling provisions, lifting provisions (lugs, supports, brackets etc.) and access. Similarly, adequate & suitable inspection provisions shall also be kept for equipment/facilities for smoother O&M and monitoring purposes.			
14.02.00	Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable.			
14.03.00	Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform.			
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14.04.00	The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.			
14.05.00	A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.			
14.06.00	Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach along with suitable platforms shall be provided for ball loading hoppers.			
14.07.00	A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.			
14.08.00	A 2000 mm wide floor/platform shall be provided all around each belt filter.			
14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc., are included in Contractor's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc/chain pulley block mounting arrangement.			
14.10.00	The regular basement floor is not acceptable in FGD area. Further local Pits/trenches shall be avoided as far as possible.			
14.11.00	Handling arrangement of Booster fans, Slurry recirculation pumps, oxidation blower, belt feeder system etc. complete with crane/monorail along with removal space for maintenance shall be provided by the Contractor.			
14.12.00	Approach for removal of equipment for maintenance shall be provided.			
14.13.00	All other safety requirements as per the Factories Act, National Electricity code shall be complied with while developing Layout.			
14.14.00	Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC.			
14.15.00	Each Equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and Statutory bodies/insurance companies.			
14.16.00	Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M.			
14.17.00	Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the Contractor. The clear head room for the same shall be minimum 8 M at rail/road crossings and 3 M or higher at other places as per system requirement.			
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15.00.00 ELEVATORS 15.01.00 Elevators shall be designed based on following criteria: (i) Type of service (ii) Design/construction/installation codes (iii) (c) ELEVATOR CAPACITY (iv) Rated speed (v) Total Travel (vi) Number of floors to be served (vii) Entrance (viii) Entrance and platform size (ix) Drive/motor (x) Method of control (xi) Machine room and lift Shaft (xii) Position of machine room (xiii) Power Supply 15.02.00 Landing doors of the elevators shall have fire resistance of at least one hour. These doors shall also be smoke tight as far as possible. 15.03.00 Construction of the elevators shall specifically meet all requirements of the codes indicated at Cl. 15.01.00 (ii) and shall have following additional features: (i) Flooring of Cabin : 6 mm thick Checkered Plate flooring. Flooring of passenger elevator for MCC cum control room building can also be vitrified ceramic tiles (ii) Design, Construction : and finish of car & car door : Car inside enclosure including inner side of door shall be of stainless steel plate of grade SS:304 of bright finish/hair line finish. (iii) Car entrance and landing doors : As per BS:476 (Part 20 & 22)	One (1) no. Passenger cum goods elevator per Absorber (higher than 15 m) and dewatering building (a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666, IS:1860 and IS:3534. (b) Any other equivalent code, subject to Employer's approval. Load carrying capacity 1000 kg (minimum)).For absorber (higher than 15 m), Dewatering Building.&680 KG For MCC cum control room building. 1.0 m/s. As per FGD supplier's recommendations subject to Employer's approval. As per requirement and subject to Employer's approval As per requirement and subject to Employer's approval As per design/installation codes at (ii) above As per Electrical Specifications. As per Electrical Specifications. Pressurized dust proof or Air-conditioned machine room as per the requirement of lift manufacturers. Directly above the lift shaft. As detailed in Electrical Specification			
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(iv) Door construction : Hollow metal construction from 16 guage thick steel sheet spray painted. 15.04.00 Technical requirements of Electrical items shall be as per details given in Electrical Sub-Section, Part-B. 15.05.00 Provide sound reducing material below machines in machine room. 15.06.00 Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's approval. 15.07.00 Elevators shall have provisions to meet following operational requirements: Easy access and landing level controls for ease of human operation and their travel with user friendly operating features including open holding time for any floor level. 15.08.00 Fireman's switch shall be provided for each elevator. 16.00.00 DUCT WORK AND DAMPERS: Details as specified in part-B (A-02 SG _ Aux including ESP with Auxiliary Boiler) to be referred for design and other requirements. 17.00.00 THERMAL INSULATION AND CLADDING 17.01.00 Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60degree Celsius. The specification of the insulation including type, density, thickness, heat conductivity and finish shall be as specified in Sub-Section A-13, Part B of the Technical Specification. 18.00.00 TYPE TEST 18.01.00 Full scale type tests using actual equipment shall be conducted by the Contractor for the equipment mentioned in the subsequent clauses below: 18.01.01 Full range and full scale performance testing shall be conducted at shop on one number each of the following Fans as per BS 848, Part-1: (a) Booster Fan (in case Booster Fan is provided by the Contractor) The performance testing at shop shall be conducted using actual fans 18.01.02 Leak tightness testing of gates &dampers for each type and size at shop to demonstrate the guaranteed gas tightness efficiency (on flow). The minimum guaranteed gas tightness efficiency of dampers shall not be less than that indicated in clause no. 3.03.00 of this Sub-Section. 18.02.00 The Bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of Bid Proposal Sheet (BPS) and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
18.03.00	The type tests shall be carried out in presence of the Employer's representative. Contractor shall inform the Employer about his readiness for conducting the type test and issue such notice to the Employer 30 days in advance, along with schedule of the type tests. The Contractor shall obtain the Employer's approval for the type test procedure before notifying the Employer about his readiness for conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
18.04.00	Irrespective of the requirement of conducting the type tests under this contract, The Contractor shall submit the reports of the type tests carried out for the equipments listed above in clause no. 18.01.00 and These reports should be for the tests conducted on the equipment for the model / type / size / rating to those proposed to be supplied under this contract and the test(s) should have been either be conducted at an test facility/shop/independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.			
18.05.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X 800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-A-05 (FGD)	PAGE 26 OF 26

SUB-SECTION-A-12

SURFACE PREPARATION & PAINTING

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC. NO. CS-9587-001R-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	Specification of surface preparation & painting			
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.			
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.			
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.			
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.			
1.05.00	SURFACE PREPARATION			
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.			
1.05.02	The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.			
	SP1	Solvent cleaning		
	SP2	Application of rust converter (Ruskil or equivalent grade)		
	SP3	Power tool cleaning		
	SP4	Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)		
	SP4*	Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns		
	SP5	Shot blasting/ abrasive blasting.		
	SP6	Emery sheet cleaning/Manual wire brush cleaning.		
1.06.00	APPLICATION OF PRIMER/PAINT			
1.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.			
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.			
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.			
1.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.05	Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminum paint to IS 2339. PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 degC – 600 degC), IS-13183 Gr.-II (for temperature 200 degC- 400 degC and IS-13183 Gr.-III (for temperature upto 200 degC) PS13 - Rust preventive fluid by spray, dip or brush. PS14 - Weldable primer-Deoxaluminat or equivalent. PS16 - High Build Epoxy CDC mastic `15'. PS17 - Aliphatic Acrylic Polyurethane CDE134, %V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=35.0(min.) PS-20 - Epoxy based finish paint			
1.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.			
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.			
1.06.08	SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
1.06.09	a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: ▪ Primer coat – Epoxy based zinc phosphate ▪ Intermediate - Epoxy based TiO2 pigmented coat ▪ Finish coat - Epoxy based finish coat/Two pack polyurethane coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard			
1.06.10 A)	Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION VI, PART-B	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 2 of 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	hardener. Total thickness of primer and paint should not be less than 400 microns. B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION VI, PART-B	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 3 of 8



1.06.11 Primer/Painting Schedule

Sl. No	Description	Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade	
			Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)			
A) Power Cycle Piping														As per NTPC Colour shade/ coding scheme
1.	All insulated Pippings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40		
2.	All un-insulated Pippings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipment etc.	Design temperature < or equal to 60°C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 \$	35 \$	155 \$	
		Design temperature above 60°C- 200°C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200°C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)	SP4*	PS19	1	40	-	-	-	PS17	1	30	70		
4	Piping hangers / supports (other than (3) above. (un-insulated)	SP3/SP5	PS5	2	25	-	-	-	PS4	2	25	100		

	Valves												
5.	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS5	2	35	-	-	-	PS4	2	25	120
		Design temperature above 60 degC	SP3/SP5	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside building and in SG envelope TG	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a) Epoxy coat	2	35	250
										b) Final coat of paint PS17	1	30	
		Within building TG	SP4*	-do-	1	35	PS18	1	35	a) Epoxy coat	2	25	150
										b) Final coat of paint PS17	1	30	
7.	Weld Edges		SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25

1. \$ - The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site.
2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.
3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable.
4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content > 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme.
5. For corrosion protection, all inner parts of the hangers (CLH/VLH) shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.
6. # - For Cast/forged valves upto & including design temperature 60Deg.C, Aluminium painting as per IS-13183 Gr-3 or better with total DFT 40Micron is also acceptable.

B) Steam Generator & Auxiliaries:

1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	PS 4	2 \$	20 \$	100 \$
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40

Note: 1) SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.



C) LOW PRESSURE PIPING

1	All Piping, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											Color shade/ coding scheme.
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

D) Fire Detection & Protection System, Compressed air system and Air-conditioning & Ventilation System

For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System

For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System.

For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Ventilation System.

For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section--A-16 compressed air system.

E) ESP

1	All surfaces with surface temperature 95°C or less (with or without insulation)	SP3/SP4	PS3/ PS3*	1	25	-	-	-	PS 4	1	30	55
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60



General Notes (Applicable for all above points A to E)

- i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.
- ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

- (i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard.
- (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.
- (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.
- (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION VI, PART-B	SUB-SECTION -A-12 SURFACE PREPARATION & PAINTING	Page 8 of 8

SUB-SECTION–A-13

THERMAL INSULATION

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC. NO. CS-9587-001R-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.00.0	THERMAL INSULATION			
	a) For all Piping / SG / TG systems and the equipment with surface operating temperature of 60 deg.C and above, thermal insulation shall be applied for heat conservation and/or personnel protection such that the temperature of protective cladding shall not exceed 60 deg.C. Insulation thickness shall be calculated based on the following design data & methodology:			
	Design ambient temperature	40 Deg.C for inside and 45 Deg.C for outside the Main plant building.		
	Maximum cladding temperature	60 Deg.C		
	Wind speed	0.5m/sec. for inside and 0.25m/sec for outside the Main plant building		
	Emissivity of cladding	0.2		
	Pipe/Equipment wall temp.	Maximum operating temperature.		
	Thickness calculation	As per ASTM C-680 (Latest edition) or equivalent		
	Thermal insulation shall also be provided for piping systems where it is expected that occasional rise in fluid temperature during operation exceeds 60 deg.C,			
	Upstream of all drain lines and the lines connected to steam traps, shall be insulated up to and including isolating valve for heat conservation. Rest of such lines drain lines and other lines such as safety valve discharges, vents, etc. shall be insulated for personnel protection.			
b) Insulating materials should conform to the following requirements:				
i) The minimum insulation thickness, however, shall not be less than 75 mm for Steam Generator surfaces and 25 mm for other surfaces. Also refer as specified at clause no 1.00.00 b (ii) of this chapter. Material and application of insulation material, protective cladding, wire mesh etc. shall also be conforming to latest edition of following Codes: IS: 8183, IS: 3677, IS: 3144, IS: 14164, IS: 280, ASTM-B 209.				
Physical requirements — Following shall be met by testing as per relevant clauses of IS: 3144.				
a) Shot content	5% by weight (maxm.), size of any shot not to exceed 5 mm in diameter (size details, as applicable, shall be as per referred standard.).			
b) Bulk density	To comply with Table 2.01.00 below.			
c) Weight gain by moisture absorption	2% (maxm.)			
d) Sulphur Content	Not exceeding 0.6%			
e) Alkalinity	7-10 pH			
f) Maximum oil content	Not exceeding 0.3% by weight			
g) Total carbon content	Not exceeding 0.3% by weight			
h) Settlement	Nil (When tested as per Cl. 22 of IS:3144)			
i) Handability	Fully handable, without any lump formation and disintegration of material			
j) Loss of weight after combustibility test	Not exceeding 5% by weight			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION	Page 1 of 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	In addition to requirements of as specified above, the Mineral wool shall: (a) Pass standard combustibility test both immediately after application and after subjected to maximum operating temperature for not less than 100 hrs. (b) Not suffer permanent deterioration as a result of contact with moisture due to condensation and shall be free from objectionable odor. (c) Not cause corrosion of the surface being insulated or of cladding on it under normal site conditions. (d) Not suffer any quality deterioration under specified service conditions (both cold/hot face temp.) of use. (e) Not contain asbestos in finishing materials of insulation in any form (ii) Insulation mattress/section shall be supplied in thickness of 25, 40, 50, 60, 65 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/slabs of thickness specified above. However, if the required thickness is such that by using above mattress/slabs the calculated thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable for outer layers. The min. thickness however, shall not be less than 25 mm and number of layers shall be minimum and innermost layer shall be thickest. c) INSULATION (STEAM TURBINE AND BFP) (a) The HP cylinder, IP cylinder, steam chest and interconnection piping, crossover / cross-around piping, such parts of LP cylinder as considered necessary, and all associated piping and valves shall be efficiently insulated with inner thermal insulating materials. In case the noise limit as specified elsewhere in the specification is exceeded, the insulated portion of the steam turbines shall be covered with fabricated steel cover, provided with suitable anti-drumming and sound pressure attenuating material inside. The insulation and steel covering should be so designed and erected as to provide easy accessibility to parts requiring frequent inspection. (b) The thermal insulation for the turbine casing shall preferably be insulated by preformed ceramic mattress blankets conforming to IS15402 or equivalent. These mattresses are fixed over the casing and held in position by metallic washers fastened to the MS rod welded to the casing. To meet the thickness requirements, multiple layers of mattresses may be applied. Alternatively, bidder may apply turbine insulation as per their standard practice i.e. sprayed insulation produced by projecting specially prepared mineral wool along with a fine liquid spray. However, the casing parting plane shall necessarily be provided with blanket type insulation. The bidder may apply complete spray type or complete blanket type or combination of both of above as per their standard practice. These blankets shall consist of high temperature felted mineral insulation fully enclosed in wire inserted asbestos free cloth for temperature exposure to 445°C to 595°C. A single layer of blanket shall not be more than 75 mm thick. Voids around the blankets should be avoided. However, unavoidable voids shall be filled with loose mineral wool.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION	Page 2 of 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c) Nuts and other exposed portions of the casing and valve flanges shall be suitably insulated for minimum heat loss. (d) Suitable stainless steel lugs shall be tack welded on turbine casing to support the insulation. In places where welding is not permitted, suitable alternative arrangement shall be provided by the Contractor. The design of the support shall be so as to involve minimum number of lugs. (e) The thermal insulation designed, furnished and installed by the Contractor shall be such that the following items of performance shall be guaranteed, and the specific design and application features adopted shall be so as not to exceed the stipulated limits in temperature differentials. The Employer shall have the option to have any random check of specimen as per his choice, to establish conformity to guaranteed particulars: (1) The difference in temperature between upper and lower metallic parts of HP and IP casings in the zone of governing stage/ steam admission shall not be more the 40 °C during cooling of the casing. (2) The difference in metallic temperatures of upper and lower halves of both H.P. and I.P. casings, during normal operating conditions shall not be more than 15 °C. (f) Applicable Standards: 1. IS15402 Ceramic mattress insulation 2. IS - 9742 Sprayed mineral wool thermal insulation. 3. IS - 5696 Loose mineral wool. 4. IS - 3677 Unbonded slag wool for thermal insulation. 5. IS - 8183 Lightly bonded mineral wool for thermal insulation. 6. IS - 7413, IS - 3144, IS - 9482 (g) The use of asbestos in any form for insulation and elsewhere is not permitted. The insulating material and cladding material shall be as per the tables of material given below:			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION	Page 3 of 8	

2.01.00 Insulation Materials

	Type # 1	Type # 2	Type # 3	Type # 4	Type # 5	Type # 6
Type	Lightly resin Bonded mineral wool	Lightly resin bonded mineral wool	Resin bonded mineral wool preformed pipe section	Resin bonded glass wool preformed pipe section	Calcium silicate preformed block type	Ceramic Fiber
Apparent Density	120-150 Kg/M ³	100 Kg/M ³	140-150 kg/M ³	60-80Kg/M ³	200-250Kg/m ³	128 Kg / m ³
Mtl. Standard	IS:8183	IS:8183	IS:9842	IS:9842	IS:8154	IS : 15402
Applicable Service	Piping system & equipment with operating temp. in range of 400-500 deg.C	Piping system & equipment with operating temp. in range of 60-400 deg.C	Piping system of 350 NB and below with temp. in range of 60 – 500 deg. C	Piping system of 350 NB and below with operating temp. in range of 60-400 deg.C	Piping system & equipment with operating temp. in range of 400 – 500 deg. C	Piping system & equipment with operating temp 500 deg. C and above. (except Vent and drain Lines). [See Note: 1& 2 below]
Testing Requirement	As per IS:8183	8183	IS:9842	IS:9842	IS:8154	IS : 15402

Note: (1) For piping systems with operating temperature 500 Deg. C and above, the first (innermost) 75 mm thickness shall be of ceramic fiber Insulation followed by subsequent layers of mineral wool/LBM.

Thickness of Ceramic fiber and LBM is to be calculated layer wise considering the first layer of ceramic fiber **insulation followed** by mineral wool/LBM of appropriate thickness to reach cladding surface temperature 60 Deg. C or less)

- (2) For drains & vent lines with operating temperature 500 Deg C and above either Lightly resin Bonded mineral wool or ceramic fiber or combination of ceramic fiber & LRBM of suitable thickness as per approved calculation can be provided.

2.02.00 Cladding Material & Accessories shall be as specified here under.

S.No.	Item	Basic Specification	Description
1.	Cladding	Aluminum ASTM B-209-1060 temper H14 or IS:737 Gr.19000/H2	Thickness of sheathing (a) 18SWG (1.219mm) for diameter for insulated surface 450 mm and above and for flat surfaces (b) 20 SWG (0.91 mm) for diameter of insulated surface 150 mm and above up to 450 mm. (c) 22 SWG (0.71 mm) for diameter of insulated surface 150 mm and below. (d) 16 SWG ribbed Aluminum for Steam Generator outer casing
2.	Binding & lacing wire	Galvanized Steel wire to IS: 280 for temp. below 400°C and stainless to IS:6528 for temp above 400°C	20 SWG for all insulation interface temperature
3.	Straps & Bands	(i) Aluminum where interface temperature are below 400 deg. C (ii) Stainless steel where temperatures are above 400 deg. C	Band shall be 20 mm wide and 0.6 mm thick for securing Aluminum Sheathing anodized aluminum bends shall be used.
4.	Screws	Stainless steel	Self-tapping, cheese headed
5.	Hexagonal wire mesh	(i) Galvanized steel wire to IS: 280 mesh for interface temperature up to 400 deg. C. (ii) Stainless steel wire for temperature above 400 deg. C	Wire mesh netting shall be 10 to 13 mm aperture at least 0.56mm diameter wire. Wires used for stitching/tying the hexagonal mesh facing with the insulation mattress shall be minimum 0.4 mm thick.

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.03.00	SPECIFIC REQUIREMENTS FOR APPLICATION OF THERMAL INSULATION 1) All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/crushing of insulation due to its self-weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3-meter straight length between support rings. 2) Where insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For pipe sections, the sections shall be held in place by binding wires without any wire mesh. 3) The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter unto and including 550 mm and with metal bends for insulation surfaces with diameter over 550 mm. The fastening shall be done at intervals of 250 mm except where specified otherwise. The ends of the binding wires shall be hooked and embedded in the insulation. The straps shall be mechanically stretched and fastened with metallic clamping seals of the same materials as the strap. 4) Weather hoods shall be provided for insulated piping passing through floors/walls. 5) All pipe attachments exposed to weather shall be provided with weather proof. 6) All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminum sheets of thickness same as the connected pipe cladding. The portion of the valve which cannot be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. Expansion joints, metallic or rubber shall not be insulated unless otherwise specifically indicated. 7) All insulation shall be protected by means of an outer covering of aluminum sheathing. All insulation / cladding joints shall be sealed and made effectively weather and waterproof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. 8) Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands. The insulation applied to the equipment shall be reinforced with hexagonal wire mesh. One layer of wire mesh shall be provided on the equipment surface prior to application of insulation. All vertical vessels/tanks shall be provided with support rings/ribs with other necessary frame work to take up the weight of the insulation prior to HT. Where vessel/tank outer diameter exceeds 1500 mm, binding wire passing through insulation clips provided both longitudinally and circumferentially at 500 mm centers shall be used 9) Application of insulation on Steam Generator and other flat surfaces and equipments Insulation to various areas shall be applied as under.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION
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CLAUSE NO.	TECHNICAL REQUIREMENTS														
	<table><tr><th></th><th>Insulation Area</th><th>Form of Insulation</th></tr><tr><td>(a)</td><td>SG surfaces, hot air & gas ducts</td><td>Mineral wool block Mineral wool blankets</td></tr><tr><td>(b)</td><td>Burner panel and soot blower area</td><td>Ceramic pad type insulation</td></tr><tr><td>(c)</td><td>All other surfaces/not enclosed by SG casing</td><td>Calcium silicate block or as per (a) above</td></tr></table>		Insulation Area	Form of Insulation	(a)	SG surfaces, hot air & gas ducts	Mineral wool block Mineral wool blankets	(b)	Burner panel and soot blower area	Ceramic pad type insulation	(c)	All other surfaces/not enclosed by SG casing	Calcium silicate block or as per (a) above		
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(c)	All other surfaces/not enclosed by SG casing	Calcium silicate block or as per (a) above													
	I. For the Steam Generator furnace, if provided with skin casing and the super heater, reheater and economizer casings where water cooled walls are involved, a first covering of refractory material shall be applied to the external tube surfaces before the application of any further heat resistant insulating material II. The access doors and inspection doors in the Steam Generator shall be lined with refractory material. The access doors in other portions of the Steam Generator shall be insulated in a similar manner corresponding to any casing, flue-ducts or air, ducts where such openings and access doors occur. III. While applying mineral wool blanket insulation: (a) Provide expended metal or hexagonal wire mesh on both sides for single layer mattress and on first layer in case of multilayer insulation. Subsequent layers of multilayer insulation to have only one side wire netting. (b) The edges of adjacent blankets to be leased together, by appropriate lacing wire as per as specified at clause no 2.02.00 of this chapter. (c) Any gap between joints between insulation layers shall be filled by loose mineral wool confirming to IS 3677. (d) All insulation to be secured by 1.63 mm diameter wire netting over blankets with ends of wire tightly twisted, and pressed in to insulation surface. (e) Impelling pins shall be placed on centers not exceeding 300 mm. IV. Air & Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in as specified at clause no 21.10.00 of this chapter. V. Penthouse Insulation Arrangement: Penthouse vertical wall shall be insulated from outside. Alternately, insulation material inside penthouse shall be protected by SS sheet cladding. Similarly, the upper deck sheet of pent house shall also be insulated from outside only. The flat surface of deck sheet shall be insulated by calcium silicate blocks/pourable/castable refractory only. Alternately, outer casing shall be provided over upper deck sheet insulation. 10) Testing and Guarantee for insulation: 1. All tests, as per the applicable material standards and as specified shall be carried out in accordance with the methods prescribed. Employer shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.														
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION												
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2. The Contractor shall guarantee that if on actual measurement the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.			
2.04.00	Refractories			
2.04.01	The refractory material shall comply with relevant Indian Standards. The refractory selected shall ensure perfect sealing, and shall have good thermal cycling properties allowing quick startup/shut down of Steam Generators.			
2.04.02	The refractory material shall (a) Have high bulk density and minimum moisture content, (b) Be capable of withstanding service temperature of 1700 degree Celsius. (c) Be resistant to slagging products due to coal, and to impurities of oil like V_2O_5, Fe_2O_3, K_2O_2, Na_2O etc. and to erosion due to fly ash. (d) Be chemically inactive towards alkalis, iron, silica etc. shall pose no health hazard to working personnel, and shall not have any explosive properties. (e) Have sufficient strength to withstand forces generated in Steam Generator, without any rupture or damage.			
2.04.03	Application of refractory shall be such that: (a) To ensure perfect sealing, easy maintenance, minimum time for application. (b) To ensure minimum number of joints, all the joints to be filled and tightly packed with loose powder of same material. (c) Selection of Refractory shall consider the applied stress, stress distribution and expansion allowance. (d) Refractories shall have good thermal cycling properties to ensure quick start up and shut down of Steam Generators.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION	Page 8 of 8

SUB-SECTION-A-24

ELEVATORS, CRANES AND HOISTS

**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC. NO. CS-9587-001R-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS																							
1.00.00	SERVICE ELEVATORS, CRANE, HOIST & MONORAIL																							
	SERVICE ELEVATORS																							
	DESIGN CRITERIA AND OPERATIONAL SPECIFICATION																							
	Design																							
	Elevator shall be of conventional type for TG building. The elevator shall meet the quality of international standard.																							
	No. of floors to be served shall be as per the specification and tender drawing of the Employer. Bidders shall quote variation in price for addition/deletion of one landing level in the relevant schedule of Forms and Procedures. However, bidder shall quote for above indicated landing levels in his base offer. No of floors and landing elevations are tentative only. The final landing elevations for all buildings shall be subject to approval by the Employer after award.																							
	Elevators shall be designed based on following criteria:																							
	<table><tr><td>i)</td><td>Design/construction/installation codes.</td><td>:</td><td>Latest edition of IS: 14665 (all parts)</td></tr><tr><td>ii)</td><td>Load carrying capacity</td><td>:</td><td>884 kgs. (equivalent to 13 persons) for passenger elevator for TG building</td></tr><tr><td>iii)</td><td>Rated speed</td><td>:</td><td>1.0 m/sec.</td></tr><tr><td>iv)</td><td>Position of machine room</td><td>:</td><td>Directly above the elevator shaft.</td></tr><tr><td>v)</td><td>Machine room</td><td>:</td><td>Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.</td></tr></table>				i)	Design/construction/installation codes.	:	Latest edition of IS: 14665 (all parts)	ii)	Load carrying capacity	:	884 kgs. (equivalent to 13 persons) for passenger elevator for TG building	iii)	Rated speed	:	1.0 m/sec.	iv)	Position of machine room	:	Directly above the elevator shaft.	v)	Machine room	:	Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.
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CONSTRUCTION																								
Construction of the elevators shall specifically meet all requirements of the codes indicated and shall have following additional features:																								
<table><tr><td>i)</td><td>Flooring of Cabin</td><td>:</td><td>Vitrified ceramic tiles of mat finish.</td></tr><tr><td>ii)</td><td>Car enclosure & car panels</td><td>:</td><td>Stainless Steel</td></tr><tr><td>iii)</td><td>Handrails on 3 sides</td><td>:</td><td>Mirror Stainless Steel</td></tr><tr><td>iv)</td><td>False ceiling</td><td>:</td><td>Powder painted</td></tr><tr><td>v)</td><td>Car opening & Hoist way opening</td><td>:</td><td>Protected by central opening sliding Stainless Steel door</td></tr></table>				i)	Flooring of Cabin	:	Vitrified ceramic tiles of mat finish.	ii)	Car enclosure & car panels	:	Stainless Steel	iii)	Handrails on 3 sides	:	Mirror Stainless Steel	iv)	False ceiling	:	Powder painted	v)	Car opening & Hoist way opening	:	Protected by central opening sliding Stainless Steel door	
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B		SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL																				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	vi)	CABIN ACCESSORIES	:	The following accessories shall be provided : a) Recessed fluorescent light/LED fittings on car ceiling. b) Car control station c) Emergency stop switch. d) 5/15A, 3 pin plug socket with switch on top of lift car. e) Switches with Braille characters.
	1. AUTOMATIC RESCUE DEVICE (ARD) - (BATTERY DRIVE): Bidder to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in a ELEVATOR”.			
	2. EMERGENCY SAFETY DEVICES : The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car.			
	3. Elevator shall have Floor announcement system & Braille switches			
1.02.01	All steel embedment for fixing landing doors/indicators etc. to the Elevator well shaft and fascia plate shall be supplied by the Bidder.			
1.02.02	Guide rails complete with supporting brackets for the car and counter weights. Bidder to take care of granite tiles (approx 80 kg) to be provided for cabin flooring in selecting counter weights.			
1.02.03	Elevator drive machines complete with electric motor, reduction gear unit, suspension ropes, buffers for the cars and the counter weights and other drive and control mechanism. All foundation anchor bolts, sleeves, anchoring steel and any item required to complete the job satisfactorily shall be provided by the bidder. The bidder shall also provide for the grouting of anchor bolts, sleeves, anchoring steel, etc. and other anchorages			
1.02.04	Any other steel works as well as all other accessories/components not specified in the specification but necessary for making the Elevator complete.			
1.02.05	All building work including the supply of steel items, associated with installation of equipment in the machine room hoist way, hoist way door, frames and Elevator pit, shall form part of bidders scope of service, Bidder shall also provide the Elevator-well complete with foundation and brick walls around the lit-well together with overhead machine room. The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots.			
1.03.00	OPERATION			
1.03.01	Elevator shall have provisions to meet following operational requirements :			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B		SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	a) Selective Duplex collective, automatic operation with or without attendant through illuminated push button station located inside the lift car. b) Door operating shall be automatic door operation and electronic door protection system for opening/closing of car and landing doors. c) Bidder shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls. d) Bidder shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual) e) Bidder shall provide electronic door detector (Infra red curtain type). f) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing and one push button at each terminal landing shall be provided in order to call the car. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the bidder. g) For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided. h) All fixtures shall be in stainless steel face plates. i) Push buttons shall be fixed in the car for holding the doors open for any length of the time required. j) All other safety/protection/operation interlocks as required by IS:14665 (latest edition). 1.04.00 Elevator Electricals: 1.04.01 Electric motor: The driving motors shall conform to I.S 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130 (B) or better insulation 1.04.02 Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.04.03	Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. a) Oxygen index of min. 29 (as per IS:10810 Part-58) b) Acid gas emission of max. 20% (as per IEC-754-I). c) Smoke density rating shall not be more than 60% (as per ASTMD-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.			
1.04.04	Earthing: The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET i) Type of services : Passenger ii) Load carrying capacity : As per specification iv) Rated speed : One (1) m/s v) Total Travel : TG hall- As per layout vi) No. of floor to be served : TG hall- To be decided during detailed engineering. vii) Method of control : Variable voltage variable frequency (VVVF) viii) Position of M/c room : Directly above lift shaft ix) Size of platform : As per IS14665 & manufacturer's standard latest. x) Size of lift well : -do- xiii) Specification code : As per IS:14665 (5 parts) (Latest Edition). xiv) Design seismic co-efficient : According to the IS 1893-1977			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	CRANE, HOIST & MONORAIL			
2.01.00	Suitable EOT Crane/HOT Crane/Monorail beams with hoists/Chain Pulley Blocks of adequate capacity, to meet the erection and maintenance requirements are to be provided by the vendor for the various areas/equipment. Some of the areas/equipment not covered by TG hall EOT cranes are indicated below. For balance areas/equipment, not listed hereinafter, the requirements of Specification shall be followed. (a) Feed water heaters & deaerator (Applicable Hoists/Chain pully block for maintenance purpose shall be provided). (b) Various pumps & Heat Exchangers. (c) Condenser Water Boxes (front & rear), (Applicable If hinged type water box not envisaged) (d) CW Butterfly Valves (e) Vacuum Pumps (f) Control Fluid Room (g) Auxiliary cooling water (clarified) pumps and DM cooling water pumps of ECW systems. (h) Central Lube Oil System room. (i) Any other equipment. The above requirement is indicative only, the requirement given in the respective chapter is to be adhered to.			
2.02.00	The EOT cranes shall be designed as per IS-3177 (Latest edition) class -2 duty and the monorail hoists (hand operated) shall be designed to duty class 2 to IS 3832. Electrical wire rope hoist shall be designed as per IS:3938 (latest).			
2.03.00	The design, manufacture inspection and testing of the crane shall comply with the requirement of latest version of IS:3177			
2.04.00	The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality Act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.			
2.05.00	For the hoists with more than 2.0 ton lifting capacity or more than 10.0 M lift, motor operated hoist block for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. However, all monorails coming out of the building shall be provided with electric hoist block, irrespective of load and lift. For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the monorail hoist with the help of floor operated pendant. The creep speed for vertical movement shall also be provided as per the system requirement.			
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NTPC Limited

(A Government of India Enterprise)



LARA SUPER THERMAL POWER PROJECT STAGE - II (2x800MW)

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-9587-001R-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

PART - C

GENERAL TECHNICAL REQUIREMENTS

LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-C SEPARATOR BID DOC NO. CS-9587-001R-2

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.			
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Bidders may note that this is a EPC Package contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.			
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.			
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4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following : a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m) Explosive Rules, 1983 (n) Petroleum Act, 1984 (o) Petroleum Rules, 1976, (p) Gas Cylinder Rules, 1981			
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5.02.00	(q) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r) Workmen's Compensation Act, 1923 (s) Workmen's Compensation Rules, 1924 (t) NTPC Safety Rules for Construction and Erection (u) NTPC Safety Policy (v) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise in the specifications, the latest editions (as applicable as on the date of bid opening), of the codes and standards given below shall also apply: a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute, U.S.A. h) International Organization for Standardization (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC)/ European Norm (EN) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI) p) IEEE standard			
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5.03.00 5.04.00 5.05.00 5.06.00 5.07.00 5.08.00 6.00.00 6.01.00	q) JEC standard Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English. As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered. In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern. Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award. In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect. A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification. EQUIPMENT FUNCTIONAL GUARANTEE The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
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6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.		
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS		
7.01.00	DESIGN OF FACILITIES		
	All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.		
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path, turbine & equipments, inspection of the steam path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.		
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8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is an EPC Package contract. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engineering and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.			
8.02.00	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification.			
8.03.00	The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:			
8.03.01	A) BASIC ENGINEERING DOCUMENTATION Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.			
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	iv) Optimization studies including thermal cycle optimization. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. vii) Water Balance diagram. viii) Operation Philosophy and the control philosophy of the Main Plant and other plants. ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope. x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. B) DETAILED ENGINEERING DOCUMENTS i) General layout plan of the station. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, Process and Instrumentation diagrams along with write up and system description. iv) Start-up curves for boiler and both turbines and boiler combined together as a unit for various start-ups, viz. Cold, Warm and Hot start up.			
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	v) Piping isometric, composite layout and fabrication drawings, design philosophy & design parameter selection for each piping system, Pressure drop calculation & flash tank sizing calculation. vi) Piping engineering diagrams, pipe and fittings schedules, System-wise or P&ID wise prepared pipe schedule, valve schedule, insulation schedule, hanger and support schedule and Piping isometric / fabrication isometric drawings for pipe size 65mm NB and above with BOM, Painting schedule. Hanger / support arrangement drawing with BOM, Valve GA drawings, Layout drawings for site routed piping (i.e. for pipe sizes below 65NB) along with BOM (and submission of the same to the employer / project manager before start of work) and System wise stress analysis / dynamic analysis report (including input) along with stress isometric drawing / sketch marked with node points. Also As-Built drawing for information & Records: (i) Piping fabrication isometric drawing (ii) composite piping layout drawing (iii) Hanger / Support arrangement drawing. vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors. viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like Mills, Fans, BFPs, CEPs, Heaters/ Deaerators, Water cooled Condensers, Vacuum pumps etc. ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier. x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes. xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser, design ramp rates of SG and TG and heat exchanger thermal calculations etc.). xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters. xiii) Comprehensive list of all Terminal Points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.			
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	xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xv) Protection system diagrams and relay settings. xvi) Cables schedules and interconnection diagrams. xvii) Cable routing plan. - xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points. xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report and power system stability study report. xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. - xxiii) Detailed DDCMIS system manuals. xxiv) Detailed flow chart for digital control system. xv) Mimic diagram layout, Assignment for other application engg. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. - xxvii) Underground facilities, levelling, sanitary, land scaping drawings. - xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable.			
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8.03.02	xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. xxxii) BOP documents such as P&IDs, Sizing calculations for various equipment's, performance curves, datasheet etc. (For CHP, AHP, PU, Water System etc.) shall be as per MDL. xxxiii) Bidder shall submit all tabulated design calculations/ data (e.g. Pipe schedule, valve schedule, etc.), in both EXCEL format as well as in PDF format to enable NTPC for fast review /approval. INSTRUCTION MANUALS The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of a particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection. c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tools, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation.		
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	h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows: 1) <u>Chapter 1 - Plant Description:</u> To contain the following sections specific to the equipment/system supplied (a) Description of operating principle of equipment / system with schematic drawing / layouts. (b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (This to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared.			
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	(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided. (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures. (i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure.		
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	3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc. (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.			
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	(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.	
8.03.03	After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and/or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.	
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT	
8.03.03.01	PLANT HANDBOOK The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including - Design and performance data. - Process & Instrumentation diagrams. - Single line diagrams. - Sequence & Protection Interlock Schemes. - Alarm and trip values. - Performance Curves. - General layout plan and layout of main plant building and auxiliary buildings - Important Do's & Don't's	
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	The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.			
8.03.03.02	PROJECT COMPLETION REPORT The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
8.03.04	DRAWINGS a) i) All the plant layouts shall be made in computerized 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check. ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C. iv) Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary. All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings and RCC layout of major buildings and structural arrangement			
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	drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer. The complete 3D data (editable model) which shall be utilised for all future detailed engineering related to maintenance, operation, R&M, efficiency improvement of the project etc. Complete 3D model along with as built GADs, layout, isometrics, reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases. All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information. Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time. All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period . Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D		
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	model stage. Database backup shall be taken every month and handed over to NTPC. b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission in line with suggestive MDL. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or		
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	approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package. Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per Annexure VI. k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout			
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	completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. l) The Contractor shall submit adequate prints of drawing / data / document as per Annexure-VI. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.			
8.03.05	e-Learning Package: e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system.			
8.03.05.01	Steam Turbine Generator & Auxiliaries Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralized oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system. Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system. Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable etc. Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank,			
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8.03.05.02 8.03.05.03	high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable. Steam Generator & Auxiliaries Furnace/evaporator, separator & drain collection vessel, superheater, reheater, economiser, startup recirculation & drain system, desuperheating spray system, safety valves, soot blowing system, draft plant including FD & ID fans, PA fan, air preheaters, SCAPH, coal preparation and firing system including raw coal feeder and pulverisers, coal burners, fuel oil system and oil burners, Electrostatic precipitator, NOx control system and Flue gas desulphurisation system, Aux. PRDS system. These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI. 1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system . 2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above. a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc. b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc. c. The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections etc. d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling. Depth of coverage of above courses shall be as specified for “Instruction Manuals” in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system. 3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or			
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	representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site. The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit. 4. e-Learning course broad requirements: - The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc. - The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices. - Course content text shall be in English language and be associated with a voiceover in English language with Indian accent. - Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI. - Each course shall have every physical and functional detail of the equipment / system supplied. - Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules. - There shall be option for self-assessment test after every course. In case the user doesn't opt for self-assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz. - If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same. - Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window. - The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course. - The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.		
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	l. The system shall provide the user with the ability to select the information with a Cursor. m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function. n. Every course shall contain the 3D design/drawing/exploded view/360° turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio. o. The users shall be able to control audio sound level associated with the courses. p. Drawings / text in the courses shall be scalable (Zoom In/ Out). q. The user shall have the capability to record a bookmark to mark displayed information for later recall, whenever he accesses the same course next time. Notes: - e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system. - e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system. - The vendor shall get the approval of one sample course from EIC before proceeding for further courses. 8.04.00 Provision for Fail Safe operation of vital Equipments All the Plant and equipments / Systems supplied under the contract shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves/dampers etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery. 8.05.00 Engineering Co-ordination Procedure 8.05.01 The following principal coordinators will be identified by respective organizations at time of award of contract:		
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	NTPC Engineering Coordinator (NTPC EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE :			
8.05.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.			
8.05.03	Contractor's/Vendor's Drawing Submission and Approval Procedure: a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) Not used c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance. d) Not used			
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	e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories: CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records. h) After Rev 0 comments, the drawing will be locked in the system. Contractor will review the Rev 0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to NTPC as an agenda point for TCM. TCM shall be conducted with Contractor on non-agreed comments of CRS. System will not allow Contractor to submit approval category drawings before the scheduled submission date. However, documents may be unlocked on case to case basis. Based on resolution of all comments and agreements, the document will be approved in TCM itself. The contractor will revise the document based on the resolutions and certify that all the resolutions has been taken care of. Based on this certification, the document will be opened and submitted by contractor in the system for approval as Rev 01 within 10 days of TCM.			
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	i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
8.06.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.06.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
8.06.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.			
9.00.00	TECHNICAL CO-ORDINATION MEETING			
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.			
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9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the comments of the Employer shall be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.			
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
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13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H₂, CO₂ and N₂ for Generator) etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder scope shall include supply of H₂, CO₂ and N₂ as applicable for the Generator till successful commissioning of Generator. Bidder shall supply a quantity not less than 10% of the full charge or one (1) year topping requirement mentioned above (Whichever is higher) of each variety of lubricants, servo fluids, gases etc. (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.			
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. However, the lube oil for Main Turbine, Drive Turbine, TDBFP and MDBFP shall be kept same in view of ease of operation and maintenance. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.			
14.00.00	LUBRICATION			
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.			
15.00.00	MATERIAL OF CONSTRUCTION			
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.			
16.00.00	RATING PLATES, NAME PLATES & LABELS			
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16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.			
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.			
16.03.00	Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non-pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
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16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a non-metallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING			
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	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date. 20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer. 20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer. 20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled. 20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications. 21.00.00 QUALITY ASSURANCE PROGRAMME 21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme	
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	b) Quality System Manual c) Design Control System d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component .Formats for the same will be shared along with QA Coordination procedure.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will			
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22.02.00 22.03.00 22.04.00 22.05.00 22.06.00	be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished. Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP, for review and approval. Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning. The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
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22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC / CHP Clearance).			
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details			
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative prior to carrying out the welding/brazing.			
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. All welding / brazing procedures qualified / used at shop, will be made available to NTPC during audit / inspection. Procedures to be qualified at site will be submitted to NTPC for approval.			
22.11.00	Not Used.			
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding			
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
22.14.00	No welding shall be carried out on cast iron components for repair.			
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.			
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22.17.00	In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be Ultrasonically tested. The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-vendors proposed by the Main contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format as Annexure-III. List of NTPC approved sub vendors against similar Pkg/items is attached as Section-VI, Part-B ,Chapter E-60 Indicative sub-vendor list. The contractor's proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own assessment report assessed as per their quality management system for NTPC review and acceptance . New sub vendor proposal will only be considered for NTPC review, provided the proposal is received sufficiently in time: 90 days prior to ordering date of a Bought-Out Items/Start of Manufacturing so as not to impede the progress of the contract. Major checks and quality requirements as mentioned below shall necessarily be assessed by main contractor and complied with documentary support in case the same is not the part of their Quality management system. - Duly Filled Main supplier Evaluation Report. - Duly Filled Sub-Supplier Questionnaire. - Factory Registration Certificate. - Overall Organization Chart with Manpower details (Design, Manufacturing, Quality etc.) - Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date /year of supply, date / year of commissioning. - List of Manufacturing Equipment available with sub vendor. - List of Testing Equipment available with sub vendor. - Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any. - Details of Outsourced Manufacturing Processes, if any. - Quality control exercised during receipt, in-process & final inspection. - Compliance of Statutory requirements (As applicable) After first submission of proposal to NTPC , In absence of relevant documents/ Incompleteness of the proposal, The main contractor will be given a period of maximum 10 days to submit the compliance of the NTPC comments. In case of noncompliance it will be			
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	presumed that main contractor is not serious about pursuing the proposal & the proposal will be foreclosed. The proposed Sub vendor will be assessed broadly on following criteria i) Quality Management System Compliance including raw material/BOI control, traceability & control over outsources process ii) Design Capabilities (As applicable) iii) Manufacturing, Testing & Storage Facility iv) Processing Capabilities v) Supply Experience vi) Safety Aspect In case of major observations or non-compliance observed during sub vendor works visit (Jointly with the main contractor) with respect to the submitted documents, proposed sub vendor will not be considered for acceptance and Main contractor will be solely responsible in such cases. Monthly progress reports on sub-vendor detail. Submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract. 22.18.00 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within two (2) weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract. 22.19.00 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance. 22.20.00 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and			
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	the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.			
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.			
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.			
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.			
22.24.00	Environmental Stress Screening Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be furnished for NTPC acceptance			
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.			
22.26.00	Software Reliability / Quality Certification Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.			
23.00.00	QUALITY ASSURANCE DOCUMENTS			
23.01.00	The Contractor shall be required to submit the QA Documentation in soft copies, as identified in respective quality plan with tick (✓)mark.			
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.			
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23.02.00	The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, soft copies will be furnished not later than two (2) weeks. Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC			
23.03.00	Similarly, the contractor shall be required to submit soft copies containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review. (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.			
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23.05.00	(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than two (2) weeks after the despatch of equipment.		
	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than two (2) weeks after the date of the last delivery of equipment.		
	PROJECT MANAGER'S SUPERVISION		
	24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.		
	24.02.00 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (a.) Interpretation of all the terms and conditions of these documents and specifications		
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	(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc. (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.			
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25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.			
25.05.00	When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Failure on the part of Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.			
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.			
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.			
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no. 25.03.00 - of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.			
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.			
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25.10.00	ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME			
25.10.01	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).			
25.10.02	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.			
25.10.03	Field Welding Schedule Format enclosed at Annexure-V.			
25.11.00	TESTING OF MAJOR DESIGN FEATURES: The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following. a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B. b) Loop reaction time for sample loops/ logics. c) SOE functionality tests. d) Server changeover. e) Various response times, having serious implication on operation & maintenance philosophy. f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load. g) Connectivity of Switchgear DDCMIS with Switchgear Relay Network. The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer. If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder			
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	for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.			
25.12.00	DEMONSTRATION OF APPLICATION ENGINEERING			
25.12.01	Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports. e) Calculations (Basic & Performance Calculations).			
25.12.02	The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as			
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	part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant			
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	rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.	
26.01.00	Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain: (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.	
26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours with demonstration of the capability of the machine to raise load upto 105% of full rated load. The Initial Operation shall be considered successful, provided that each item/part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the	
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26.03.00	equipment, shall not be considered as reasons for with- holding the aforesaid permission. Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. To conduct such tests, the contractor's Commissioning, start-up Engineer shall make the unit ready (including tuning and all other enabling activities as required for PG tests) before start of initial operation. Such test shall be conducted along with the Initial Operations. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.		
26.04.00	Before start of commissioning of critical equipment, Commissioning Clearance Certificate (CCC) to be submitted by Main contractor. List of the critical equipments and CCC format will be provided along with QA Coordination procedure.		
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.		
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL		
28.01.00	The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance. Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:		
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	(a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments. (b) Training for Electric Systems including VFD and Electric power supply system. (c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc. system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc. c1: Training on Engineering, Model building,pre-testing, Post -test fine tuning of Advance process control systems with faculty having experience of atleast 5 years in Model Process Control. (d) Training for special packages specified elsewhere in Technical Specification, Section-VI. (e) Training for various C&I systems/equipment supplied includes the following: i) DDCMIS - Human Machine Interface – Hardware & Operating System ii) DDCMIS-Human Machine Interface System Engineering & Application Software. iii) DDCMIS – Control System Hardware and Control system Application Software. iv) DDCMIS – Operator Training : Use of the system at Works + at site. v) DDCMIS – Specialized Network security. (f) Training for power cycle piping/critical piping. (g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system. (h) Training on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis. (i) Training on Non-Intrusive hardwired Electric Actuator and Fieldbus based Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator (k) Training for numerical relays & networking systems supplied under MV & LT switchgear system. (l) Training courses on offered PLC system in the following areas:			
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	(a.) Operator training (b.) Hardware Maintenance training (c.) Software training (d.) Any other specialized training as required for system operation and maintenance. (m) Training for Ash Handling System & Coal Handling Plant Equipment and Auxiliaries <table><tr><th>Area</th><th>Topics</th><th>Mandays</th></tr><tr><td>Ash Handling Plant</td><td>Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization</td><td>300</td></tr><tr><td>Coal Handling Plant</td><td>Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work - Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization</td><td>150</td></tr></table>				Area	Topics	Mandays	Ash Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	300	Coal Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work - Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	150
Area	Topics	Mandays											
Ash Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	300											
Coal Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work - Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	150											
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	n) Training for UF Membranes, RO membranes, Zero Liquid Discharge (ZLD) Chlorine Di-Oxide (ClO ₂) generation & dosing system, Condensate Polishing Plant (CPU) and CW Treatment System.			
	Area	Topics	MANDAYS	
	UF Membranes	Product design -Basic design features -Theory & principle of operation -Latest technological trends in Ultrafiltration membranes and design -CIP & CEB of UF system Plant Visit -Operational feedback -O&M history/problems related to UF membranes Visit to Manufacturer's Work -Manufacturing process of UF membranes and equipment -Testing facilities Operation & Maintenance of Plant -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	7	
	Area	Topics	MANDAYS	
	RO membranes	Product design -Basic design features -Theory & principle of operation -Latest technological trends in RO membranes and design -Failure analysis, types of failures, causes & its evaluation, remedies -CIP of RO system	7	
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		Plant Visit -Operational feedback -O&M history/problems related to RO membranes Visit to Manufacturer's Work -Manufacturing process of RO membranes and equipment -Testing facilities Operation & Maintenance of Plant -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization		
	Zero Liquid Discharge (ZLD)	System Design - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant Plant Visit - Operational feedback - O&M history/problems related to plant	5	
	Chlorine Di-Oxide (ClO ₂) generation & dosing system	System/Product Design - Basic design features - Theory & principle of operation - Latest technological trends in Chlorine Di-Oxide (ClO₂) generation & dosing system and design aspects & Selection criteria. Plant Visit - Operational feedback - O&M history/ problems related to ClO₂ plant Performance Test of generator - Generator capacity performance testing. Operation & Maintenance of Plant -Trouble shooting and fault analysis	5	
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		-Familiarization of special maintenance techniques -Special tool and tackles familiarization	
	Condensate Polishing Plant (CPU)	System/Product Design - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. Plant Visit - Operational feedback - O&M history / problems related to CPU plant Visit to Manufacturer's Work -Manufacturing process of pre-filters and major equipment -Testing facilities Operation & Maintenance of Plant -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	3
	CW Treatment System	System/Product Design - Basic design features - Theory & principle of operation - Latest technological trends and design aspects & Selection criteria. Operation & Maintenance of Plant - Operational feedback - O&M history / problems related to plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	3
	Note: One week shall constitute of five (5) man days.		
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	(o) Training for Electrical System			
	Area	Topics	MANDAYS	
	Generator	Product design -Design aspects of associated auxiliary systems - Familiarisation with cooling medium and arrangements, winding and core support systems Plant Visit -Operational feedback -O&M history/problems related to Insulation system Visit to Manufacturer's Work -Manufacturing process of core, winding bars, Assembly -Testing facilities Operation & Maintenance (Site) -Trouble shooting and fault analysis - Storage and Familiarization of special maintenance techniques -Special tool and tackles familiarization	60 (15+15+30)	
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	Excitation systems including AVR	System Design - Design features of various sub systems, Exciter PMG - Excitation transformers, Controllers and different limiters - PSS and associated system studies Plant Visit - Operational feedback - O&M history/problems related to Excitation systems - Familiarization with various equipment functioning at reference plant Visit to Manufacturer's Work -Manufacturing process for various equipment of excitation systems -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization Performance Test of generator - Generator capacity performance testing.	60 (15+15+30)	
	MV VFD (If applicable)	System/Product Design - Basic design features - Theory & principle of operation Plant Visit - Operational feedback - O&M history/ problems related to VFD - Familiarization with various equipment functioning at reference plant Operation & Maintenance (At Site) -Trouble shooting and fault analysis - Familiarization of special maintenance techniques -Special tool and tackles familiarization	90(15+15+60)	
	MV and LT switchgear	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through	150 (45+15+90).	
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		relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection testing of protection functions. - Familiarisation of IMCC and Interface with DCS Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of Switchgear, IMCC and interface with DCS, relays and interfacing software. -Special tool and tackles familiarization		
	MDBFP, CW and BMCP Motors	System/Product Design - Basic design features of stator core and rotor core, winding insulation and cooling arrangements - Theory & principle of operation - Study of forces and Vibration. - Diagnostic and testing Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) - O&M practices Familiarization of special maintenance techniques - Special tool and tackles familiarization	45 (15+15+15)	
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	Relays and Substation Automation System	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of SAS and Cyber security Features. Plant Visit - Operational feedback - O&M history / problems Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of relay configuration, settings and interfacing software. -Familiarization of SAS Hardware, software and Application software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of cyber security features	75 (30+15+30)	
	AIS and bay equipment's	Operation & Maintenance (At site) -Erection, Storage and handling of bay equipment -Familiarization of special maintenance techniques -Special tool and tackles familiarization	30 (0+15+15)	
	Note: One week shall constitute of five (5) man days. (p) Training on Erection methodologies for all the Sub-packages, System and Equipments associated with the EPC Package, including a visit to power plant construction site. The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.			
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28.03.00	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.			
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.			
28.05.00	Contractor shall provide training on application of PAUT (Phased array ultrasonic testing) and TOFD (Time of flight diffraction) techniques for two weeks (at least 80 Hours). The training shall be arranged at least six months prior to the start of erection works of SG & TG works.			
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.			
28.07.00	In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.			
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. Note: 1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person. 2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage. 3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be classroom training. 4. A) Location of classroom training for engineering shall be at Design/Engineering office. B) Classroom training for erection/O&M shall be at location of Manufacturers' works.			
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28.09.00	TRAINING REQUIRED IN MAN MONTH				
	Area	Engineering (Man months)	Erection (Man months)	O&M (Man months)	
	Steam Turbine Generator and its Auxiliaries	5.5	8.0	21	
	Steam Generator and its Auxiliaries	5.5	8.0	20.5	
	Station C&I (Control and Instrumentation)	3.5	5.5	10	
	Ash Handling Plant	2.0	3.0	5.0	
	Coal Handling Plant	1.0	1.5	2.5	
	UF Membranes, RO Membranes, ZLD, Chlorine Di Oxide (ClO2) generation & dosing system, Condensate Polishing Plant (CPU), CW Treatment System	0.2	0.3	0.5	
	Electrical systems consisting of generators, Excitation systems, VFD, Motors, MV/LV switchgears, relays, SAS and Switchyard	4.5	3.5	9	
	Total	22.2	29.8	68.5	
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION				
	In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer’s safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.				
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनडीपीसी NTPC		
30.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA. ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA. iii) Mill noise which will be limited to 85-90 dBA. iv) TG unit in which case it shall not exceed 90 dBA. v) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 90 dBA. vi) For BFP Motor Noise level shall be within the limit of 90 dBA.			
31.00.00	PACKAGING, TRANSPORTATION AND STORAGE All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage at site due to improper packing and preservation. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation. In addition to above, the contractor shall take all necessary measures for storage of all electronic equipment / systems at site in a dust free Air conditioned space ensuring proper temperature & humidity.			
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32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES			
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.			
33.00.00	INSTRUMENTATION AND CONTROL			
	All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.			
33.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.			
	All scales and charts shall be calibrated and printed in Metric Units as follows:			
	1. Temperature	-	Degree centigrade (deg C)	
	2. Pressure	-	Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.	
	3. Draught	-	Millimetres of water column (mm wc).	
	4. Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).	
	5. Flow (Gas)	-	Tonnes/ hour	
	6. Flow (Steam)	-	Tonnes/ hour	
	7. Flow (Liquid)	-	Tonnes / hour	
	8. Flow base	-	760 mm Hg. 15 deg.C	
	9. Density	-	Grams per cubic centimetre.	
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33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.			
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).			
35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.			
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.			
37.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.			
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	i) Temperature test pockets with stub and thermowell ii) Pressure test pockets			
38.00.00	SYSTEM DOCUMENTATION The Bidder shall provide drawings, system overview & description, hardware/software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.			
38.01.00	Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.			
39.00.00	MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc. as required to do the testing and maintenance of the electronic modules. Backup & Restoration Procedures of DDCMIS, Station LAN & Advance Process Control shall be provided.			
40.00.00	MAKE IN INDIA REQUIREMENTS a) The bidder shall follow Indian laws, regulations and standards. There shall not be any restriction in terms of compliance to codes & standards of foreign origin only. The compliance to equivalent/better Indian as well as other codes & standards, wherever available, shall also be acceptable.			
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b) c) d) e) f) g) h) i) j)	The technologies/ products offered shall be environmentally friendly, consuming less energy, and safe, energy efficient, durable and long lasting under the prescribed operational conditions. The bidder/its sub vendor/supplier shall ensure supply of spares, materials and technological support for the entire life of the project. The bidder shall list out the products and components producing Toxic E-waste and other waste as specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled/ disposed of by the contractor and for this, the bidder has to establish recycling/disposal unit as specified. The equipment/ material sourced from foreign companies will be tested in accredited labs in India before acceptance wherever such facilities are available. The testing shall be carried out in accordance with MOP extant order/guidelines. The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied/services to be rendered as safe to connect. All applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/ supplier. Wherever required, the foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of Employer. To protect the security, integrity and reliability of equipment in this package, it is essential to remove vulnerabilities arising out of the possibility of cyber-attack through malware/ Trojans etc. embedded in imported equipments. This requirement shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in this package. Contractor shall comply all the requirements of Order No 25-11/6/2018-PG, dated 02/07/2020 (attached as Appendix-I), issued by Ministry of Power, Government of India and its subsequent amendments/revisions. Contractor shall furnish declaration of compliance of MOP order dated 02/07/2020 requirements with dispatch of equipment/ item. Further, Contractor shall furnish back up testing certificates, whenever Employer asks the same. All equipment/materials/parts/items required in this package which are domestically manufactured with sufficient domestic capacity as identified in Annexure-I of MOP order dated 16/11/2021 including its subsequent revisions (copy attached as Appendix-II) shall necessarily be sourced from the class-I local suppliers only as per the extant provisions of the Public Procurement (Preference to Make in India) Orders issued by DPIIT and MoP. Any violation w.r.t Make in India and minimum local content (MLC) requirements as specified shall be sole responsibility of the Bidder.			
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Appendix-I

No.25-11/6/2018-PG
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi – 110001
Tele Fax: 011-23730264

Dated 02/07/2020

ORDER

Power Supply System is a sensitive and critical infrastructure that supports not only our **national defence, vital emergency services** including health, disaster response, **critical national infrastructure** including classified data & communication services, defence installations and manufacturing establishments, logistics services but also the **entire economy** and the **day-to-day life** of the citizens of the country. Any danger or threat to Power Supply System can have catastrophic effects and has the potential to cripple the entire country. Therefore, the Power Sector is a **strategic and critical sector**.

The vulnerabilities in the Power Supply System & Network mainly arise out of the possibilities of cyber attacks through malware / Trojans etc. embedded in imported equipment. Hence, **to protect the security, integrity and reliability of the strategically important and critical Power Supply System & Network** in the country, the following directions are hereby issued :-

(1) All equipment, components, and parts imported for use in the Power Supply System and Network shall be tested in the country to check for any kind of embedded malware/trojans/cyber threat and for adherence to Indian Standards.

(2) All such testings shall be done in certified laboratories that will be designated by the Ministry of Power (MoP).

(3) Any import of equipment/components/parts from "prior reference" countries as specified or by persons owned by, controlled by, or subject to the jurisdiction or the directions of these "prior reference" countries will require prior permission of the Government of India

(4) Where the equipment/components/parts are imported from "prior reference" countries, with special permission, the protocol for testing in certified and designated laboratories shall be approved by the Ministry of Power (MoP).

This order shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in power supply system or any activity directly or indirectly related to power supply system.

This issues with the approval of Hon'ble Minister of State for Power and New & Renewable Energy (Independent Charge).


(Goutam Ghosh)
Director
Tel: 011-23716674

To:

1. All Ministries/Departments of Government of India (As per list)
2. Secretary (Coordination), Cabinet Secretariat
3. Vice Chairman, NITI Aayog
4. Comptroller and Auditor General of India
5. Chairperson, CEA
6. CMDs of CPSEs/Chairman of DVC & BBMB/MD, EESL/DG, NPTI/DG, CPRI/DG, BEE/
7. All ASs/JSs/EA, MoP

Copy:

1. PS to Hon'ble PM, Prime Minister's Office
2. PS to Hon'ble MOS(IC) for Power and NRE
3. Sr. PPS to Secretary(Power)

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	Appendix-II No. A-1/2021-FSC-Part(5) Government of India Ministry of Power Shram Shakti Bhawan, New Delhi Dated: 16th November, 2021 ORDER Subject: Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Power Sector. Reference: Department for Promotion of Industry and Internal Trade (DPIIT) Notification No. P-45021/2/2017-PP (BE-II) dated 16.09.2020. The Government of India, Department for Promotion of Industry and Internal Trade (DPIIT) issued Public Procurement (Preference to Make in India), Order 2017, for encouraging 'Make in India' and promoting manufacturing and production of goods and services in India with a view to enhancing income and employment. Subsequently, DPIIT vide order No. P-45021/2/2017-PP (BE-II) dated 4th June, 2020 and further vide order dated 16th September, 2020 have issued the revised Public Procurement (Preference to Make in India) Order 2017. 2. In light of the Public Procurement (Preference to Make in India) Order 2017, this Ministry had notified purchase preference (linked with local content) for Hydro and Transmission sectors vide Order No. 11/05/2018-Coord dated 20.12.2018, for Thermal sector vide Order dated 28.12.2018 and for Distribution sector vide Order dated 17.03.2020. Further, a combined order dated 04.04.2020 was also issued in supersession of all previous orders to indicate equipment/material/components for which there was sufficient local capacity and competition and also to indicate conditions for including suitably in the tenders to be issued by the procurers. In furtherance of Para 19 of the DPIIT Notification No. P-45021/2/2017-PP(BE-II) dated 04.06.2020, Ministry of Power (MoP) issued a revised comprehensive Order dated 28.07.2020 (Annexure-I amended by order dated 17.09.2020). 3. DPIIT Notification No. P-45021/2/2017-PP(BE-II) dated 16.09.2020 has further revised its order dated 04.06.2020. Therefore, in supersession of all the aforementioned orders including order No.10/1/2019-St.Th. (Part-II) dated 20.03.2020 issued by this Ministry, the following has been decided: i. For the purpose of this order, the definitions of various terms used in the order, and provisions relating to (i) Eligibility of 'Class-I local supplier'/'Class-II local supplier'/'Non-local suppliers' for different types of procurement, (ii) purchase preference (iii) exemption to small purchases and (iv) margin of purchase preference shall be the same as in DPIIT order dated 16.09.2020, referred to above and extracts of the same is given at Appendix. ii. In procurement of all goods and services or works in respect of which there is sufficient local capacity and local competition as in Annexure-I, only "Class-I local supplier" shall be eligible to bid irrespective of purchase value. "Class-I local supplier" is a supplier or service provider whose goods, services or works offered for procurement meets the Minimum Local Content (MLC) as prescribed in Annexure-I of this order. "Class-II local supplier" means a 			
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supplier, as defined by DPIIT in its Order No. P-45021/2/2017-PP (BE-II) dated 16-09-2020.

- iii. In the procurement of all goods and services or works other than those listed in Annexure-I, only "Class-I local supplier" and "Class-II local supplier" as defined in the order of this Ministry herewith shall be eligible to bid in procurement undertaken by procuring entities, except when Global Tender Enquiry has been issued. In Global tender enquiries, "Non-local suppliers" shall also be eligible to bid along with "Class-I local suppliers" and "Class-II local suppliers". In procurement of all goods, services or works not covered by sub-para 3(ii) above, and with estimated value of purchases less than Rs. 200 crores, in accordance with Rule 161(iv) of GFR, 2017, Global Tender Enquiry(GTE) shall not be issued except with the approval of the competent authority as designated by Department of Expenditure.
- iv. For the purpose of this order, 'Works' means all works as per Rule 130 of GFR- 2017, and will also include 'turnkey works', Engineering, Procurement and Construction (EPC) contracts and service contracts including System Integrator (SI) contracts.
4. The list of items, in respect of which, local capacity with sufficient competition exists as per **Annexure-I**, will be reviewed at regular intervals with a view to increase number of items in this list and also to increase the MLC for each item, wherever it is less than 100%.
5. Purchase preference shall be given to local suppliers in accordance with **para 3A** of DPIIT Order dated 16.09.2020, and extracts of the same are given at **Appendix**.
6. Further, it has been decided to constitute a committee for independent verification of self-declarations and auditor's / accountant's certificates on random basis and in the case of complaints. The composition of the committee is given below:

Member (Planning), Central Electricity Authority (CEA)	Chairperson
Chief Engineer (PSETD), CEA	Member
Chief Engineer (HETD), CEA	Member
Chief Engineer (TETD), CEA	Member
Chief Engineer (DP&R), CEA	Member
As may be co-opted by CEA	External Expert
Chief Engineer (R&D), CEA	Convener

7. Further, it has also been decided to constitute a committee to examine the grievances in consultation with stakeholders and recommend appropriate actions to the Competent Authority in MoP. The composition of the Committee is given below:

Chairperson, CEA	Chairperson
Member (Hydro), CEA	Member



Member (Power System), CEA	Member
Member (Thermal), CEA	Convener

8. The complaint fee of Rs. 2 Lakhs or 1% of the value of the local item being procured (subject to maximum of Rs. 5 Lakhs), whichever is higher, shall be paid in the form of Demand Draft, drawn in favour of **PAO, CEA, New Delhi**. In case the complaint is found to be incorrect, the complaint fee shall be forfeited. In case, the complaint is upheld and found to be substantially correct, the deposited fee of the complainant would be refunded without any interest.

9. All other conditions, not stipulated in this order, shall be as laid down in the DPIIT's order No. P-45021/2/2017-PP (BE-II) dated 16.09.2020.

10. This order shall be applicable in respect of the procurement made by all attached or subordinate offices or autonomous bodies under the Government of India including Government Companies as defined in the Companies Act, and/or the States and Local Bodies making procurement under all Central Schemes/ Central Sector Schemes where the Scheme is fully or partially funded by the Government of India. The aforesaid orders shall also be applicable in respect of projects wherein funding of goods, services or works is by Power Finance Corporation (PFC) /Rural Electrification Corporation (REC) and any Financial Institution in which Government of India/ State Government share exists. This order shall be applicable to Tariff Based Competitive Bidding (TBCB) projects also. Procuring entities as defined in the DPIIT's Order dated 16.09.2020 are advised to revise their tender documents to fully comply with the said DPIIT's Order and the subsequent Orders that would be issued in this regard by DPIIT/ this Ministry from time to time.

11. All tenders for procurement by Central Government Agencies or the States and Local Bodies, as the case may be, have to be certified for compliance of the Public Procurement (Preference to Make in India) 'PPP-MII' Order by the concerned procurement officer of the Government Organization before uploading the same on the portal.

12. Exemption from meeting the stipulated local content is allowed as per clause 13 and 13A of PPP-MII Order dated 16.09.2020, if the manufacturer declares that the item is manufactured in India under a License from a foreign Manufacturer who holds Intellectual Property Rights (IPRs) and there is Transfer of Technology (ToT) with phasing to increase Minimum Local Content. For such items, if any CPSE under the administration of Ministry of Power requests exemption for any item, it shall be considered by Ministry of Power, on case to case basis.

13. In order to further encourage Make in India initiatives and promote manufacturing and production of goods and services in India, general guidelines as enclosed at **Annexure-II** may be adopted in an appropriate manner according to the circumstances by the procuring entities in their tendering process.

14. The procurers may specify the higher values of MLC than those specified in this Order in respect of goods, services or works covered in their tenders and award the weightage to the product of higher MLC for which they have to specify the criteria beforehand in their tender. The values given in Annexure-I are the minimum prescribed values for becoming a class-I local supplier for the products indicated therein.



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	15. This issues with the approval of Hon'ble Minister for Power and New & Renewable Energy.  (S. Majumdar) Under Secretary to the Government of India Tele No. 011- 23356938 To: 1. Secretary to Government of India (All Ministries/ Departments of Government of India) (As per list) 2. Secretary (Coordination), Cabinet Secretariat 3. CEO, NITI Aayog 4. Chief Secretaries of all States/ UTs 5. Comptroller and Auditor General of India 6. Secretary, DPIIT, Chairman of Standing Committee for implementation of Public Procurement Order, 2017 7. Director General, Bureau of Indian Standards (BIS) 8. Joint Secretary, DPIIT, Member-Convener of Standing Committee for implementation of Public Procurement Order, 2017 9. Chairperson, CEA 10. CMDs of CPSEs, CMD NLC, Chairman of DVC/ BBMB/ EESL, DGs of BEE/ CPRI/ NPTI 11. All Additional Secretaries/ JSs/ EA/ CE, Ministry of Power Copy to: Director (Technical), NIC with a request to publish the Order on the website of Ministry of Power			
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	APPENDIX <u>Extracts of important provisions contained in DPIIT Order No. P-45021/2/2017-PP (BE-II) dated 16-09-2020</u> 1. Definitions (Para 2 of DPIIT order): 'Local content' means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value, in percent. 'Class-I local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-I local supplier' under this Order. 'Class-II local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-II local supplier' but less than that prescribed for "Class-I Local supplier" under this Order. 'Non-Local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content less than that prescribed for 'Class-II local supplier' under this Order. 'L1' means the lowest tender or lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation. 'Margin of purchase preference' means the maximum extent to which the price quoted by a 'Class-I local supplier' may be above the L1 for the purpose of purchase preference. 'Nodal Ministry' means the Ministry or Department identified pursuant to this order in respect of a particular item of goods or services or works. 'Procuring entity' means a Ministry or department or attached or subordinate office of, or autonomous body controlled by, the Government of India and includes Government companies as defined in the Companies Act. 'Works' means all works as per Rule 130 of GFR- 2017, and will also include 'turnkey works'. 2. Eligibility of 'Class-I local supplier'/ 'Class-II local supplier'/ 'Non-local suppliers' for different types of procurement (Para 3 of DPIIT order) (a) In procurement of all goods, services or works in respect of which the Nodal Ministry / Department has communicated that there is sufficient local capacity and local competition, only 'Class-I local supplier', as defined under the Order, shall be eligible to bid irrespective of purchase value. (b) Only 'Class-I local supplier' and 'Class-II local supplier', as defined under the Order, shall be eligible to bid in procurements undertaken by procuring entities, except when Global tender enquiry has been issued. In global tender enquiries, 'Non-local suppliers' shall also be eligible to bid along with 'Class-I local suppliers' and 'Class-II local suppliers'. In procurement of all goods, services or works, not covered by 3(a) above, and with estimated value of purchases less than Rs 200 crores, in accordance with Rule 161(iv) of GFR, 2017 Global tender enquiry shall not		
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	be issued except with the approval of competent authority as designated by Department of Expenditure. (c) For the purpose of this Order, works includes Engineering, Procurement and Construction (EPC) contracts and services include System Integrator (SI) contracts. 3. Purchase Preference (Para 3A of DPIIT order) (a) Subject to the provisions of this Order and to any specific instructions issued by the Nodal Ministry or in pursuance of this Order, purchase preference shall be given to 'Class-I local supplier' in procurements undertaken by procuring entities in the manner specified here under. (b) In the procurements of goods or works, which are covered by para 3(b) of DPIIT Order No. P-45021/2/2017-PP(BE-II) dated 16-09-2021 and which are divisible in nature, the "Class-I local supplier" shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure: i. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract for full quantity will be awarded to L1. ii. If L1 bid is not a 'Class-I local supplier', 50% of the order quantity shall be awarded to L1. Thereafter, the lowest bidder among the 'Class-I local supplier' will be invited to match the L1 price for the remaining 50% quantity subject to the Class-I local supplier's quoted price falling within the margin of purchase preference, and contract for that quantity shall be awarded to such 'Class-I local supplier' subject to matching the L1 price. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price or accepts less than the offered quantity, the next higher 'Class-I local supplier' within the margin of purchase preference shall be invited to match the L1 price for remaining quantity and so on, and contract shall be awarded accordingly. In case some quantity is still left uncovered on Class-I local suppliers, then such balance quantity may also be ordered on the L1 bidder. (c) In the procurements of goods or works, which are covered by para 3(b) of DPIIT Order No. P-45021/2/2017-PP(BE-II) dated 16-09-2021 and which are not divisible in nature, and in procurement of services where the bid is evaluated on price alone, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure: iii. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract will be awarded to L1, iv. If L1 is not 'Class-I local supplier', the lowest bidder among the 'Class-I local supplier', will be invited to match the L1 price subject to Class-I local supplier's quoted price falling within the margin of purchase preference, and the contract shall be awarded to such 'Class-I local supplier' subject to matching the L1 price. v. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price, the 'Class-I local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on and contract shall be awarded accordingly. In case none of the 'Class-I local supplier' within the margin of purchase preference matches the L1 price, the contract may be awarded to the L1 bidder. (d) "Class-II local supplier" will not get purchase preference in any procurement, undertaken by procuring entities.		
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	4. Applicability in tenders where contract is to be awarded to multiple bidders (<i>Para 3B of DPIIT order</i>)- In tenders where contract is to be awarded to multiple bidders subject to matching of L1 rates or otherwise, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure: a) In case there is sufficient local capacity and competition for the items to be procured, as notified by the Nodal Ministry, only 'Class-I local supplier' shall be eligible to bid. As such, the multiple supplier who would be awarded the contract, should be all and only 'Class-I local suppliers'. b) In other cases, 'Class-II local suppliers' and 'Non-Local suppliers' may also participate in the bidding process along with 'Class-I local supplier' as per provisions of this order. c) If 'Class-I local supplier' qualify for award of contract for at least 50% of the tendered quantity in any tender, the contract may be awarded to all the qualified bidders as per award criteria stipulated in the bid documents. However, in case 'Class-I local supplier' do not qualify for award of the contract for at least 50% of the tendered quantity, purchase preference should be given to the 'Class-I local supplier' over 'Class-II local supplier'/'Non-local suppliers' provided that their quoted rate falls within 20% margin of purchase preference of the highest quoted bidder considered for award of contract so as to ensure that the 'Class-I local suppliers' taken in totality or considered for award of contract for at least 50% of the tendered quantity. d) First purchase preference has to be given to the lowest quoting 'Class-I local supplier', whose quoted rates fall within 20% margin of purchase preference subject to its meeting the prescribed criteria for award of contract as also the constraints of maximum quantity that can be sourced from any single supplier. If the lowest quoting 'Class-I local supplier', does not qualify for purchase preference because of aforesaid constraints or does not accept the offered quantity, an opportunity may be given to next higher 'Class-I local supplier' falling within 20% margin of purchase preference, and so on. e) To avoid any ambiguity during bid evaluation process, the procuring entities may stipulate its own tender specific criteria for award of contract amongst different bidders including the procedure for purchase preference to 'Class-I local supplier' within the broad policy guidelines stipulate in sub-paras above. 5. Exemption of small purchases (<i>Para 4 in DPIIT order</i>): Procurements where the estimated value to be procured is less than Rs. 5 lakhs shall be exempt from this Order. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this Order. 6. Minimum Local Content (<i>Para 5 in DPIIT order</i>): The 'local content' requirement to categorize a supplier as 'Class-I local supplier' is minimum 50%. For 'Class-II local supplier', the local content requirement is minimum 20%. Nodal Ministry/Department may prescribe only a higher percentage of minimum local content requirement to categorize a supplier as 'Class-I local supplier'/'Class-II local supplier'. For the item for which Nodal Ministry/Department has not prescribed higher minimum local content notification under the order, it shall be 50% and 20% for 'Class-I local supplier'/'Class-II local supplier' respectively.			
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	7. Vide DPIIT OM No. P-45021/102/2019-BE-IIPart(1) (E-50310) dated 4.03.2021 services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc. shall not be considered as local value addition. Bidders offering imported products will fall under the category of Non- local suppliers. They can't claim themselves as Class-I local suppliers/Class-II local suppliers by claiming the services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc. as local value addition. 8. Margin of Purchase Preference (Para 6 of DPIIT order): The margin of purchase preference shall be 20%. 9. Specifications in Tenders and other procurement solicitations (Para 10 of DPIIT order): - Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports. - Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of 'Class-I local supplier'/ 'Class-II local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier. - Procuring entities shall, within 2 months of the issue of this Order review all existing eligibility norms and conditions with reference to sub-paragraphs 'a' and 'b' above. Reciprocity Clause: - When a Nodal Ministry/Department identifies that Indian suppliers of an item are not allowed to participate and/ or compete in procurement by any foreign government, due to restrictive tender conditions which have direct or indirect effect of barring Indian companies such as registration in the procuring country, execution of projects of specific value in the procuring country etc. it shall provide such details to all its procuring entities including CMDs/CEOs of PSEs/PSUs, State Governments and other procurement agencies under their administrative control and GeM for appropriate reciprocal action. - Entities of countries which have been identified by the nodal Ministry/Department as not allowing Indian companies to participate in their Government procurement for any item related to that nodal Ministry shall not be allowed to participate in Government procurement in India for all the items related to that nodal Ministry/Department, except for the list of items published by the Ministry/Department permitting their participation. - The stipulation in (ii) above shall be part of all tenders invited by the Central Government procuring entities stated in (i) above. All purchase on GeM shall also necessarily have the above provisions for items identified by nodal Ministry/Department. - State Governments should be encouraged to incorporate similar provisions in their respective tenders. - The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time. - Specifying foreign certification/ unreasonable technical specifications/ brands/ models in the bid document is restrictive and discriminatory practice against local			
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	suppliers. If foreign certification is required to be stipulated because of non-availability of Indian Standards and/ or for any other reason, the same shall be done only after written approval of Secretary of Department concerned or any other authority having been designated such power by the Secretary of the Department concerned. f. "All administrative Ministries/Departments whose procurement exceeds Rs. 1000 Crore per annum shall notify/ update their procurement projections every year, including those of PSEs/PSUs, for the next 5 years on their respective website."		
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Annexure-I

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficient local capacity and competition	Class-I Local Supplier (Minimum Local Content (%))
(A) Common items for Transmission, Distribution and Generation Sector		
1	Power Transformers (up to 765 kV, including Generator transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (up to 400 kV)	60
6	Resin Insulated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765 kV AC - Alternating Current)	60
8	Disconnectors/Isolators (up to 765 kV AC)	60
9	Wave trap (up to 765 kV AC)	60
10	Oil Filled Distribution Transformers up to & including 33 kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry Type Distribution Transformer upto and including 33 kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional Conductor	60
13	Accessories for Conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and Accessories	60
15	Optical ground wire (OPGW) – all designs	60
16	Fiber Optic Terminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and Accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33 kV	60
20	Control cables including accessories	60
21	XLPE Cables up to 220 kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Longrod Insulators with Room Temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for Porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) System (up to 800 kV)	60
33	Gas Insulated Switchgear (up to 400 kV AC)	60
34	Gas Insulated Switchgear (above 400 kV AC)	50
35	Surge/Lightning Arrester (up to 765 kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6 kV to 33 kV)	60
38	Ring Main Unit (RMU) (up to 33 kV)	60
39	Medium Voltage (MV) GIS Panels (up to 33 kV)	60
40	Automation and Control System/Supervisory Control and data Acquisition (SCADA) System in Power System	50
41	Control and Relay Panel (including Digital/Numerical Relays)	50
42	Electrical Motors 0.37 kW to 1 MW	60
43	Energy Meters excluding smart meters	50
44	Control & power cables and Accessories (up to 1.1 kV)	60
45	Diesel Generating (DG) set	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficient local capacity and competition	Class-I Local Supplier (Minimum Local Content (%))
46	DC system (DC Battery & Battery Charger)	60
47	AC & DC Distribution Board	60
48	Indoor Air Insulated Switchgear (AIS) upto 33 kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxiliary Relays	50
55	Load Break Switch	50
(B) Hydro Sector		
56	Hydro Turbine & Associated equipment	
	a) Francis Turbine	60
	b) Kaplan Turbine	60
	c) Pelton Turbine	50
57	Main Inlet Valve & Associated Equipment	60
58	Penstock Protection Valve and Associated Equipment	60
59	Governing system & Accessories	60
60	Generator for Hydro Project & Associated Equipment	60
61	Static Excitation System	60
62	Workshop Equipment	60
63	Cooling Water System	60
64	Compressed Air System	60
65	Drainage/Dewatering System	60
66	Fire Protection System	60
67	Heating, Ventilation & Air Conditioning System (HVAC)	60
68	Oil Handling System	60
69	Mechanical Balance of Plant (BOP) Items	60
(C) Thermal Sector		
Boiler Auxiliaries		
70	Air Pre-Heater	60
71	Steam Coil Air Pre Heater (SCAPH)	60
72	Steam soot blowers [wall blowers & Long Retractable Soot Blower (LRSB)]	60
73	Auxiliary Steam Pressure Reducing & Desuperheating (PRDS)	60
74	Fuel oil system	60
75	Seal air Fan	60
76	Ducts and dampers	60
77	Duct expansion joints	60
78	Blowdown tanks	60
79	Coal burners and oil burners	60
80	Coal mills	60
81	Gear Box of Coal Mill	50
82	Coal feeders	60
83	Primary Air Fans	60
84	Forced Draft Fans	60
85	Induced Draft Fans	60
86	Forced Draft (FD)/Induced Draft (ID)/ Primary Air (PA) Fan Servo Motor Assembly	50
87	Tubes (Carbon Steel)	50
88	Steam pipes (Carbon Steel)	50
89	Steam drum	50
90	Separator	50
91	Selective Catalytic Reduction (SCR)	50

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficient local capacity and competition	Class-I Local Supplier (Minimum Local Content (%))
	Electro-Static Precipitators (ESPs)	
92	Casing	60
93	Electrodes	60
94	Rapping System	60
95	Hopper Heaters	60
96	Transformer Rectifiers	60
97	Insulators	60
	Turbine & Auxiliaries	
98	Turbine (High Pressure/Intermediate Pressure/Low Pressure)	50
99	Condensate Extraction Pumps	60
100	Condenser On line Tube Cleaning System (COLTC)	60
101	Debris filters	60
102	Deaerator	60
103	Drain Cooler and Flash Tank	60
104	ECW Pump	50
105	Plate Heat Exchanger	50
106	Self- cleaning filters	50
107	Condensate Polishing Units (CPUs)	60
108	Chemical Dosing System	60
109	Oil Filter	60
110	Gland Steam Condenser	60
111	Oil Purifying Centrifuge	50
112	Water Cooled Condenser	50
113	Boiler Feed Pumps (BFPs)	50
	Generator and Auxiliaries	
114	Generator (including Seal Oil System, Hydrogen Cooling System, Stator water cooling system)	60
	Electrical Works	
115	Control and metering equipment	60
	Control & Instrumentation System (C&I System)	
116	Thermocouples	50
117	Measuring instruments [Resistance Temperature Detectors (RTDs)], Local gauges	50
118	Actuators (Pneumatic and conventional electric)	50
119	Interplant Communication/ Public Address (PA) system except IP based	50
	Coal Handling Plant	
120	Conveyors	60
121	Wagon Tippler	60
122	Side Arm Charger	60
123	Paddle feeder	60
124	Crushers & Screens	60
125	Dust suppression (dry fog & plain water) system	60
126	Air Compressors	50
127	Magnetic separators & metal detectors	60
128	Coal Sampling System	60
129	Stacker cum reclaimer	60
130	Belt weighing & monitoring system	60
131	Wheel & axle assembly (without bearings) for Bottom Opening Bottom Release (BOBR) Wagons	60
	Ash Handling System	
132	Clinker grinder	60
133	Water jet ejectors	60
134	Scraper chain conveyor	60
135	Dry fly ash vacuum extraction system	60
136	Pressure pneumatic conveying system	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficient local capacity and competition	Class-I Local Supplier (Minimum Local Content (%))
137	Ash water & ash slurry pumps	60
138	Compressors, air dryers & air receivers	50
139	Ash water recovery system	60
Raw Water Intake & Supply System		
140	Travelling water screens	60
141	Raw water supply pumps	60
142	Valves, RE joints etc.	60
Water Treatment System and Effluent Treatment System		
143	Clarification plant	60
144	Filtration plant	60
145	Ultra filtration plant	50
146	Reverse Osmosis (RO) plant and its membrane	55
147	De-Mineralised water plant (DM Plant)	60
148	Chlorination plant	60
149	Chemical dosing system	60
150	Effluent Treatment Plant	60
Circulating Water (CW) & Auxiliary Circulating Water (ACW) System		
151	CW & ACW Pumps	60
152	Butter Fly (BF) valves, Non-return Valves (NRVs) etc.	60
153	Rubber Expansion (RE) joints	60
154	Air release valves	60
Cooling Towers (NDCT/ IDCT)-Natural-Draft and Induced Draft Cooling Tower		
155	Water Distribution System	60
156	Spray nozzles	60
157	Packing	60
158	Drift eliminators	60
159	Cooling Tower (CT) Fans (for Induced Draft Cooling Towers IDCT)	60
160	Gear boxes, shafts & motors (for IDCT)	60
Air Conditioning & Ventilation System		
161	Split & window air conditioners	60
162	Chilling/ condensing unit [upto 500 ton of refrigeration(TR)]	55
163	Air Handling Unit (AHU) and Fresh air unit	60
164	Cooling Towers	60
165	Air Washing Units (AWUs), axial fans, roof extractors	60
166	Ducts, louvers & dampers	60
Flue Gas Desulphurization (FGD)		
167	Spray Nozzles,	50
168	Spray header	50
169	Oxidation Blowers	50
170	Limestone wet Ball Mill	50
171	Slurry Handling Pumps for FGD system	50
172	Booster Fans for FGD system	50
173	Carbon Steel Ducts and Dampers for FGD	60
174	Storage Tanks and Silos	60
175	Process Water Pump for FGD system	50
(D) Other Common Items		
Fire protection and detection system		
176	Motor driven fire water pumps	60
177	Diesel engine driven fire water pumps	60
178	Hydrant system for the power plant.	60
179	High velocity water spray system	60
180	Medium velocity water spray system	60
181	Foam protection system	60
182	Inert gas flooding system	60

Sl. No.	Electrical Equipment for Generation, Transmission and Distribution sectors with sufficient local capacity and competition	Class-I Local Supplier (Minimum Local Content (%))
183	Fire tenders	60
184	Portable fire-extinguishers	60
185	Cranes, EOT cranes, gantry crane & chain pulley blocks etc.	60
186	Elevator	60

(E) Minimum Local Content percentages in Engineering, Procurement & Construction (EPC) / Turnkey project

In case the contract is awarded through the EPC route, the contractor should comply with the requirement of MLC for individual items as listed in Annexure-I and should purchase these items only from Class-I Local supplier. In addition, MLC for complete EPC project may also be prescribed as below:

	(1) Package Based Works	Minimum Local Content (%)
1	Boiler	60
2	TG System (Water Cooled Condenser)	60
3	Ash Handling Plant	60
4	Coal Handling Plant	60
5	Electro-static Precipitator (ESP)	60
6	Circulating Water (CW) System	60
7	Cooling Tower	60
8	Water Treatment System	60
9	Air Conditioning System (below 500TR)	60
10	Flue Gas Desulphurisation (FGD) System	60
11	Station Control & Instrumentation (C&I)	50
12	Hydro Power Projects (Electro-Mechanical Works)	60
	Gas based generation	
	Overall Gas Turbine Package (on finished Product basis)	
13	< 44 MW	60
14	44 – 145 MW	50
	Overall Combined Cycle Gas Turbine (CCGT) Package (on finished Product basis)	
15	< 44 MW	60
16	44 – 145 MW	60
17	> 150 MW	60
	(2) Project as a whole	
1	Works and service contracts in Power Sector	60
2	Transmission Line with Conventional conductors (ACSR, AAAC, AL-59 etc.)	60
3	Transmission Line with High temperature Low Sag (HTLS) conductors	60
4	HVAC Substation Air Insulated (AIS)	60
5	HVAC Substation Gas Insulated (GIS)	60
6	HVDC Substation	60
7	Distribution Sector	60

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	Annexure-II General guidelines to be adopted selectively in an appropriate manner by the procuring entities in their tender documents. 1. The bidder shall have to be an entity registered in India in accordance with law. 2. The bids shall be in the language as prescribed by the tenderer/procurer. 3. The bids shall be in Indian Rupees (INR) (in respect of local content only). 4. Indian subsidiaries of foreign bidders shall have to meet the qualifying criteria in terms of capability, competency, financial position, past performance etc. 5. The bidder shall follow Indian laws, regulations and standards. 6. To be eligible for participation in the bid, foreign bidders shall compulsorily set up their manufacturing units on a long term basis in India as may be specified by the tenderer/ procurer. 7. Similar or better technology than the technology offered in respect of material, equipment and process involved shall be transferred to India. Along with the transfer of technology, adequate training in the respective field shall also be provided. 8. Country of origin of the equipment/material shall be provided in the bid. 9. For supply of equipment / material from the country of origin other than India, the bidder shall submit performance certificate in support of satisfactory operation in India or a country other than the country of origin having climatic and operational conditions including ambient temperature similar to that of India for more than _____ years (to be specified by the procurer). 10. The technologies/ products offered shall be environmental friendly, consuming less energy, safe, energy efficient, durable and long lasting under the prescribed operational conditions. 11. The supplier shall ensure supply of spares, materials and technological support for the entire life of the project. 12. The manufacturers/ supplier shall list out the products and components producing Toxic E-waste and other waste as may be specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled / disposed of by the Manufacturer/ supplier and for this, the Manufacturer/supplier along with procurer has to establish recycling / disposal unit or as may be specified. 13. Minimum Local Content requirement for goods, services or works shall be in accordance with the conditions laid down in respective Order(s) of the sectors on Public Procurement (Preference to Make in India) to provide for purchase preference (linked with local content).		
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	14. The equipment/ material sourced from foreign companies may be tested in accredited labs in India before acceptance wherever such facilities are available. 15. The Tender fee and the Bank Guarantee (BG) shall be in Indian Rupees only. 16. The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied/services to be rendered as safe to connect. 17. Applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/ supplier. 18. Statutory laws/regulations including the labour and environmental laws shall be strictly complied with during supply, storage, erection, commissioning and operation process. A regular compliance report shall be submitted to the procurer/appropriate Authorities. 19. Formation of new joint venture in India shall be permitted only with the Indian companies. 20. Tendering by the agent shall not be accepted. 21. In case local testing is not considered necessary by the procurer, the original test report in the language prescribed by the procurer may be accepted. The translated test report shall not be accepted unless it is notarised. 22. Certification/compliance as per the Indian Standards/ International Standards/ Indian Regulations/ specified Standards shall be mandatory, where ever applicable. 23. Quality assurance of the product shall be carried out by the procurer or an independent third party agency appointed by the procurer. Manufacturing Quality Plan as approved by the procurer shall be followed by the manufacturer/supplier. 24. Wherever required by the procurer, foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of utilities. 25. Arbitration proceedings shall be instituted in India only and all disputes shall be settled as per applicable Indian Laws.			
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	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
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	IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)	
	IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965	
	IS:2825	Code for unfired vessels		
	IS:1520	Horizontal centrifugal pumps for clear cold and fresh water		
	IS:1600	Code for practice for performance of constant speed IC Engines for general purpose		
	IS:1601	Specification for perform- ance of constant speed IC Engines for general Purpose		
	IS:1893	Criteria for earthquake resistant design of structures		
	IS1978-1971	Line Pipe April 1969.	API Standards 5L	
	IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954	
	IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968	
	IS:2312	Propellant type Ventilation fans		
	IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963	
	IS:3354	Outline dimensions for electric lifts.		
	IS:3401	Silica gel		
	IS:3588	Specification for electrical axial flow fans		
	IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)		
	IS:3677	Unbonded rock and slag wool for thermal insulation		
	IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)	
	IS:3895	Specification for monocrystalline semiconductor rectifier cells and stacks		
	IS:3963	Roof extractor unit		
	IS:3975	Mild steel wires, strips and tapes for armouring cables		
	IS:4503	Shell and tube type heat Exchanger		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C		GENERAL TECHNICAL REQUIREMENTS
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS:4540 IS:4671 IS:4736 IS:4894 IS:5456 IS:5749 IS:6392 IS:6524 Part-I IS:7098 IS:7373 IS:7938 ISO:1217 ASHRAE-33 and air heating coils. ASHRAE-52-76 particle matter.	Specification for monory- stallines rectifire assembly equipment Expanded polystyrene for thermal insulation purpose Hot dip zinc coating on steel tubes Centrifugal fans Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only) Forged ramshorn hooks Steel pipe flanges Code of practice for design of tower cranes Static and rail mounted Cross linked Polyethylene insulated PVC sheathed cables Specification for wrought aluminium and aluminium sheet and strips Air receivers for compressed air installation Displacement compressor-Acceptance test Methods of testing for rating of forced circulation air cooling Air cleaning device used in general ventilation for removing	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958 BS 4504 : 1969 BS 2799 : 1956 Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनडीपीसी NTPC		
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 84 OF 119	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guidelines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 85 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS: 1489 (Part-I) (Part-II) IS: 1542 IS: 1566 IS: 1786 IS: 2062 IS: 2116 IS: 2386 (Parts-I to VIII) IS: 3150 IS: 3495 (Parts-I to IV) IS: 3812 IS: 4031 IS: 4032 IS: 4082 IS: 8112 IS: 8500 IS: 12269 IS: 12894	Specification for Portland-pozzolana cement: Fly ash based. Calcined clay based. Specification for sand for plaster. Specification for hard-drawn steel wire fabric for concrete reinforcement. Specification for high strength deformed bars for concrete reinforcement. Specification for steel for general structural purposes. Specification for sand for masonry mortars. Testing of aggregates for concrete. Hexagonal wire netting for general purpose. Methods of tests of burnt clay building bricks. Specification for fly ash, for use as pozzolana and admixture. Methods of physical tests for hydraulic cement. Methods of chemical analysis of hydraulic cement. Recommendations on stacking and storage of construction materials at site. Specification for 43 grade ordinary portland cement. Medium and high strength structural steel. 53 grade ordinary portland cement. Specification for Fly ash lime bricks.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 86 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Cast-In-Situ Concrete and Allied Works IS: 280 Specification for mild steel wire for general engineering purposes. IS: 456 Code of practice for plain and reinforced concrete. IS: 457 Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. IS: 516 Method of test for strength of concrete. IS: 650 Specification for standard sand for testing of cement. IS: 1199 Methods of sampling and analysis of concrete. IS: 1791 General requirements for batch type concrete mixers. IS: 1838 (Part-I) Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). IS: 2204 Code of practice for construction of reinforced concrete shell roof. IS: 2210 Criteria for the design of reinforced concrete shell structures and folded plates. IS: 2438 Specification for roller pan mixer. IS: 2502 Code of practice for bending and fixing of bars for concrete reinforcement. IS: 2505 General requirements for concrete vibrators, immersion type. IS: 2506 General requirements for concrete vibrators, screed board type. IS: 2514 Specification for concrete vibrating tables. IS: 2645 Specification for Integral cement water proofing compounds. IS: 2722 Specification for portable swing weigh batches for concrete. (single and double bucket type) IS: 2750 Specification for Steel scaffolding.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C		GENERAL TECHNICAL REQUIREMENTS
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.		
	IS: 3025	Methods of sampling and test waste water.		
	IS: 3366	Specification for Pan vibrators.		
	IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.		
	IS: 3414	Code of practice for design and installation of joints in buildings.		
	IS: 3550	Methods of test for routine control for water used in industry.		
	IS: 3558 concrete.	Code of practice for use of immersion vibrators for consolidating concrete.		
	IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.		
	IS: 4326 of buildings.	Code of practice for earthquake resistant design and construction of buildings.		
	IS: 4461	Code of practice for joints in surface hydro-electric power stations.		
	IS: 4656	Specification for form vibrators for concrete.		
	IS: 4925	Specification for batching and mixing plant.		
	IS: 4990	Specification for plywood for concrete shuttering work.		
	IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.		
	IS: 5256	Code or practice for sealing joints in concrete lining on canals.		
	IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.		
	IS: 5624	Specification for foundation bolts.		
	IS: 6461	Glossary of terms relating to cement concrete.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 88 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103 IS: 9417 IS: 10262 IS: 11384 IS: 11504 IS: 12118 IS: 12200 IS: 13311 Part-1 Part-2 SP:23 SP: 24 SP: 34 Precast Concrete Works SP: 7(PartVI/	Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete. Recommendations for welding cold worked steel bars for reinforced concrete construction. Recommended guidelines for concrete mix design. Code of practice for composite construction in structural steel and concrete. Criteria for structural design of reinforced concrete natural draught cooling towers. Specification for two-parts poly sulphide. Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. Method of non-destructive testing of concrete. Ultrasonic pulse velocity. Rebound hammer. Handbook of concrete mixes Explanatory Handbook on IS: 456-1978 Handbook on concrete reinforcement and detailing. National Building Code- Structural design of prefabrication and Sec.7) systems building.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 89 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork. IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory handbook on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 90 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS: 8869 IS: 12093 IS: 12866 IS: 14246 Fabrication and Erection of Structural Steel Work IS: 2016 IS: 814 IS: 1852 IS: 3502 IS: 6911 IS: 3757 IS: 6623 IS: 6649 IS: 800 IS: 816 IS: 4000 IS: 9595 IS: 817	Washers for corrugated sheet roofing. Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced). Specification for continuously pre-painted galvanised steel sheets and coils. Specification for plain washers. Specification for covered Electrodes for Metal Arc Welding for weld steel. Specification for Rolling and Cutting Tolerances for Hot rolled steel products. Specifications for chequered plate. Specification for stainless steel plate, sheet and strip. Specification for high strength structural bolts Specification for high strength structural nuts. High Tensile friction grip washers. Code of practice for use of structural steel in general building construction. Code of practice for use of Metal Arc Welding for General Construction. Code of practice for assembly of structural joints using high tensile friction grip fasteners. Code of procedure of Manual Metal Arc Welding of Mild Steel. Code of practice for Training and Testing of Metal Arc Welders.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 91 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS: 1811 IS: 9178 IS: 9006 IS: 7215 IS: 12843 IS: 4353 SP: 6 (Part 1 to 7) IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). Criteria for Design of steel bins for storage of Bulk Materials. Recommended Practice for Welding of Clad Steel. Tolerances for fabrication steel structures. Tolerance for erection of structural steel. Recommendations for submerged arc welding of mild steel and low alloy steels. ISI Handbook for structural Engineers. Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 92 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	Plastering and Allied Works IS : 1635 Code of practice for field slaking of Building lime and preparation of putty. IS : 1661 Application of cement and cement lime plaster finishes. IS : 2333 Plaster-of-paris. IS : 2402 Code of practice for external rendered finishes. IS : 2547 Gypsum building plaster. IS : 3150 Hexagonal wire netting for general purpose. Acid and Alkali Resistant Lining IS : 158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. IS : 412 Specification for expanded metal steel sheets for general purpose. IS : 4441 Code of practice for use of silicate type chemical resistant mortars. IS : 4443 Code of practice for use of resin type chemical resistant mortars. IS : 4456 Method of test for chemical resistant tiles. (Part I & II) IS : 4457 Specification for ceramic unglazed vitreous acid resistant tiles. IS : 4832 Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type IS : 4860 Specification for acid resistant bricks. IS : 9510 Specification for bitumasitc, Acid resisting grade.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 93 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनडीपीसी NTPC		
	Water Supply, Drainage and Sanitation IS : 458 Specification for concrete pipes. IS : 554 Dimensions for pipe threads, where pressure tight joints are made on thread. IS : 651 Specification for salt glazed stoneware pipes. IS : 774 Flushing cisterns for water closets and urinals. IS : 775 Cast iron brackets and supports for wash basins and sinks. IS : 778 Copper alloy gate, globe and check valves for water works purposes. IS : 781 Cast copper alloy screw down bib taps and stop valves for water services. IS : 782 Caulking lead. IS : 783 Code of practice for laying of concrete pipes. IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1230 Cast iron rain water pipes and fittings. IS : 1239 Mild steel tubes, tubulars and other wrought steel fittings. IS : 1536 Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. IS : 1537 Vertically cast iron pressure pipes for water, gas and sewage. IS : 1538 Cast iron fittings for pressure pipe for water, gas and sewage. IS : 1703 Ball valves (horizontal plunger type) including float for water supply purposes. IS : 1726 Cast iron manhole covers and frames. IS : 1729 Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 1742	Code of practice for building drainage.		
	IS : 1795	Pillar taps for water supply purposes.		
	IS : 1879	Malleable cast iron pipe fittings.		
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.		
	IS : 2065	Code of practice for water supply in building.		
	IS : 2326	Automatic flushing cisterns for urinals.		
	IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.		
	IS : 2501	Copper tubes for general engineering purposes.		
	IS : 2548	Plastic seat and cover for water-closets.		
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).		
	IS : 2963	Non-ferrous waste fittings for wash basins and sinks.		
	IS : 3114	Code of practice for laying of cast iron pipes.		
	IS : 3311	Waste plug and its accessories for sinks and wash basins.		
	IS : 3438	Silvered glass mirrors for general purposes.		
	IS : 3486	Cast iron spigot and socket drain pipes.		
	IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).		
	IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.		
	IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.		
	IS : 4127	Code of practice for laying of glazed stone-ware pipes.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 95 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS : 4764 IS : 4827 IS : 5329 IS : 5382 IS : 5822 IS : 5961 IS : 7740 IS : 8931 IS : 8934 IS : 9762 IS : 10446 IS : 10592 IS : 12592 IS : 12701 SP: 35 - Doors, Windows and Allied Works IS : 204 Part-I Part-II	Tolerance limits for sewage effluents discharged into inland-surface waters. Electro plated coating of nickel and chromium on copper and copper alloys. Code of practice for sanitary pipe work above ground for buildings. Rubber sealing rings for gas mains, water mains and sewers. Code of practice for laying of welded steel pipes for water supply. Cast iron grating for drainage purpose. Code of practice for road gullies. Cast copper alloy fancy bib taps and stop valves for water services. Cast copper alloy fancy pillar taps for water services. Polyethylene floats for ball valves. Glossary of terms for water supply and sanitation. Industrial emergency showers, eye and face fountains and combination units. Specification for precast concrete manhole covers and frames. Rotational moulded polyethylene water storage tanks. Handbook on water supply and drainage. Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated. Tower Bolts Ferrous metals. Nonferrous metals.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS : 208 IS : 281 IS : 362 IS : 420 IS : 1003 Part-I door IS : 1038 IS : 1081 IS : 1341 IS : 1361 IS : 1823 IS : 1868 IS : 2202 (Part-II) IS:2209 IS:2553 IS:2835 IS:3548 IS:3564 IS : 3614 IS:4351 IS:5187 IS:5437	Door Handles. Mild steel sliding door bolts for use with padlocks. Parliament Hinges. Specification for putty, for use on metal frames. Specification for timber panelled and glazed shutters- (Part-I) shutters. Steel doors, windows and ventilators. Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. Steel butt hinges. Steel windows for industrial buildings. Floor door stoppers. Anodic coatings on Aluminium and its alloys. Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels Mortice locks (vertical type). Safety glass Flat transparent sheet glass. Code of practice for glazing in buildings. Door closers (Hydraulically regulated). Fire check doors; plate, metal covered and rolling type. Steel door frames. Flush bolts. Wired and figured glass		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 97 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
		IS:6248 Metal rolling shutters and rolling grills. IS:6315 Floor springs (hydraulically regulated) for heavy doors. IS:7196 Hold fasts. IS:7452 Hot rolled steel sections for doors, windows and ventilators. IS:10019 Mild steel stays and fasteners. IS:10451 Steel sliding shutters (top hung type). IS:10521 Collapsible gates. Roof Water Proofing and Allied Works IS:1203 Methods of testing tar and bitumen. IS:1322 Specification for bitumen felts for water proofing and damp proofing. IS:1346 Code of practice for water proofing of roofs with bitumen felts. IS:1580 Specification for bituminous compound for water proofing and caulking purposes. IS:3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS:3384 Specification for bitumen primer for use in water proofing and damp proofing. Floor Finishes and Allied Works IS:1237 Specification for cement concrete flooring tiles. IS:1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS:2114 Code of practice for laying in-situ terrazzo floor finish. IS:2571 Code of practice for laying in-situ cement concrete flooring. IS:3462 Specification for unbacked flexible PVC flooring. IS:4971 Recommendations for selection of industrial floor finishes.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS:8042 Specification for white portland cement. IS:13801 Specification for chequered cement concrete flooring tiles.			
	Painting and Allied Works			
	IS:162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required.			
	IS:1477 Code of practice for painting of ferrous metals in buildings.			
	Part-I Pretreatment.			
	Part-II Painting.			
	IS:1650 Specification for colours for building and decorative finishes.			
	IS:2074 Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.			
	IS:2338 Code of practice for finishing of wood and wood based materials.			
	Part-I Operations and workmanship			
	Part-II Schedules			
	IS:2395 Code of practice for painting concrete, masonry and plaster surfaces.			
	Part-I Operations and workmanship.			
	Part-II Schedule.			
	IS:2524 Code of practice for painting of nonferrous metals in buildings.			
	Part-I Pretreatment.			
	Part-II Painting.			
	IS:2932 Specification of synthetic enamel paint, exterior, under-coating and finishing.			
	IS:2933 Specification enamel paint, under coating and finishing.			
	IS:4759 Code of practice for hot dip zinc coating on structural steel and other allied products.			
	IS:5410 Specification for cement paint			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C		GENERAL TECHNICAL REQUIREMENTS PAGE 99 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS:5411 Specification for plastic emulsion paint-for exterior use (Part-I) IS:6278 Code of practices for white washing and colour washing. IS:10403 Glossary of terms relating to building finishes. Piling and Foundation IS:1080 Code of practice for design and construction of simple spread foundations. IS:1904 Code of practice for design and construction of foundations in Soils; General Requirements. IS:2911 Code of practice for designs and construction of Pile foundations (Relevant Parts). IS:2950 Code of practice for designs and construction of Raft (Part-I) foundation. IS:2974 Code of practice for design and construction of machine (Part-I TO V) foundations. IS:6403 Code of practice for determination of Allowable Bearing pressure on Shallow foundation. IS:8009 Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Part-I Shallow foundations. Part-II Deep foundations. IS:12070 Code of practice for design and construction of shallow foundations on rocks. DIN:4024 Flexible supporting structures for machines with rotating machines. VDI:2056 Criteria for assessing mechanical vibrations of machines. VDI:2060 Criteria for assessing rotating imbalances in machines. Stop Log and Trash Rack IS:4622 Recommendations for fixed - wheel gates structural design. IS:5620 Recommendations for structural design criteria for low head slide gates. IS:11388 Recommendations for design of trash rack for intakes. IS:11855 General requirements for rubber seals for hydraulic gates. Roads		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 100 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IRC:5 IRC:14 IRC:16 IRC:19 IRC:21 IRC:34 IRC:36 IRC:37 IRC:56 IRC:73 IRC:86 IRC:SP:13 IRC - Publication IS:73 Loadings IS:875 (Pt. I to V) IS:1893 IS:4091 IRC:6 M.O.T. Safety IS:3696 (Part I & II)	Standard specifications and Code of practice for road bridges, section-I general Features of Design. Recommended practice of 2cm thick bitumen and tar carpets. Specification for priming of base course with bituminous primers. Standard specifications and code of practice for water bound macadam. Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). Recommendations for road construction in waterlogged areas. Recommended practice for the construction of earth embankments for road works. Guidelines for the Design of flexible pavements. Recommended practice for treatment of embankment slopes for erosion control. Geometric design standards for rural (non-urban) highways. Geometric Design standards for urban roads in plains. Guidelines for the design of small bridges & culverts. Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works. Specification for paving bitumen Code of practice for design loads other than earthquake) for buildings and structures. Criteria for earthquake resistant design of structures. Code of Practice for design and construction of foundation for transmission line towers & poles. Standard specifications & code of practice for road bridges, Section-II Loads and stresses. Deptt. of railways Bridge Rules. Safety code for scaffolds and ladders.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Handbook on functional requirements of buildings (other than industrial buildings) Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134. Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968).		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. 6. Printed circuit boards - IPC TM - 650, IEC 326 C. 7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. 8. Edge socket connectors - IEC 130-11. 9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. 10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). 11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R). 12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. 13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. 14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. 15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988. 16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	Instrument Switches and Contact - Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. - Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures - Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13). - Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). - Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area - Classification of hazardous area - NFPA 70 - 1984, Article 500. - Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. - Intrinsically safe apparatus - NFPA 493 1978. - Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982. - Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977. Sampling System - Stainless steel material of tubing and valves for sampling system - ASTM 296-82, Grade 7 P 316. - Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977. - Water and steam in power cycle - ASME PTC 19.11. - Standard methods of sampling system - ASTM D 1066-99. Annunciators - Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. - Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 - Damp heat cycling test - IS:2106		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78 Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991. 6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनडीपीसी NTPC		
	Process Connection & Piping - Codes for pressure piping "power piping" - ANSI B 31.1. - Seamless carbon steel pipe ASTM - A - 106. - Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. - Material for socket welded fittings - ASTM - A - 105. - Seamless ferritic alloy steep pipe - ASTM - A - 335. - Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. - Composition bronze of ounce metal castings - ASTM - B - 62. - Seamless Copper tube, bright annealed - ASTM - B - 168. - Seamless copper tube - ASTM - B - 75. - Dimension of fittings - ANSI - B - 16.11. - Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing - Seamless carbon steel pipe - ASTM - A 106. - Material of socketweld fittings - ASTM - A105. - Dimensions of fittings - ANSI - B - 16.11. - Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables - Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. - Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. - Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83. - Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). - Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. - Rules for Testing insulated cables and flexible cables : VVDE - 0472 - Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81. 9. Oxygen index and temperature index test - ASTM D - 2863. 10. Smoke density measurement test - ASTM D - 2843. 11. Acid gas generation test - IEC - 754 - 1. 12. Swedish Chimney test - SEN - 4241475 (F3). 13. Teflon (FEP) insulation & sheath test - ASTM D - 2116. 14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784. 15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I). Cable Trays, Conduits 1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984. 2. -do- Test Standards. NEMA VE-1-1979. 3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78. Public Address System 1. Specifications for loud speakers - IS:7741 (Part-I, II and III) 2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301 3. Specification for Public Address Amplifiers - IS:10426. 4. Code of practice for outdoor installation of PA system - IS:1982. 5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881. 6. Basic environmental testing procedures for electronic and electrical items - IS:9000. 7. Characteristics and methods of measurements for sound system equipment - IS:9302 8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 108 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II) 10. Fittings for rigid steel conduits for electrical wiring - IS:2667 11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147. Vibration Monitoring System 1. API 670 - 1994 2. BS : 4675 Part-2		
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ANNEXURE-III

	Project :	Stage ::	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL						DOC. NO.:	
	Package :								REV. NO.:	
	Supplier :								DATE :	
	Contractor No. :		SUB-SYSTEM :						PAGE : OF	
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”

QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

FORMAT NO.: QS-01-QAI-P-1/F3-R0

1/1

Engg. Div. / QA&I

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ANNEXURE-IV

	Project :		Stage ::		STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL				DOC. NO.:		
	Package :								REV. NO.:		
	Contractor :								DATE :		
	Contractor No. :								PAGE : OF		
S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT						1/1		Engg. Div. / QA&I			

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Contractor :				(To be raised by the contractor)							REV. NO.:			
		Contractor No. :				Welding Code:							DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT						1/1						Engg. Div. / QA&I				

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)				
	S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk	
	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			
		First submission and submission with major changes			
		▪ Layout (A0&A1 sizes)	3	-	
		▪ Other Drawings/Documents (A0 & A1 sizes)	3	-	
		▪ P&ID (All sizes)	3	-	
		a) Final drawings/documents (Directly to site)	3	2	
		b) "As Built" Drawing/Documents (Directly to site)	3	2	
		c) Analysis reports of Equipments / piping / structures components/system employing software packages as detailed in the specifications.	2	2	
	2	Erection Manual (Directly to site)	3 sets	2	
	3	Operation & Maintenance manual i) First Submission	0	--	
		ii) Final Submission (Directly to site)	3 sets	2	
	4	Plant Hand Book i) Final Submission	1	1	
	5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--	
4		ii) Final Submission (Directly to site)	3 sets	2	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-C		GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 113 OF 119

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)				
	S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk	
	6	Performance and Functional Guarantee Test Report i) First Submission	1 sets	—	
		ii) Approved Copies (Direct to Site)	3 sets	2	
	7	Project Completion Report (Directly to site)	3 sets	2	
4 LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-C		GENERAL TECHNICAL REQUIREMENTS Annexure-VI		PAGE 114 OF 119

	CORPORATE QUALITY ASSURANCE/ कॉरपोरेट गुणवत्ता आश्वासन MAIN CONTRACTOR'S PROPOSAL CUM EVALUATION REPORT मुख्य संविदाकार प्रस्ताव सह मुल्यांकन रिपोर्ट

Ref No: संदर्भ सं.:		Date: तिथि:	
i.	Main Contractor मुख्य संविदाकार		
ii.	Project परियोजना		
iii.	Package Name पैकेज का नाम	Package No पैकेज सं.	
iv.	Proposed Item/Scope of Sub-contracting उप-संविदा(अनुबंध) का प्रस्तावित मद/ दायरा		
v.	Item covered under निम्नलिखित के अंतर्गत शामिल मद	Schedule-1 /अनुसूची- 1	As per contract clause No- अनुबंध के अनुसार खंड सं.- -
		Schedule-2 अनुसूची- -2	
vi.	If item is Schedule-1 and proposed sub-vendor is indigenous, Main Contractor to explain how the contractual provisions will be fulfilled /यदि मद अनुसूची -1 है और प्रस्तावित उप-विक्रेता स्वदेशी है, तो मुख्य संविदाकार को स्पष्ट करना होगा कि संविदा/अनुबंध के प्रावधान कैसे पूरे किए जाएंगे		
vii.	Name and Address of the proposed Sub-vendor's works /प्रस्तावित सब-वेंडर का नाम तथा पता		
viii.	PO placement date/ Start of manufacturing (if self-manufactured) as per L2 network पीओ नियोजन की तिथि / एल- 2 नेटवर्क के अनुसार विनिर्माण (यदि स्व-निर्मित है) की शुरुआत		
ix.	Item Description (Type/Size/Rating/Scope of Sub-Contracting) मद का विवरण (प्रकार / आकार / रेटिंग / उप-अनुबंध का दायरा)	Total quantity of proposed item envisaged in this package (Nos/ Running Meters/ Kgs/ Tons etc) इस पैकेज में परिकल्पित प्रस्तावित मद की कुल मात्रा (संख्या / क्रियाशील मीटर / किलोग्राम / टन आदि)	Quantity proposed to be procured from proposed sub-vendor (Nos/ Running Meters /Kgs /Tons etc) प्रस्तावित उप-विक्रेता (संख्या / क्रियाशील मीटर / किलोग्राम / टन आदि) से खरीदी जाने वाली मात्रा
			Timeline for quantity requirements as per project schedule & whether the proposed Sub-vendor equipped with adequate capacity to supply proposed order quantity in time / परियोजना समय सूची के अनुसार मात्रा आवश्यकताओं के लिए समय-सीमा और क्या प्रस्तावित उप-विक्रेता समय पर प्रस्तावित मांग की मात्रा की आपूर्ति करने में पूरी तरह से सक्षम है
x.	Supply experience of the proposed sub-vendor (including supplies to Main Contractor, if any) for similar item/scope of sub-contracting, for last 3 years (Note:- Only relevant experience details w.r.t. proposed item/scope of subcontracting to be brought out here) पिछले 3 वर्षों के लिए उप-अनुबंध के समान मद / दायरे के लिए प्रस्तावित सब-वेंडर (मुख्य संविदाकार हेतु		

	CORPORATE QUALITY ASSURANCE/ कॉर्पोरेट गुणवत्ता आश्वासन MAIN CONTRACTOR'S PROPOSAL CUM EVALUATION REPORT मुख्य संविदाकार प्रस्ताव सह मुल्यांकन रिपोर्ट	

आपूर्ति, यदि कोई हो, सहित) का आपूर्ति अनुभव (नोट: - उप-अनुबंध के प्रस्तावित मद / दायरे के संबंध में केवल प्रासंगिक अनुभव के विवरण का उल्लेख हो							
Project/Package परियोजना/पैकेज	Customer Name ग्राहक का नाम	Supplied Item (Type/Rating/Model /Capacity/Size etc) आपूर्ति मद (प्रकार/रेटिंग /मॉडल /क्षमता/आकार आदि)	PO ref no/date पीओ संदर्भ सं. /तिथि	Supplied Quantity आपूर्ति की मात्रा	Date of Supply आपूर्ति की तिथि		
I	I	I	I	I	I		
We confirm that as per our assessment, the proposed sub-vendor has requisite capabilities & supply experience and is suitable for supplying the proposed item/scope of sub-contracting/हम अपने आकलन के अनुसार इस बात की पुष्टि करते हैं कि, प्रस्तावित उप-विक्रेता के पास अपेक्षित क्षमता और आपूर्ति करने का अनुभव है और उप-अनुबंध के दायरे /प्रस्तावित मद की आपूर्ति के लिए उपयुक्त है।							
Name: नाम:	I	Desig: पद:	I	Contact No: दूरभाष सं.:	I	Sign: हस्ताक्षर:	Date: तिथि:

Company's Seal/Stamp:- कंपनी का मुहर:-

	CORPORATE QUALITY ASSURANCE/ कॉरपोरेट गुणवत्ता आश्वासन SUB-VENDOR QUESTIONNAIRE/ सब-वेंडर प्रश्नावली

i.	Item/Scope of Sub-contracting उप-संविदा(अनुबंध) का मद/ दायरा			
ii.	Address of the registered office पंजीकृत कार्यालय का पता 	Details of Contact Person संपर्क व्यक्ति का विवरण (Name, Designation, Mobile, Email) (नाम, पदनाम, मोबाइल, ईमेल) 		
iii.	Name and Address of the proposed Sub-vendor's works where item is being manufactured प्रस्तावित उप-विक्रेता के कार्यों का नाम और पता, जहां मद का निर्माण किया जा रहा है 	Details of Contact Person: संपर्क व्यक्ति का विवरण (Name, Designation, Mobile, Email) (नाम, पदनाम, मोबाइल, ईमेल) 		
iv.	Annual Production Capacity for proposed item/scope of sub-contracting उप-संविदा(अनुबंध) के प्रस्तावित मद / दायरे के लिए वार्षिक उत्पादन क्षमता			
v.	Annual production for last 3 years for proposed item/scope of sub-contracting उप-संविदा(अनुबंध) के प्रस्तावित मद / दायरे के लिए पिछले 3 वर्षों का वार्षिक उत्पादन			
vi.	Details of proposed works प्रस्तावित कार्यों का विवरण			
1.	Year of establishment of present works वर्तमान फैक्टरी की स्थापना का वर्ष			
2.	Year of commencement of manufacturing at above works उपरोक्त फैक्टरी में निर्माण कार्य शुरू होने का वर्ष			
3.	Details of change in Works address in past (if any) पूर्व में फैक्टरी स्थल में परिवर्तन का विवरण (यदि कोई हो)			
4.	Total Area कुल क्षेत्र Covered Area शामिल क्षेत्र			
5.	Factory Registration Certificate फैक्टरी पंजीकरण प्रमाण पत्र	Details attached at Annexure – F2.1 विवरण अनुलग्नक- एफ 2.1 पर संलग्न है		
6.	Design/ Research & development set-up डिजाइन / अनुसंधान और विकास सेटअप (No. of manpower, their qualification, machines & tools employed etc.) (श्रमिकों की संख्या, उनकी योग्यता, मशीन और उपलब्ध उपकरण आदि)	Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design) Details attached at Annexure – F2.2 (if applicable) लागू / लागू नहीं, अगर विनिर्माण मुख्य संविदाकार / खरीददार के डिजाइन के अनुसार है) विवरण अनुलग्नक –एफ 2.2 पर संलग्न है। (यदि लागू हो)		
7.	Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc) मैनपावर विवरण के साथ समग्र संगठन का चार्ट(डिजाइन / विनिर्माण / गुणवत्ता आदि)	Details attached at Annexure – F2.3 विवरण अनुलग्नक – F2.3 में संलग्न है।		
8.	After sales service set up in India, in case of foreign sub-vendor(Location, Contact Person, Contact details etc.) भारत	Applicable / Not applicable लागू / लागू नहीं		

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	में बिक्री सेवा की स्थापना के बाद, विदेशी उप-विक्रेता के मामले में (स्थल, संपर्क व्यक्ति, संपर्क विवरण आदि)	<i>Details attached at Annexure – F2.4</i> विवरण अनुलग्नक -2.4 पर संलग्न है।
9.	<i>Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any</i> फ्लोचार्ट सहित विनिर्माण प्रक्रिया निष्पादन योजना, जिसमें आउटसोर्स प्रक्रिया, यदि कोई हो, सहित कच्चे माल से तैयार उत्पाद तक विनिर्माण के विभिन्न चरणों को दर्शाया गया हो,	<i>Details attached at Annexure – F2.5</i> विवरण अनुलग्नक - F2.5में संलग्न है।
10.	<i>Sources of Raw Material/Major Bought Out Item</i> कच्चे माल के स्रोत / खरीदे हुए मुख्य मद	<i>Details attached at Annexure – F2.6</i> विवरण अनुलग्नक - F2.6में संलग्न है।
11.	<i>Quality Control exercised during receipt of raw material/BOI, in-process, Final Testing, packing</i> कच्चे माल / खरीदे हुए मद, प्रक्रियाबद्ध, अंतिम परीक्षण, पैकिंग करते समय गुणवत्ता नियंत्रण	<i>Details attached at Annexure – F2.7</i> विवरण अनुलग्नक - F2.7 पर संलग्न है
12.	<i>Manufacturing facilities (List of machines, special process facilities, material handling etc.)</i> विनिर्माण सुविधा (मशीनों की सूची, विशेष प्रक्रिया सुविधाएं, सामग्री रख-रखाव आदि)	<i>Details attached at Annexure – F2.8</i> विवरण अनुलग्नक - F2.8में संलग्न है।
13.	<i>Testing facilities (List of testing equipment)</i> परीक्षण सुविधाएं (परीक्षण उपकरण की सूची)	<i>Details attached at Annexure – F2.9</i> विवरण अनुलग्नक – F2. 9 में संलग्न है।
14.	<i>If manufacturing process involves fabrication then-</i> यदि निर्माण प्रक्रिया में फेब्रिकेशन की गई है तो- <i>List of qualified Welders</i> पात्र वेल्डर की सूची <i>List of qualified NDT personnel with area of specialization</i> विशेषज्ञता के क्षेत्र सहित पात्र एनडीटी कार्मिकों की सूची	<i>Applicable / Not applicable</i> लागू / लागू नहीं <i>Details attached at Annexure – F2.10</i> विवरण अनुलग्नक - F2.10में संलग्न है। <i>(if applicable)</i> लागू / लागू नहीं
15.	<i>List of out-sourced manufacturing processes with Sub-Vendors' names & addresses</i> सब-वेंडर द्वारा बाह्य स्रोतों (उनके नाम और पते सहित) से करवाएं गए निर्माण प्रक्रियाओं की सूची	<i>Applicable / Not applicable</i> लागू / लागू नहीं <i>Details attached at Annexure. –F2.11</i> विवरण अनुलग्नक - F2.10में संलग्न है। <i>(if applicable)</i> (यदि लागू हो)
16.	<i>Supply reference list including recent supplies</i> नवीनतम आपूर्ति सहित आपूर्ति संदर्भ सूची	<i>Details attached at Annexure – F2.12</i> विवरण अनुलग्नक - F2.12 में संलग्न है। <i>(as per format given below)</i> (नीचे दिए गए प्रारूप के अनुसार)
<i>Project/ package परियोजना / पैकेज</i>	<i>Customer Name</i> ग्राहक का नाम	<i>Supplied Item (Type/Rating/Model /Capacity/Size etc)</i> आपूर्ति की गई वस्तु (प्रकार / रेटिंग / मॉडल / क्षमता / आकार आदि)
17.	<i>Product satisfactory performance feedback letter/certificates/End User Feedback</i> उत्पाद के संतोषजनक प्रदर्शन संबंधी फीडबैक पत्र / प्रमाण पत्र / अंतिम उपयोगकर्ता फीडबैक	<i>Attached at annexure - F2.13</i> अनुलग्नक F2. 3पर संलग्न है
18.	<i>Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product</i>	<i>Applicable / Not applicable</i> लागू / लागू नहीं

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	<i>(similar or higher rating)</i> प्रस्तावित उत्पाद (एक समान या उच्च रेटिंग वाले) के लिए टाइप टेस्ट रिपोर्ट (टाइप टेस्ट विवरण, रिपोर्ट संख्या, एजेंसी, जांच की तारीख) का सारांश नोट: - रिपोर्ट प्रस्तुत करने की आवश्यकता नहीं है <i>Note:- Reports need not to be submitted</i>	<i>Details attached at Annexure – F2.14</i> विवरण अनुलग्नक - F2.1 4 में संलग्न है <i>(if applicable)</i> (यदि लागू हो)					
19.	Statutory / mandatory certification for the proposed product प्रस्तावित उत्पाद के लिए वैधानिक / अनिवार्य प्रमाणीकरण	<i>Applicable / Not applicable</i> लागू / लागू नहीं <i>Details attached at Annexure – F2.15</i> <i>(if applicable)</i> (यदि लागू हो)					
20.	Copy of ISO 9001 certificate आईएसओ 9001 प्रमाण पत्र की प्रति <i>(if available)</i> (यदि उपलब्ध हो)	<i>Attached at Annexure – F2.16</i> अनुलग्नक में संलग्न - F2.1 6 है					
21.	Product technical catalogues for proposed item <i>(if available)</i> प्रस्तावित मद के लिए उत्पाद तकनीकी कैटलॉग (यदि उपलब्ध हो)	<i>Details attached at Annexure – F2.17</i> विवरण अनुलग्नक - F2.1 7 में संलग्न है					
Name: नाम:		Desig: पद:		Sign: हस्ताक्षर:		Date: तिथि:	

Company's Seal/Stamp:- कंपनी की मुहर / मोहर: -

NTPC Limited

(A Government of India Enterprise)



LARA SUPER THERMAL POWER PROJECT STAGE - II (2x800MW)

PART - D

ERECTION CONDITIONS OF CONTRACT

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-9587-001R-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
1.00.00	GENERAL			
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.			
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.			
2.00.00	REGULATION OF LOCAL AUTHORITIES AND STATUTES			
2.01.00	In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.			
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.			
3.00.00	WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING			
	The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:			
3.01.00	Qualification of Weld Procedures			
	Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.			
3.02.00	Welder's Qualification			
	Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders. All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested			
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	and authorised to carry out welding.			
3.03.00	Records Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.			
3.04.00	MARKING On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.			
3.05.00	Welding Equipment for high pressure (Boiler , PCP) - For GTAW process: HF Welding machines to be used. For SMAW process: Inverter based welding machine are to be used. Main contractor to ensure the availability of sufficient nos of welding equipment during the each phase of project construction so as not to impede the progress of the project			
4.00.00	HEAT TREATMENT			
4.01.00	Heat Treatment -Pre-heating, post-heating and post-weld heat treatment operations of all welds, shall be performed in accordance with the requirements of applicable code and WPS . Local post weld heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils as acceptable to employer. Oxyacetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of chartless recorder / IIOT sensors duly password protected with a connectivity to remote server /Cloud . All hardware and software required to meet above intent shall be in the scope of bidder.			
4.02.00	After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.			
4.03.00	Heat Treatment - weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding. Schedule shall be mentioned on data for identification.			
5.00.00	WELD EDGE PREPARATION			
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	Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used. 6.00.00 CLEANING AND SERVICING 6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested. 6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced. 6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations. 7.00.00 FIELD WELDING SCHEDULE The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following: (a.) Drawing No (s) (b.) Location of the weld (c.) Size of the weld (outside diameter and thickness) (d.) Type of joints (e.) Material specifications (f.) Size of fillet on backing ring, when the type of joint is with backing ring (g.) Electrode/ filler metal specifications (h.) Number of welds per unit (i.) Quantity of filler metal per weld (j.) Indication of required Non-destructive Examination (NDE) for each weld (k.) Pre-heat temperatures for welding (l.) Process of welding			
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8.00.00	(m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment".			
	(n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.			
8.00.00	SITE RUN MISCELLANEOUS PIPING			
	Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.			
9.00.00	THERMAL EXPANSIONS			
	All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.			
10.00.00	PIPING SUPPORTS			
10.01.00	Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.			
10.02.00	The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.			
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11.00.00 11.01.00 11.02.00 11.03.00	PRESSURE TESTING On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor. All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated. Thy hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.			
12.00.00 12.01.00 12.02.00	THERMOWELLS AND FLOW NOZZLES All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work. All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.			
13.00.00 13.01.00 13.01.01 13.01.02	INSULATION, LAGGING AND CLADDING The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder. Piping, Pipe Fittings & Valves All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein. Piping The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts. Flanges Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to			
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	overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.			
13.01.03	Bends and Elbows Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.			
13.01.04	Cladding Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as specified at clause no 13.02.00 of this chapter, shall be taken.			
13.01.05	Valves and Fittings All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.			
13.02.00	Protection of Equipment during Insulation Applications All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.			
14.00.00	CODE REQUIREMENTS The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules & Codes, Indian Boiler Regulations, ASME codes and accepted good practices, the			
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15.00.00 15.01.00 15.02.00 15.03.00 15.04.00 15.05.00 16.00.00 17.00.00 18.00.00	Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India. ELECTRICAL SAFETY REGULATIONS In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer. Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall: (a) Satisfy the Employer that the appliance is in good working condition. (b) Inform the Employer of the maximum current rating, voltage and phase of the appliances. (c) Obtain permission of the Employer detailing the socket to which the appliances may be connected. The Employer will not grant permission to connect until he is satisfied that (d) The appliance is in good condition and is fitted with suitable plug (e) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores. No electric cable in use by the other Contractor/Employer will be disturbed without permission. No weight of any description will be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it. No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out. The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation.. REMOVAL OF MATERIAL No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer. INSPECTION, TESTING AND INSPECTION CERTIFICATES The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work. ACCESS TO SITE AND WORKS ON SITE			
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18.01.00	Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.			
18.02.00	In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.			
19.00.00	CONTRACTOR'S SITE OFFICE ESTABLISHMENT The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.			
20.00.00	CO-OPERATION WITH OTHER CONTRACTORS			
20.01.00	Contractor, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his works. Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.			
20.02.00	The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.			
21.00.00	DISCIPLINE OF WORKMEN The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise unde-sirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.			
22.00.00	CONTRACTOR'S FIELD OPERATION			
22.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews			
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	shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods. 22.02.00 The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.			
	23.00.00 PHOTOGRAPHS AND PROGRESS REPORT			
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.			
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.			
23.03.00	The Contractor shall submit the progress of work in video cassettes (2 copies) quarterly highlighting the progress and constraints at site.			
	24.00.00 MAN-POWER REPORT			
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.			
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.			
25.00.00	PROTECTION OF WORK The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 20.00.00- of this chapter entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The			
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26.00.00 26.01.00 26.02.00 26.03.00 26.04.00 26.05.00 27.00.00 27.01.00 27.02.00 28.00.00 28.01.00 28.02.00	Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes. EMPLOYMENT OF LABOUR In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed. All travelling expenses including provisions of all necessary transport to and from Site, lodging allow-ances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor. The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday. Contractor's employees shall wear identification badges while on work at Site. In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills. FACILITIES TO BE PROVIDED BY THE EMPLOYER Communication The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facilities. Railway Siding Railway siding shall be provided by owner (up to plant entry point) for coal transportation to site. However the same may not be available to the bidder for material/supplies transport etc. Bidder has to plan its own arrangement for movement of ODC consignment to plant site. Further, irrespective of readiness of railway siding, owner reserves the option of coal supply in stackyard before the synchronization of first unit for which bidder has to ensure readiness of coal supply system up to mill bunker. FACILITIES TO BE PROVIDED BY THE CONTRACTOR Contractor's site office Establishment The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC. The site office will include one conference meeting room (250-300 Sq Ft) for site meetings between the Contractor and the Employer. The contractor shall also provide four (4) furnished office rooms (150-250 SqFt) for use by the Employer to facilitate effective co-ordination during the tenancy of the contract. Tools, tackles and scaffoldings			
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28.03.00	The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning. Testing Equipment and Facilities: The contractor shall provide the necessary testing, equipment and facilities.			
28.04.00	Site laboratory for civil works: Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.			
28.05.00	First-aid			
28.05.01	The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.			
28.05.02	The Employer will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital.			
28.06.00	Cleanliness			
28.06.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.			
28.06.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.			
28.07.00	Not used			
28.08.00	Electricity Refer to construction power, as envisaged at Clause 1.15.00 of Sub Section-II-B, Part A, Sec VI of Technical specification.			
28.09.00	Water Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawal of construction/potable water from bore-well shall be permitted if			
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29.00.00 30.00.00 30.01.00 30.02.00 30.03.00 30.04.00 31.00.00	found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner. LINES AND GRADES All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense. FIRE PROTECTION The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area. Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources. All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract. The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time. SECURITY The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.			
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32.00.00	CONTRACTOR'S AREA LIMITS The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.			
33.00.00	CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.			
34.00.00	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
34.01.00	GENERAL			
34.01.01	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.			
34.01.02	The pre-commissioning and commissioning activities including Guarantee/demonstration/acceptability tests, checks and trial operations of the equipment/systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.			
34.01.03	The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him. (a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the			
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	contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer. (b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer. (c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer. (d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.			
34.01.04	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.			
34.01.05	The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.			
34.02.00	COMMISSIONING DOCUMENTATION			
34.02.01	The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/ systems covered under the contract, for the approval of employer.			
34.02.02	Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.			
34.02.03	The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump, compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.			
34.02.04	The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.			
34.02.05	The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.			
34.03.00	COMMISSIONING ACTIVITIES			
34.03.01	Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.			
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34.03.02	Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.			
34.03.03	Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.			
34.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.			
34.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.			
34.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.			
34.05.00	Initial Operation Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.			
35.00.00	MATERIALS HANDLING AND STORAGE			
35.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.			
35.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.			
35.03.00	The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.			
35.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.			
35.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings,			
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	commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage. 35.06.00 All the electrical equipment such as motors, genera-tors, etc. shall be tested for insulation resistance as per OEM Practice. Storage of EHV/Generator transformers under Nitrogen /Dry air shall not exceed the time duration as defined by OEM practice. 35.07.00 The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed. 35.08.00 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage. 35.09.00 All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable. 35.10.00 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost. 35.11.00 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with. 35.12.00 Sound Storage Management system need to be followed for storage of material. First in First Out method (FIFO) to be adopted to avoid longtime storage. Storage duration of any material at site shall not be more than 3 months. Accordingly supply of material in sequence of erection at site to be ensured. To achieve the same, following is to be adopted: a. Dispatch clearance is to be given in order of sequence of erection. To achieve the goal, proper tags shall be maintained in ascending order. The tag shall be self-explanatory. b. MDCC shall be issued by RIO based on clearance from Site FQA head, Main contractor, Erection head for dispatch and supply of material. Strict adherence to sequential supply of material as per supply schedule. 35.13.00 An automated storage and retrieval system consists of a variety of computer-controlled systems for automatically placing and retrieving of material may be adopted. Accordingly, each material shall be marked with unique identification code. 36.00.00 CONSTRUCTION MANAGEMENT 36.01.00 The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the			
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36.02.00	Employer shall not be a cause for extra compensation or extension of time for the Contractor. The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.			
36.03.00	Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.			
36.04.00	The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.			
36.05.00	Site management during construction phase till handing over of plant Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project. a) Unhindered motorable road access to all work areas and facilities both during the construction/erection and as they get completed progressively. Required temporary access roads other than the permanent roads shall also be provided. Bidder shall prioritize the construction of approach roads, roads around the main plant block, roads to office & storage areas and the offsite areas from the start of project itself. He shall finalize and submit the complete road layout plan along with priority and completion schedule immediately after the award for review by the Employer .He shall ensure that the roads are promptly repaired and maintained against any damages due to movement of traffic/heavy trailers & cranes etc providing motorable access at all times. Adequate onsite stock of road materials shall be kept and maintained disturbed over the site for repairs especially before the monsoon period. b) Proper drainage of rain water, ground water from excavations, water flows from batching plant / construction sites etc. He shall prioritize the construction of permanent drains from the start of the project itself. Till such time the permanent drainage network is done, he shall construct adequate temporary drains to ensure that there is no accumulation /stagnation of water in the plant site. Bidder may consider providing pre-cast RCC drains for temporary/ permanent drain construction for faster construction of drains. The drain construction shall be matched with progress of road construction for preventing damage to roads. Bidder shall provide and maintain adequate			
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	number of drainage pumps (both electrical and diesel operated) of suitable capacity for pumping out accumulated water especially during the monsoon periods. All drain diversions required shall be undertaken at the start of the project itself. c) The plant site is fully secured against unauthorized access. d) Proper housekeeping by systematic and proper disposal of earth from excavations(separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tie-up will also be made for periodic disposal of wastes/ scrap from the designated places. e) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platforms. Suitable sheds preferably pre-engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum. f) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself. g) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi-finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted. h) First aid facilities and amenities like rest rooms, suitable pre-engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided. i) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also			
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	be prioritized along with road construction. The construction power ring main shall be planned and erected immediately after the award. j) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc. k) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis. l) Compliance to all safety requirements as specified in this document. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install 25 Nos. CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room." m) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC (No objection certificate) to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction. n) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rain water harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development. o) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps. Bidder shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be			
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	developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with Employer. In case the progress on site management plan is unsatisfactory, Employer may withhold up to 1% of the monthly running bill (for civil and site erection works) till such time the required progress is demonstrated. In case in the opinion of Employer, bidder's actions on site management aspects is not adequate, Employer may get the relevant work executed through a separate agency and deduct the expenses incurred from Bidder's bill along with overheads @10 %. 36.06.00 QUALITY CONTROL ROOM Bidder to refer clause no 1.01.00 -G of section IV -Part-A. 36.07.00 Welder Training Center -Contractor shall setup a small welding training center 3 -4 welding booths equiped with GTAW & SMAW setup in a pota cabin/suitable enclosed space to train & hone skill of high pressure welders who are giving high rate of welding defect. 36.08.00 SMART STORAGE AREA/YARD MONITORING Bidder to refer clause no 1.01.00 -F of section IV -Part-A. 37.00.00 FIELD OFFICE RECORDS The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies. 38.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE 38.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto. 38.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.			
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38.03.00	After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.			
39.00.00	PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY			
39.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be re-sponsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.			
39.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utili-ties when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.			
40.00.00	PAINTING			
	For painting refer Part-A, sub section-III, Section VI of Technical specification.			
	Painting for structures shall conform to the painting specification specified in Part-B under Civil.			
	Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.			
	Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.			
41.00.00	INSURANCE			
41.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.			
41.02.00	Workmen's Compensation Insurance			
	This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:			
	Workmen's Compensation	-	As per Statutory Provisions	
	Employee's Liability	-	As per Statutory Provisions	
41.03.00	Comprehensive Automobile Insurance			
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41.04.00 41.04.01 41.04.02 41.05.00 42.00.00 43.00.00 44.00.00	This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated: Fatal Injury : Rs.100, 000 each person : Rs.200, 000 each occurrence Property Damage : Rs.100, 000 each occurrence Comprehensive General Liability Insurance The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC). The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract. The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract. UNFAVOURABLE WORKING CONDITIONS The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule. PROTECTION OF MONUMENTS AND REFERENCE POINTS The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc. WORK & SAFETY REGULATIONS			
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44.01.00	General i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable. ii) The Contractor shall follow NTPC Safety Rules as specified in SCC with respect to safety in construction & erection. iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge. iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - III. v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site. vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard. vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite. viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material. ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when			
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	required he can refer / obtain copy of NTPC safety documents as stated above. x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured. The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 Of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c). xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site. 44.01.01 Emergency Action Plan The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies. 44.01.02 Scaffolding The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards. 44.01.03 Opening The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means. 44.01.04 Explosives The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884. 44.02.00 Fencing of Machinery			
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44.03.00	The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery. The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person. Carrying of Excessive Weight by a Worker The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.			
44.04.00	Dangerous and Harmful Gases / Equipment The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.			
44.05.00	Overhead Protection The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.			
44.06.00	Working at Heights All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping. Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work. Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls. Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards. The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts			
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44.07.00	fitted with suitable fall arresting system (fall arrestors) for climbing/getting down through ladders to prevent fall from height. Handling of Hazardous Chemicals The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed. Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule. Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same. The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material. The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids. As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.			
44.08.00	Eye Protection The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.			
44.09.00	Excavation			
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44.10.00	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
	Electrical Hazards The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules. The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks. The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools. The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.			
44.11.00	Vehicular Traffic The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.			
44.12.00	Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc. The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.			
44.13.00	Excessive Noise, Vibration The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000. Generally for brownfield projects background noise is in the range of 58-60 DB, however it shall be responsibility of contractor to collect and measure the latest noise data at site.			
44.14.00	Electrical Installations			
44.14.01	The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances,			
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	whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment. Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall - Satisfy the Engineer I/C that the appliance is in good working condition; - Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances; - Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected. The Engineer I/C will not grant permission to connect until he is satisfied that: The appliance is in good condition and is fitted with suitable plug; having earth connection with the body. Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth. - No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers. - The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. he installations are provided with suitable ELCBs and RCCBs wherever required.			
44.15.00	Safety Organisation			
44.15.01	The contractor shall employ full time safety officer(s) as per requirement stipulated in NTPC Safety Rules, exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub-contractor shall also be considered as the contractor's employees/workmen for the above purpose.			
44.15.02	The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.			
44.16.00	Reporting of Accident and Investigation In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C,			
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44.17.00 44.17.01 44.17.02 44.18.00 44.19.00	NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws. Right to stop Work The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor. The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages. Fire Protection The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment. Penalties I If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of SCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor. II If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has (1) not complied with keeping adequate PPEs in stock or (2) defaulted in providing PPEs to his workmen (3) not followed statutory requirements / NTPC safety rules (4) been issued warning notice/s by NTPC head of the project on non observance of safety norms (5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident. The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evaluation of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.			
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44.20.00	The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availabilitly of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.			
44.21.00	The Contractor shall abide by the following during Construction and Erection activities: I. Chain pulley block shall not be used for loads more than 2 (Two) tonne. II. Hydra shall not be used for material transport. III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m. IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.			
44.22.00	Contractor shall ensure following regarding implementation of Safety:			
a)	Two Tier Safety Monitoring System: Separate Safety Consultancy contract shall be awarded by NTPC for assisting and guiding overall Plant Safety during Construction. The safety consultant shall induct and engage manpower required as per specific requirements of project. For Construction safety , Contractor shall engage certified safety team in consultation with NTPC Safety team /safety Consultant for each package/area.			
b)	Risk level of different area of plant shall be evaluated by NTPC Safety & Safety consultant. Based on the severity of risk level, total project area shall be categorized into different safety zones and each zone will be identified with different color coding.			
c)	Dedicated Project Safety Manager of Safety Consultant will be deployed. Contratcor to deploy area/ system wise safety representative for each system/ area of project e.g. SG area, TG Main Power House area and similarly in other BOP Systems.			
d)	The Safety Officer can stop work of any contractor if safety rules are violated.			
e)	There should also be safety clearance in Quarterly RA bills in addition to the clearances being presently taken from HR and Quality dept.			
f)	PPEs, scaffoldings, safety nets, testing tools etc. should be monitored by NTPC Safety Manager to control and maintain the uniformity of Quality for Safety equipment/ PPEs.			
g)	There should be 24/7 Safety Control room equipped with IP Camera, AI Input alarms and proper communication system for monitoring safety. All CCTV footage shall be available to control room. Drone based safety monitoring			
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	shall be done during day. The safety control room shall be operated & managed by NTPC through safety consultant. h) Safety management plan for the Project must be submitted for approval before start of work. i) In line with the Project Planning, Safety planning will be done jointly by Project Team and Consultants. j) Availability of Fire Tender shall be ensured by contractor before start of construction work. k) Number of Safety Stewarts: Each area (e.g. SG, TG, etc.) should have minimum 5 safety Stewarts from Main Agency and 5 from the sub agency. l) Contractor should provide scaffolding material, pipes, clamps, boards and scaffolding of standard quality. m) Uses of Safety net, Fire blankets and fall arrester shall be adequate. n) Construction Elevators shall be used during erection phase. o) Material transport through Hydra shall be avoided. p) Good Quality and new PPEs and tools and machinery shall be used. q) All Agency /Sub Agency will deploy Safety manpower after getting approval from Head of safety Consultant. r) Contractor Safety officer shall take approval of JSA /HIRA of each area from Safety consultant. Before Start of work in a particular area, concerned Safety consultant clearance is must. s) Inspect the site to ensure it is a hazard-free environment & promotes safe practices at the job site. t) Verifies that injury logs and reports are completed and submitted to NTPC. u) Receives reports from and responds to orders issued by NTPC and Labor inspectors. v) Serve as primary contact for project site incident and injury notification, investigation, and follow-up. w) Organize and maintain necessary project safety documentation. x) Training Setup to be created for giving basic education of Safety to workers. y) Safety Park and work simulation facility to be created at site. z) Health Check Up facility of workers. aa) Vendor Safety circle (with max 25 nos person) and monthly safety award to be created. bb) 24/7 first aid center (common for all agency) and expenditure on contribution basis which is decided by NTPC safety department. 45.00.00 FOREIGN PERSONNEL 45.01.00 The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in			
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	connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him. 45.02.00 Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel. 45.03.00 No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation. 45.04.00 The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose. 45.05.00 The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics. 45.06.00 The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.			
	46.00.00 FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES 46.01.00 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations. 46.02.00 All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer. 46.03.00 The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength. 46.04.00 Grout The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm² at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.			
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46.05.00 46.05.01 46.05.02 46.05.03 46.06.00 46.07.00 47.00.00	The Grout shall have good flowability even at very low water/ grout powder ratio. The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use. The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout. Placing of Grout After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base. The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases. In addition to the above, recommendations of Grout manufacturer shall also be followed. Finishing of the Edges of the Grout The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothed with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout. Checking of Equipment After Grouting After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer. SHAFT ALIGNMENTS All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating			
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	equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting. 48.00.00 DOWELLING All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer. 49.00.00 CHECK OUT OF CONTROL SYSTEMS After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents. 50.00.00 COMMISSIONING SPARES 50.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer. 50.02.00 These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer. 51.00.00 CABLING 51.01.00 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer. 51.02.00 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification. 51.03.00 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.			
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51.04.00	In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.			
51.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.			
51.06.00	The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.			
52.00.00	EQUIPMENT DELIVERY AND ERECTION			
52.01.00	General Requirements (a.) This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification. (b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following: (1.) Instructions for packing, shipping, receiving handling, warehousing and storage. (2.) Instructions for location and installation of equipment furnished by this specification. (3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification. (4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays. (5.) Check lists and quality assurance hold points. (6.) Format for all related documentation. (c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering. (d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE			
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52.02.00	Manual and drawing/documents approved by the Employer during detailed engg. Crating (a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site. (b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted. (c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping. (d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified. (e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior. (f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number. (g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number: a) Export case markings b) Case number c) Gross weight and net weight in Kilograms d) Dimensions in centimeters e) Complete description of material (h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site. (i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces,			
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52.03.00	couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. (j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. (k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired. (l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit. (m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site. (n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense. (o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India. Factory Assembly (a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismantled from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels. (b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing. A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.			
52.04.00	Equipment Installation (a.) General Requirements (1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.			
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	(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval. (3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer. (4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications. (b.) Installation Materials All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor. (c.) Regulatory Requirements All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes. (d.) Cleaning All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown. (e.) Equipment Assembly Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications. (f.) Equipment Setting Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it. Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level. (g.) Free-Standing Equipment Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent			
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	enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified. (h.) Non-free Standing Equipment (1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner. (2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part. (i.) Equipment Location (1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer. (2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated. (3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed. (4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading. (5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion. (6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections. For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred. (j.) Installation of Field Mounted Instruments and Devices The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage. In addition to above relevant Portion as specified elsewhere in technical specification may be referred.			
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	(k.) Piping Connections (1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping. (2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature. (l.) Equipment Checkout (1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage. (2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated. (m.) Defects (1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications. (2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications. (n.) Equipment Protection (1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit. (2.) The equipment shall be protected during storage as described herein. (3.) Equipment shall be protected from weld spatter during construction. (4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance. (5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor. (6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non-drying, oily type, rust preventive compound.			
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53.00.00 54.00.00 55.00.00 55.01.00 56.00.00	WELDING - SPECIAL REQUIREMENTS If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work. DEVIATIONS DISPOSITIONING: Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning. NON-DESTRUCTIVE TESTING (NDT): The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed. Computed RT shall be used as an advanced Engineering Practice. Main contractor to ensure minimum 10% computed radiography of weld joint to be performed in construction phase for scope agreed in FWS for boiler pressure parts. Main contractor to ensure the transfer & storage of these records in Server Sub contracting of NDT & PWHT / SR Agencies- NDT & PWHT / SR contract shall be directly awarded by the main contractor to their approved NDT & PWHT / SR agencies . TESTING EQUIPMENT & FACILITIES: Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.			
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	ANNEXURE-I STANDARD CHECKLIST COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE 1. MECHANICAL (A.) VALVES (1.) MANUALLY OPERATED VALVE (2.) ELECTRICALLY OPERATED VALVE (3.) PNEUMATICALLY ACTUATED VALVE (4.) HYDRAULICALLY ACTUATED VALVE (5.) SAFETY VALVE (6.) ELECTROMATIC RELIEF VALVE (7.) STEAM TRAP (8.) BUTTERFLY VALVE (ELECTRICALLY OPERATED) (9.) BUTTERFLY VALVE (MANUALLY OPERATED) (10.) BUTTERFLY VALVE (FOUR WAY-ELECTRICAL) (11.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC FCNRVS) (12.) THREE WAY CONTROL VALVE (13.) RELIEF VALVE (14.) DIFFERENTIAL PRESSURE REGULATING VALVE (15.) FLOAT OPERATED VALVES (B.) TANKS AND PRESSURE VESSELS (1.) TANKS (METAL) UPTO 20 M2 (2.) TANKS (LARGE STORAGE) (3.) PRESSURE VESSEL (BELOW 17 BARS) (4.) AIR RECEIVER (5.) PRESSURE VESSEL-ACCESS DOOR (6.) TURBINE MAIN OIL TANK (C.) PUMPS (1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN) (2.) PUMP UP TO 350 HP (260 KW) (3.) PUMP SUMP INSTALLATION (4.) GEAR PUMP/SCREW PUMP (D.) PIPE WORK SYSTEM (1.) STEAM SERVICES			
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	(2.) WATER SERVICES (3.) OIL/FIRE RESISTANT FLUID SYSTEM (4.) AIR SERVICES (COMPRESSOR) (5.) HIGH PRESSURE SERVICES (6.) CONSTANT LOAD SUPPORT (7.) SPRING SUPPORTS (8.) HANGERS AND OTHER SUPPORTS (E.) STRAINER AND FILTER (1.) STRAINER/FILTER BASKET TYPE (2.) STRAINER ROTARY (LOW PRESSURE) (3.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS (4.) FILTER & STRAINER Y-TYPE (5.) FILTER & STRAINER (PLATE TYPE) (6.) PURIFIER (7.) FILTER-COMPRESSED AIR LINE (F.) HEAT EXCHANGER (1.) HEAT EXCHANGER (GENERAL) (2.) HEAT EXCHANGER-OIL/WATER (3.) ROTARY AIR HEATER (G.) FANS AND COMPRESSORS (1.) FANS-NON-PRESSURE LUBRICATED (2.) FANS-AXIAL FLOW PRESSURE LUBRICATED (3.) COMPRESSORS-GENERAL (4.) DAMPERS & GATES (H.) CRANES AND ELEVATORS (1.) AUXILIARY OVERHEAD CRANE (2.) TRAVEL SUPPORT STRUCTURE FOR CRANE (3.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE (4.) MAIN AUX. HOIST MOTION (CRANE) (5.) ELECTRIC HOIST (I.) POWER TRANSMISSION (1.) POWER TRANSMISSION GEAR BOX (2.) BEARING (3.) FLUID COUPLINGS			
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	2. ELECTRICAL (1.) SWITCHYARD (2.) POWER TRANSFORMERS, LT INDOOR TRANSFORMERS, OUTDOOR TRANSFORMERS. (3.) BATTERY CHARGERS, DC BATTERIES, DG SETS, STATION LIGHTING, OVERHEAD LINES. (4.) MV BUS DUCTS (5.) D.C. MOTOR (6.) HV SQUIRREL CAGE INDUCTION MOTOR (7.) 415 V SQUIRREL CAGE INDUCTION MOTOR (8.) MOTOR OPERATED ACTUATORS (9.) LT SWITCHGEARS/MCC (I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM (II.) PT CARRIAGE AND CUBICLES (III.) CABLE/BUS DUCT/BUS BARS (IV.) CONTRACTOR MODULE (V.) SWITCH FUSE MODULE (VI.) MASTER PANEL OF LUBE OIL PANEL (VII.) FEEDER PANEL OF LUBE OIL PANEL (VIII.) SPACE HEATER AND CABLE MODULE (IX.) CONTROL TRANSFORMER MODULE (X.) HT CIRCUIT BREAKER (XI.) 415 V CIRCUIT BREAKER (10.) POWER CABLE (11.) CONTROL CABLE (12.) AUXILIARY CABLE (13.) D.C. CABLE (14.) EXPLOSION PROOF ELECTRICAL EQUIPMENT (15.) JUNCTION BOX (16.) CONTROL TRANSFORMER MODULE (17.) BRUSH GEAR ASSEMBLY (18.) AUX. CONTROL AND RELAY PANEL DESK (19.) INDICATING INSTRUMENT			
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	(20.) RECORDING INSTRUMENT (21.) INTEGRATING INSTRUMENT 3. CONTROL & INSTRUMENTATION (A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES (B.) PH ANALYSER INCLUDING TEST PROCEDURE (C.) SILICA ANALYSER (D.) LEVEL SWITCH (FLOAT ACTUATED) (E.) LEVEL SWITCH (ELECTRODE TYPE) (F.) LEVEL SWITCH (DISPLACER ACTUATED) (G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE (H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE) (I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE (J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE (K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE (L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES. (M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES (N.) COLD JUNCTION BOXES (O.) ZENER BARRIER (P.) O₂ ANALYSER (Q.) O₂ IN HYDROGEN INCLUDING TEST PROCEDURES (R.) PRESSURE AND VACUUM GAUGE (S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE (T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE (U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE. (V.) FLOW INDICATOR (VARIABLE AREA) (W.) ORIFICE PLATE (X.) TURBINE FLOW TRANSMITTER (I.) FLOW SWITCH (II.) WEIR			
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	(III.) NOZZLE (IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE (V.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TESTPROCEDURE (VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE (VII.) VENTURI (FLUID) (VIII.) FLOW SWITCH (MAGNETIC TYPE) (IX.) AVERAGING INLET (X.) LIMIT SWITCHES (Y.) TURBINE SUPERVISORY MEASURING SYSTEM (Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES (AA.) TACHOMETER (BB.) VIBRATION MEASUREMENT (CC.) DIGITAL INDICATOR (DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE (EE.) RECORDER INCLUDING TEST PROCEDURE (FF.) FLAME SCANNER (GG.) ELECTRICAL AUTO MANUAL CONTROL STATION (HH.) PUSH BUTTON MODULE (II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO (JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS KK.) THERMO CONTROL VALVE (LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS (MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT Note: The items which are not part of this specification may be considered as not applicable.			
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	ANNEXURE-II BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices. Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self-contained one: 1. Plant Details/Design data 2. Testing Objective/Proposals 3. State of the Plant a) Erection Status with respect to Mech. Elect and C&I b) Availability of the services required c) Safety requirements as per Manufacturer's 4. Test method including completion/acceptance criteria 5. Results 6. Appendix a) Testing Programme b) Mech/Elect/C&I -Plant item completing list c) List of Drawing/documents required for carrying out the testing.			
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	ANNEXURE - III SAFETY PLAN 01. Safety Policy of the Contractor to be enclosed: 02. When was the Safety Policy last reviewed: 03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules: 04. Name, Qualification, experience of Safety Officer 05. Review of Accidents Analysis Method, Methods to ensure Safety and Health: 06. Unit executive responsible to ensure Safety at various levels in work area: 07. List of employees trained in safety employed before execution of the job. Give the details of training: 08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees: 09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed): 10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed: 11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity: 12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up: 13. Provision for treatment of injured persons at work site: 14. Review of overall safety by top Management and Periodicity: 15. System for Implementation of Statutory legislations: 16. Issue of PPEs to employees, Periodicity / stock on hand etc: Signature Head of the Organisation with date & stamp		
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1. 1.1	ANNEXURE-IV Health Safety and Environment (HSE) Policy and HSE Management Manual INTRODUCTION Background NTPC safety policy and various safety requirement has already been indicated in the site regulation and safety section of GCC. This document shall be supplementary to above document and shall be read in conjunction with site regulation and safety section of GCC. In case of any contradiction, the stringent of the two requirements (in the opinion of the employer) shall prevail. NTPC being India's largest power utility and a responsible corporate entity, the statement of policy on health and safety at work sets out the commitment of NTPC to manage health and safety effectively, and what shall be achieved by NTPC, the Contractor and any appointed sub- contractor. NTPC, the Contractor and any appointed sub-contractor is committed to provide and maintain a safe and healthy workplace for all staff, and to provide the information, training and supervision needed to achieve this. All involved parties are committed to protect the fundamental rights of all appointed workers and feel obliged to create a sound worker-management relationship as a key ingredient in a sustainable and successful project execution. All involved parties will have to assume the responsibility for H&S procedures, and need to be made aware of their responsibilities and to comply with NTPC's H&S Policy. The following requirements are mandatory for each worker in maintaining a safe and healthy workplace through: • Being involved in the workplace H&S System; • Sticking to correct procedures and equipment; • Wearing protective clothing and equipment whenever required; • Reporting any pain or discomfort as soon as possible; • Ensuring that all accidents and incidents are reported; • Helping new workers, trainees and visitors to the workplace understand the right safety procedures and why they exist; • Telling the responsible managers immediately of any H&S concerns; • Keeping the work place tidy to minimise the risk of any accidents. The aim of all the stake holders is to achieve the following goals: • Zero fatalities of workers, visitors or the public; • Zero accidents and incidents of workers, visitors or the public; • Zero harmful, hazardous or dangerous situations or occurrences; • Zero environmental concerns or impacts; • Continuous improvement of the health & safety performance at site under practical conditions.			
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1.2	Definition of Occupational Health & Safety Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995 and is defined as follows: Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job. "The main focus in occupational health is on three different objectives: • the maintenance and promotion of workers' health and working capacity; • the improvement of working environment and work to become conducive to safety and health and • the development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking." Workers safety has to be understood as the practice of an employer using preventative measures to prevent hazards to the employees' personal safety. This practice includes creating plans and procedures for employees and managers in the workplace. In addition, workplace safety involves creating policies and keeping emergency materials available for employee and manager use while at a work site.			
1.3	Purpose of the H&S Management Manual The present H&E Management Manual shall delineate the Health and safety Requirements, incl. policies and guidelines, and outline the roles and responsibilities of the different parties involved in the implementation and oversight of Health, Safety and Environment Measures to ensure community, worker and public health and safety during construction. The H&S Management Manual considers the applicable national occupational health, safety and welfare legislation as well as guidelines and standards established by the relevant Ministries and Authorities. The H&S Management Manual other than Site Regulation and Safety provisions provided in Bidding Documents takes the following applicable IFC Performance Standards (PS) into account: • PS 2: Labour and Working Conditions, dated January 1, 2012 • PS 3: Resource Efficiency and Pollution Prevention, dated January 1, 2012 • PS 4: Community, Health, Safety and Security, dated January 1, 2012. The H&S Management Manual includes the Occupational Health & Safety Requirements and arrangements that are mandatory for the Contractor for consideration and implementation.			
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1.4	In case the provisions in Site Regulation and Safety provisions provided in Bidding Documents are superior than the provisions indicated in this manual, the provisions provided in Site Regulation and Safety provisions provided in Bidding Documents shall prevail. The defined H&S Standards are part of the contractual obligations, and no changes are possible without a prior written approval by NTPC. Content of the H&S Management Manual The H&S Management Manual contains an outline of the required H&S Organization at site and to be implemented by the Contractor. It describes the overall H&S Management required for the organization of a safe and healthy working environment for the workers and to ensure that the public will not be affected by the construction activities. In addition to the organizational arrangements roles and responsibilities of the required H&S Staff of the Contractor are defined. Attention is paid to the need for training to be implemented by the Contractor. It starts with the evaluation of training needs and defines the requirement of developing a training schedule as well as workers and visitor induction. Communication procedures are addressed and needed H&S Reporting is specified for the entire construction period. As one of the most important subjects, the entire risk management process is comprehensively described, specifying the risk management process, the hierarchy of control and the safe system of work. Reporting and monitoring procedures are developed for the fulfillment by the Contractor and the standards for PPE are included. The H&S Management Manual shall highlight the entire H&S Management System and also provide information on the H&S Standards to be followed by the Contractor. 2. HEALTH & SAFETY MANAGEMENT SYSTEM An H&S Management System is implemented for the Project. The management system comprises of different components to be developed by the Contractor. That the Contractor must implement human resource policies and procedures that set out the approach to manage workers consistent with the requirements of IFC PS 2 as well as the applicable national laws and standards. 2.1 Health & Safety Management Manual Contractor will implement this H&S Management Manual in order to delineate the Project's H&S Requirements, Policies and Guidelines as well as to outline the roles and responsibilities of the different parties involved in the implementation and oversight of measures to ensure community, worker and public health and safety during construction. 2.2 Contractor's H&S Plans All Contractors shall establish an effective project specific H&S Plan. The H&S Plan will be subject of NTPC's written approval. The H&S Plan shall be submitted by the Contractor not later than 4 weeks prior to any commencement of works at site. Any work at site, incl. mobilization to the site will not be allowed to commence until NTPC deems the Contractor's H&S plan to be suitable and sufficient. The H&S Plan shall describe how health and safety will be managed at site, incl. mobilization and transport to the site, and how the specified H&S Standards will be applied in practice. In			
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	addition the Contractor shall ensure adequate communication of these requirements throughout the supply chain, its supervision, and the workers themselves. The H&S Plan shall specify the management arrangements for carrying out the work including but not limited to: • Overview of the project; • Clearly identified risks associated with the scope of works; • Program and milestones; • Site management and organization; • Key contractors and sub-contractors; • Communication, Cooperation and Co-ordination; • Site security; • Traffic management; • Welfare facilities and provision; • Arrangements for supervision of contractors on site; • Arrangements for information, instruction and training including induction; • Management of hazards on site; • Arrangements for identification of hazards, assessment of risk and production of Method Statements; • Arrangements for hazardous undertakings e.g. confined space, work at height, hot work, excavations, cofferdams etc.; • Permit to work system; • Site rules; • Arrangements for managing plant and equipment; • Management of lifting operations; • Management of temporary works; • Arrangements for monitoring and auditing etc.; • Requirements as defined by relevant statutory planning authorities e.g. traffic, noise, working hours etc.; • Incident & accident investigation. The H&S Plan shall also consider the site rules outlining the H&S Requirements for all workers. The site rules shall include but should not be limited to: • Site access; • Access to and transport on the site; • Entering and leaving the site; • Use of mobile phones; • Smoking; • PPE requirements; • General behaviour; • Transport to the site; • Vehicle traffic within the site area; • Access to the site and Working Areas; • Restricted areas. The H&S Plan shall consider related plans and the corresponding direct and indirect H&S Requirements. This refers especially to the following related plans and assessments:			
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2.3	- Hazardous materials and waste management plan; A checklist for the review and approval of project specific H&S Plans shall be developed prior to the construction contract. The checklist shall define the minimum requirements to be met by the Contractor. Contractor's H&S Procedures The Contractor is requested to develop workplace specific H&S Procedures. In this matter, it should be noted that procedures are similar to method statements probably better known by Contractors. The required content of H&S Procedures is described below. H&S Procedures are part of the Project framework for effective H&S Management. The H&S Policy states the intention to provide a safe and healthy workplace, and states the H&S goals of a workplace. Specific health & safety workplace procedures shall address particular issues or hazards and the measures how to control those identified hazards. The procedures should be used together with other hazard control measures to eliminate or reduce the risks of accidents and incidents and illness and/or injuries at the working place. H&S Procedures shall be developed for the following activities expected to apply during construction: - Site access control and site security procedure; - Health & safety protection at transmission line worksites; - Isolation and lock-out; - Use of hazardous chemicals; - Simultaneous activities; - Live line work; - Shift work, shift rotation and fatigue; - X-ray and NDT; - Risk assessment; - Job Safety Analysis; - Working at height; - Working in confined spaces; - Use of personal protective equipment; - Excavation works; - Hot works; - Welding; - Emergency response procedure; - Evacuation procedure (if applicable); - First aid; - Working in water (if applicable); - Use of electrical equipment; - Work on high voltage. This checklist shall define the minimum requirements to be met by the Contractor.			
2.4	Contractor's Safe Work Instructions			
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2.5	Safe work instructions shall be developed by the Contractor identifying the health and safety issues that may arise from use of the machinery and equipment. The safe work instruction must be based on the H&S Plan. A safe work instruction should identify: • the hazard associated with the use of a specific tool or equipment; • the required control measures to be checked to ensure a safe use of a specific tool or piece of equipment; • the specific training and/or qualification required; • the personal protective equipment to be worn. Safe work instructions do not replace the requirement for a risk assessment, preparation of a workplace procedure, the need of a permit to work or the need for training. A risk assessment of the equipment must be performed before developing safe work instruction procedures to identify the hazards and risk controls. A checklist for the review and approval of project specific Safety Work Instructions will be developed by the PIC prior to the first construction contract. The checklist will define the minimum requirements to be met by the Contractor. Contractor's H&S Forms The Contractor must develop forms like checklists for risk assessment etc. to support the support the use of workplace procedures, instructions, audits etc. These forms must be attached to the respective documents, and must be read in closed conjunction with the corresponding document(s). The checklists shall be subject of an update and revision in case improvements or needed changes were found suitable and required. The checklists must be subject of project documentation, in the same way and considering the same procedure that is applicable for the project documentation in general. H&S Forms have to comprise the following subjects as a minimum: • Contractor Audit Questionnaire • Basic Risk Assessment • Permit to Work • Workplace Inspection Checklist • Accident/Incident Report/Investigation • Fire Risk Assessment • Hazardous Substance Risk Assessment • Ladder Inspection Checklist. The forms to be used by the Contractor must include all pertinent information. Additional forms like inspection checklists, workplace inspection checklists might be necessary and should be prepared by the Contractor and are subject of approval by NTPC.			
2.6	Contractor's Grievance Management System			
2.6.1	Workers Grievance Management System			
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2.6.2	The Contractor must implement a grievance management system to enable the workers to raise complaints and to inform about non-compliances with the implemented H&S Management System. The grievance management system should provide the possibility to issues complaints in case of discrimination and/or the non-consideration of equal opportunities. The grievance management system shall consider the possibility to contact directly a member of the H&S Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to the site manager and the H&S Manager. The H&S Management is requested to solve a complaint or non-compliance within 3 working days. In case the problem could not be solved an action procedure specifying the needed activities together with a final deadline until the problem is expected to be solved must be prepared and submitted to NTPC. The Contractor is requested to provide the possibility for the workers to notify a complaint or non-compliance in a confidential way.			
	Public Grievance Management System The grievance management system shall also be open for public complaints. A respective procedure must be developed by the Contractor for review and approval. The grievance management system for the public must consider a reporting procedure to the local authority to demonstrate to the administrative body that the complaint was identified, noted, managed and solved. The responsible authorities at the community level must be identified by the Contractor 4 weeks prior to the start of the construction activities or 4 weeks prior to the mobilization to the site. The reporting procedure should be discussed and agreed upon together with the administrative body and specific attention should be paid to any specific requirements to be announced by the authority. The contact with the authority should be established by having a face-to-face meeting. This meeting should be attended by an H&S Representative of the Contractor.			
	2.7	H&S Committee It shall be governed by site regulation and safety requirement as stipulated in GCC		
	3.	ROLES, RESPONSIBILITIES AND ACCOUNTABILITY It shall be governed by site regulation and safety requirement as stipulated in GCC		
	3.2.1	Child Labour The Contractor shall not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. The Contractor must identify the presence of all persons under the age of 18 in his workforce. A respective record of all identified workers must be submitted to the H&S Coordinator for documentation purposes. The list must be subject to a continuous update. An updated list must be submitted to the H&S Coordinator of NTPC on a bi-weekly basis. It is prohibited to employ children under the age of 18 for hazardous work or works assessed to be of a medium or higher risk resulting from a particular risk assessment.		
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3.2.2	Independent from the fact that the minimum age for an employment of child labour is 14 years, all work of persons under the age of 18 must be subject to an appropriate risk assessment and regular monitoring of health, working conditions and hours of work. Pregnant Woman Pregnant employees have the following four major prerogatives: • paid time off for antenatal care • maternity leave • maternity pay • protection against unfair treatment, discrimination or dismissal. In addition, the contractor must not change a pregnant employee's contract terms and conditions without agreement. If this will be done by a employer, it has to be handled as a breach of contract. It's illegal for contractor to refuse to give pregnant employees time off for antenatal care or refuse to pay their normal rate for this time off. The following rights shall be considered: • Pregnancy-related illnesses If the employee is off work for a pregnancy-related illness in the 4 weeks before the expected date of birth of the child, maternity leave and statutory maternity pay by the employer has to start automatically. • Compulsory maternity leave In case the employee does not take statutory maternity leave, they must take 4 weeks off after the child is born. • Telling the contractor about the pregnancy Employees are obliged to inform their contractor about the pregnancy at least 15 weeks before the beginning of the week of the expected date of birth or, in case of unawareness of the pregnancy during this timeframe, the contractor must be told as soon as possible. Employees must also tell the contractor when they want to start their statutory maternity leave and pay. • Health and safety for pregnant employees After the receipt of information about the pregnancy of an employee, the employer should assess the risks to the woman and her baby. Risks could be caused by: • heavy lifting or carrying • standing or sitting for long periods without adequate breaks • exposure to toxic substances • long working hours • vibration and mechanical shocks • extreme heat • noise • ionising radiation • non-ionising (electromagnetic) radiation • carbon monoxide • lead			
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	• polychlorinated Byphenyls • organic solvents • pesticides and herbicides • tobacco smoke. The MSDS to be provided together with each chemical substance to be in use or to be delivered at the construction site, storage area etc. should highlight the category. Where there are risks, the contractor should take reasonable steps to remove the risks or by offering the employee different work or work places or by changing the working hours by the adaption of sufficient breaks. In case the contractor can't remove any risks, the contractor must suspend the employee on full pay and without any reduction. Pregnant contractor who think they're at risk but their employer disagrees should report to NTPC's H&S Manager during a site audit. The contractor is obliged to inform every pregnant employee about their rights in writing and this information must be recorded. 4. TRAINING It shall be governed by site regulation and safety requirement as stipulated in GCC 5. HEALTH & SAFETY REPORTING 5.1 Contractors Reporting Obligations Independent from the general requirement and contractual obligations to implement a reporting scheme with respect to the progress, construction schedule and project reporting in general, the Contractor will be obliged to implement an H&S Reporting. The H&S Reporting should provide an overview of the H&S Performance within a particular timeframe and with specific topics as mentioned below: The H&S Reports should be submitted to NTPC Project Manager 5.1.1 Health & Safety Performance 5.1.1.1 Weekly Reports The Contractor shall prepare weekly H&S reports. The weekly reports shall be submitted by close of business on the first working day after a completed working week, e.g. the reporting timeframe is from Monday to Saturday and the respective following working day is the upcoming Tuesday, if not a public holiday. The weekly reports shall comprise of the following information with respect to the reporting timeframe: • Originator • Name of the project • Activities performed • Health occurrences • Safety occurrences • Resulting accidents, incidents or dangerous situations • Undertaken measures.			
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5.1.1.2	Monthly Reports The Contractor shall prepare monthly H&S reports. The monthly reports shall be submitted by close of business of the last working day of the first working week after the reporting timeframe, e.g. the reporting timeframe is from 1st of January until 31 of January and the due day of the submission of the report is the Friday of the first working week in February, if not a public holiday. The weekly reports shall comprise of the following information with respect to the reporting timeframe: • Originator • Name of the project • Activities performed • Health occurrences • Safety occurrences • Resulting accidents, incidents or dangerous situations • Investigation results • Undertaken measures • Lessons learned • Informed authorities and resulting obligations/conditions • Results of workplace inspections.			
5.1.2	Hazards Reporting The H&S Staff of the contractor is requested to undertake workplace inspections. In case that hazards and risks are identified during workplace inspections, it is needed that the identified hazard or risk has to be solved immediately and without delay during the inspection. In case that the problem could not be solved, a written report has to be prepared and issued to the H&S Manager or site manager highlighting: • a description of the problem; • the reason why it could not be solved during the inspection; • the needed action; • the responsible person; • the associated hazards and risks; • the deadline until the problem must be solved. The occurrence must be reported in the monthly H&S Report. Any other reporting requirements with respect to H&S, e.g. audit reports, weekly and monthly H&S Reports, remain unchanged.			
6.	HEALTH & SAFETY RISK MANAGEMENT The risk management process with specifically requested forms requires a careful document administration and control. The Contractor should be aware that the documents resulting from the risk management process, in particular, the risk assessments, permits to work and			
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6.1 6.2 6.3 6.3.1	job safety analysis, must be available during construction site audits and/or exemplary as part of a monthly report. Risk Management Process Risk management is the identification, assessment and prioritization of risks to avoid impacts on workers and the public. The Contractor has to implement a suitable and appropriate risk management process to enable his site staff to prevent any non-compliances resulting in critical, harmful or dangerous situations followed by incidents, accidents or fatalities. Alternatively suggested risk management processes shall be provided in the H&S Plan. Hierarchy of Control The first part of evaluating the risk stage, consideration must be given how likely each hazard could cause harm. When the potential for harm has been decided, the existing control measures should be identified. In this course, each step of the activity has to determine what control measures might already in place. When evaluating a risk it is imperative to check the applicable legislation and to ensure that everything required by law is in place or has to be done. When considering current controls and further required control measures, the general principles of control should be applied: Eliminate - It has to be checked if the risk associated with the hazard could be eliminated. Reduce - It has to be assessed if the possible amount of the hazard or the exposure to the hazard could be reduced. Isolate - It must be evaluated if the hazard could be isolated. Isolating is the principle of preventing the contact with the hazard. Control - It must be assessed if a safe system of work, permit to work and/or procedures are in place to control the hazard to prevent that some body becomes injured. Personal Protective Equipment - As a final result of running through the hierarchy of control, the supply of personal protective equipment is the final result of controlling the hazard. The provision of PPE must not be the first and final stage of risk mitigation. Safe System of Work Risk Register			
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The Contractor is requested to develop and prepare a risk register. A risk register is a document that summarizes and defines the possible risks resulting from a particular activity, in the present case from particular construction or construction related activities. The concept of a risk register recognises that risk elements arising from proposed or actual activities fall into one of following three categories:

- Risks which are deemed to have a low risk and do not need to be managed;
- Risks that have a medium or high risk and will need to be managed;
- Risks which have an extreme risk and therefore the activity should probably not proceed.

The risk register records details all the risks identified for the construction phase and associates them in terms of likelihood of occurring and seriousness of impact.

The risk register to be prepared should identify:

- a description of each risk and its potential consequences;
- factors that may impact upon the likelihood and severity of the risk;
- an assessed risk ranking, such as
 - low,
 - medium
 - high or
 - very high;
- whether the risk ranking is acceptable or not;
- actions and controls that currently exist to mitigate risks

The definition of the risks from low to very high is explained in the following risk ranking table:

Likelihood					
	Severity				

Table 6-1: Risk ranking table

It is recommended to develop the risk register at the beginning stage before start of a construction site by following the following steps:

- Identification of potential risks;
- Identification of the consequences;
- Identification of the likelihood and severity that the risk would result in adverse consequences;

Where risks have been ranked as medium, high or very high, mitigation measures must be addressed:

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6.3.2	• Medium (Risk ranking 3 to 4): Mitigation actions to reduce the likelihood and severity should be identified and appropriate actions must be endorsed. • High (Risk ranking 6 to 9): If uncontrolled, a risk event at this level may have a significant impact for the actions and tasks at a construction site as a whole. Mitigating actions need to be very reliable and should be approved and monitored by the Contractor. Even with mitigating actions in place, the construction site staff potentially exposed to that risk should be advised of identified or potential risks which have been graded at this level. • Very High (Risk ranking 12 to 16): Activities and projects with unmitigated risks at this level should be avoided or terminated. Mitigation actions of these types of risks may outweigh the benefits of the execution method. This is because risk events graded at this level have the potential to have significant adverse effects with the potential to cause serious accidents and incidents resulting in fatalities. It needs to be identified if any risk mitigation procedures are in place. If it is found that there are none, procedures must be developed considering the following: • Planned actions: Reduction the likelihood a negative risk will occur and/or reduce the seriousness should it occur (What should you do now?) • Contingency actions: Planned actions to reduce the immediate seriousness of a negative risk when it does occur. (What should you do when?) • Recovery actions: Planned actions taken once a negative risk has occurred to allow you to move on. (What should you do after?) • Risk Transfer: e.g. through assignment of contractual responsibilities or insurance. • Actions: Necessary to ensure the realisation of opportunities (positive risks). A risk register for every single construction site must be developed by the responsible Contractor considering as well the tasks and activities to be undertaken and executed by sub-contractors. The risk register has to be prepared by a competent and experienced group of engineers and workers approx. 4 weeks before mobilization to the site and start of any works at site even if they are deemed to be of general nature and without having a risk potential. The risk register has to consider as well every transportation activity to the construction site. The risk register will be subject of review and approval by NTPC. Risk Assessment The Contractor is requested to undertake a risk assessment for all activities assessed to be of a medium, high or very high risk. The risk assessment has to be carried out with the participation of the staff experienced with the tasks and activities and the equipment:			
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6.3.3	- the responsible H&S Manager or a H&S Supervisor - the foreman for the execution of the activity - the worker(s) asked to undertake the activity. The risk assessment has to be performed prior to the execution of the activity and it must be done in written. The written risk assessment must be documented and stored in the project file. The risk assessment has to be undertaken in a simple and comprehensive way, understandable by each participant. A specific risk assessment must be undertaken for tasks where children between the age of 14 and 18 will get appointed. This specific part of the risk assessment must be done independent from fact if the work will have the potential of a very high, high, medium or less than medium risk. Permit to Work It shall be governed by site regulation and safety requirement as stipulated in GCC Stage 1- Highlight Potential Hazards: Worker(s) and the foreman guided by the H&S Advisor highlight potential hazards of a task and identify all necessary safety measures. The hazard identification must consider all required electrical and mechanical equipment. Stage 1 has to be carried out in writing. Work is not permitted to commence until Stage 4. Stage 2-Application of Permit: The Foreman applies for permission to start work on a prescribed form and submit the application to the H&S Advisor only when all requirements and conditions described in the permit to work have been fulfilled. The Foreman has to indicate in the written permit to work that risk assessment was conducted. The risk assessment must be attached to the permit to work. Stage 3-Evaluation of Permit: The H&S Advisor will evaluate and verify that all safety conditions specified in the permit to work have been fulfilled and are adequate described. He may also recommend additional measures in the permit to work when necessary. He will need to inspect the location of work where the permit to work has been applied for, with the Foreman during this process. Only when all safety requirements and conditions stated in the permit to work are fulfilled, the H&S Advisor will then endorse the permit to work form and forward to the Health & Safety Manager. Stage 4-Approval of Permit: The H&S Manager may approve and issue the permit to work only when he is satisfied that: - Proper evaluation of risk and hazards for the work concerned has been conducted; - No incompatible work will be carried out in the same time and location of the permit to work, which may pose a risk to the persons at work;			
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6.3.4	• All reasonably practicable safety measures have been taken and all persons involved in the work have been informed of the work hazards under the PTW; • All electrical and mechanical equipment is demonstrable checked and in safe conditions. A work permit is valid for one working day and for the specified working time. In case the tasks could not be finalised within the validity of the permit to work, the permit to work must be renewed before commencement of work on the day the work may continue. The permit to work form must include at least the following information: • Originator • Date • Description of task activity • Duration of the task • Needed equipment • Security certificates of equipment • Risk Assessment • Already implemented mitigation measures • Further mitigation measures • Needed training or induction • Approved by • Date and time of approval.			
	Job Safety Analysis (JSA) The Contractor has to undertake a JSA which is a procedure to integrate safety and health principles and practices into a particular job operation. In a JSA, each basic step of the job related hazards has to be identified and recommendations have to be provided to choose the safest way to do the job. For conducting a JSA four main steps have to be considered: • selecting the job to be analyzed • breaking the job down into a sequence of steps • identifying potential hazards • determining preventive measures to overcome these hazards. The Contractor must provide a specific methodology for conducting a JSA .			
	7. EMERGENCY RESPONSE			
	7.1 Emergency Response Procedures An emergency is a serious, unexpected, often dangerous situation that requires immediate action. The emergency procedure is the strategy of actions to be outlined in the emergency response plan to response to an emergency event. This could include, but not limited to rescue: • from working at height; • in confined spaces, shafts and tunnels; • from fire & smoke, etc.			
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7.2	Emergency Response Plan (ERP) The Contractor has to develop an ERP for review and approval by NTPC. The ERP has to consider at least the following information and instruction for an adequate management of emergency situations: • Result of a risk assessment to determine the most probably emergency situation; • Identification of suitable emergency response procedures, such as: • Determination of safe evacuation areas; • Determination of safe evacuation routes; • Determination of accurate and suitable fire fighting equipment; • Determination of fire brigade; • Training and induction of emergency response procedure. Note: Specific attention should be paid to the investigation of the nearest hospital or first aid station. The contact numbers of the hospital or first aid station together with at least one contact of a medically examined staff team member of the hospital or first aid station must be included in the ERP in case of injuries at night-time hours or during weekends or during bank holidays.			
7.3	First Aid at Site It shall be governed by site regulation and safety requirement as stipulated in GCC			
7.4	Fire Protection and Control The Contractor shall undertake a suitable and adequate fire risk assessment for whatever is applicable under the scope of work of the respective construction contract. The Contractor shall ensure that the necessary fire prevention, protection and control measures are installed and maintained. This shall commence during mobilisation and updated accordingly. The Contractor shall nominate certain of his employees who shall be trained in fire fighting duties. Nominated fire fighting personnel shall be available at all times during ongoing works on site.			
7.4.1	Fire Prevention, Protection & Control The following requirements apply with respect to fire prevention, protection & control and must be considered wherever applicable: • Adequate and suitable means for extinguishing fire shall be provided and maintained. • All stocks of inflammable substances shall be kept in a fire resisting store or in a safe place outside any occupied building. • Provided that no such store shall be so situated as to endanger the means of escape from the workplace or from any part thereof in the event of a fire occurring in the store. • Chemical fire-extinguishers shall be freshly charged at intervals not greater than those specified by the manufacturers, or otherwise once annually, and tested by the application of such hydraulic pressure thereto as shall be suited to the type of extinguisher tested, at intervals of not more than four years; and the dates of recharging the extinguisher and the last hydraulic test shall be clearly marked on the body of the extinguisher or on a tab securely attached thereto.			
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	• Install a temporary or permanent water supply with sufficient flowvolume and duration to supply the standpipes, hose stations, and sprinkler systems, before the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, connect the standpipe to the water supply, install the standpipe concurrently with construction of the structure, and maintain the standpipe in operable condition for fire protection use. Provide the standpipes with fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location atstreet or road level. • No fire, flame, open light or other agent likely to ignite volatile and inflammable substances shall be allowed or used in any part of a workplace in which volatile and inflammable substances are used. • No person shall smoke in any part of a workplace where volatile and inflammable substances are used, and a notice prohibiting smoking shall be posted in a conspicuous place in every such part of the workplace. • Inform workers of the fire hazards of the materials and processes to which they are exposed. Brief new workers on the parts of the plan that isessential for their protection and emergency evacuations. • Provide additional training for personnel assigned tasks that require themto remain in a facility during a fire emergency. • When working in potentially explosive atmospheres, safe non-electric tools and apparatus suitable for the use in such areas shall be employed. • No plant, tank or vessel which contains or has contained any explosive orinflammable substance shall be subjected to any welding, brazing or soldering operation, or to any cutting operation which involves the application of heat, until all practicable steps have been taken to remove the explosive or inflammable substance and any fumes arising there from, or to render them non-explosive or non-inflammable; and if any plant, tank or vessel has been subjected to any such operation as aforesaid, no explosive or inflammable substance shall be allowed to enter the plant, tank or vessel until the metal has cooled sufficiently to prevent any risk of igniting the substance. 7.4.2 Means of Fire Escape Every workplace shall have adequate means of escape in case of fire.and must be properly maintained and kept free from obstruction. 7.4.3 Fire Alerts The Contractor has to set up a system to alert workers on site and the public in the neighbourhood. This should be a permanent installed fire alarm (which must be tested on a weekly basis), a klaxon, an air horn or a whistle,depending on the size and complexity of the site. Any warning needs to be distinctive, audible above other noise andrecognizable by everyone in case of fire. 8. HEALTH, SAFETY MANAGEMENT & MEASUREMENT 8.1 Noise Management The Contractor is requested to develop a working noise monitoring plan to identify those areas at site where noise levels are occurring in a harmful range.			
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Generally, a reasonable mitigation measure, of more importance than wearing hearing protection devices, is the reduction of noise levels to a level as low as reasonable possible. Avoidance has always the priority in comparison to passive reduction.

Noise levels must be kept below 80 dB (A) wherever possible. In case of exceeding this value, hearing protections must be provided to the workers and warning signs must be installed.

The noise monitoring must be repeated every week in case that the location of the construction site remains unchanged. In case of a change of the site, the noise monitoring has to be undertaken after implementation of site arrangements.

In case that a construction site could not be demarked in detail, the noise monitoring has to be done for different activities.

The following table provides the standards, exposure times and need for personal protective equipment.

dB(A)	Exposure time ¹⁾		Need for PPE	Comment
	hours	minutes		
80	25	24	No	Suitable hearing protection must be provided. The hearing protection must be able to insulate the noise level to a value of 89 dB(A) or below.
85	8	0	No	
86	6	21	Yes	
87	5	2	Yes	
88	4	0	Yes	
89	3	10	Yes	
90	2	31	Yes	
95	0	47	Yes	
100	0	15	Yes	
105	0	4	Yes	
110	0	1	Yes	

Table 8-1: Noise standards, exposure times and need for PPE

¹⁾ Applicable to a 8h-working-shift

Source: US Department of Health and Human Services, Occupational Noise Exposure, page 18, dated June 1998

8.2

Air Quality Management

The air quality at site could be affected by different emissions resulting from combustion engines or resulting from the generation of dust during dry weather conditions.

Emissions from combustion engines are difficult to reduce. Some efforts not to affect the air quality are the switch-off of machines whenever possible and to limit the number of machines and equipment to a level as low as reasonable possible. The Contractor is requested to consider these recommendations during the construction phase.

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8.3	Considering this requirement, the Contractor must undertake all necessary actions to reduce the generation of dust to the lowest possible levels. Project specific measures shall be included in the H&S Plan. Mitigation measures to prevent increased dust generation include using dust-suppressing water spray in areas of active earthmoving and on unpaved roads, using aggregate-covered access roads to minimize dust emissions and minimizing the areas of exposed soil or cleared of vegetation. Truck beds should be covered with a tarp or similar material to minimize dust during the transport. Mitigation measures during project activities to prevent increased air emissions would include using requiring emission control devices on equipment, maintaining properly tuned engines, avoiding unnecessary idling, using electric motors instead of internal combustion engines, using low-sulfur diesel fuel where available, preparing asphalt away from populated areas. Pre-employment Health Assessment Pre-employment health checks for construction site workers shall be mandatory. These checks shall ensure that in no case the state of health of employed workers can be impaired by possible pre-existing diseases. The Contractor shall deploy a suitable experienced medic and appropriate materials and premises for these checks. Workers shall be checked, and all the results shall be analysed, before his first workday, in order to mitigate any risk. Therefore, the Contractor shall provide the abovementioned medical staff and material during the entire year. Usage of hospital capacities is an often used option to fulfil these requirements, where those capacities are available. Only personnel with appropriate health condition with respect to their particular job shall be employed. All workers who are subject to an exposure to occupational health risks shall undergo periodic medical surveillance. This would be required for workers: • exposed to noise levels exceeding 85dB(A); • exposed to hazardous materials, e.g. chemicals; • carrying heavy loads. It is recommended to offer such periodic examinations every 3 months. In addition to the pre-employment health checks and periodic medical surveillance, the Contractor shall enable the site workers to pass an exit medical check after finishing their jobs on site. The exit medical check shall be provided to all workers who worked more than 3 months constantly on the construction site. All pre-employment, periodic or exit health checks must be documented for each worker. The assessment records must be kept confidential and for the use by the project management only. The workers will have the right to ask for the results of the health checks.		
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	The workers will have the right to decline any pre-employment, periodic or exit medical checks. In this case they will not have the possibility to apply for any compensation in case of health interferences resulting from their work activities in connection to existing diseases. All pre-employment, periodic or exit health checks must be provided to the workers free of charge. The application for a health check must not result in a negative treatment of the respective worker. The Contractor must ensure that any health checks requiring specific facilities, equipment or medical staff will be available at the construction site or in a reachable distance to travel. 8.4 Covid-19 Prevention Contractor shall take all necessary measures related to Covid-19 prevention as per guidelines issued by Government authorities as well as NTPC guidelines (if any). 8.5 Health Surveillance 8.5.1 Management of Alcohol and Drugs Smoking shall be prohibited at all times at the construction site, at worker's camp and at storage and fabrication areas. This includes the operating or use of all electrical or manual work equipment. Smoking shall be restricted to clearly defined and highly visible areas, only. The presence and consumption of non prescription drugs and alcohol is strictly prohibited at all areas. Drug and, especially, alcohol testing shall be arranged after weekends and especially for workers appointed for works consisting of potentially high-risk activities. The drug and alcohol test shall be undertaken in case of indications of a respective consumption. Until the result of the test is public, the worker(s) must refrain from any work at site. In case of a positive test result, the worker has to be expelled from the site without any undue delay until the completion of the project. 9. PERSONAL PROTECTIVE EQUIPMENT It shall be governed by site regulation and safety requirement as stipulated in GCC 10. INCIDENT & ACCIDENT MANAGEMENT It shall be governed by site regulation and safety requirement as stipulated in GCC 11. HEALTH & SAFETY REVIEWS 11.1 MCA H&S Audits and Reviews			
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11.2	Prior to commencement of the main construction phase, NTPC will conduct a pre-construction phase H&S Review to ensure that all the necessary arrangements are in place and suitable for the work being undertaken at that time. This will include compliance with this H&S Standards document, the project H&S Plan and country specific legislation. NTPC will conduct site specific H&S Reviews on a regular basis and formal H&S Audits of the Contractor and its supply chain. Formal H&S Audits will be conducted at least, every 6 months. The duration of this audit will be a minimum of 1 day and will require the full co-operation of the Contractors project management team. In addition to H&S Reviews to be undertaken by NTPC, it is possible that further H&S Audits and Reviews will be carried out by relevant stakeholders i.e. Ministry of Labour or Ministry of Health etc. The Contractor is obliged to provide any necessary support to the stakeholders to enable them to undertake their tasks and duties and to allow the access to the sites for undertaking the audits and reviews. NTPC will spend specific focus on construction sites and their conditions where children between the age of 14 and 18 are employed.			
	Contractors Health & Safety Review Programme The Contractor shall implement an H&S Review Programme applicable for his construction site(s) that shall include a systematic evaluation of the implemented management system, compliance with this H&S Standards document, and the project H&S Plan and local legislative requirements.			
	11.2.1 Contractors H&S Audits H&S Construction Site Audits must be undertaken on a monthly basis. The audits should be performed by the Site Manager, the H&S Manager and the H&S Advisor. The audits should comprise the construction site itself, material and equipment storage areas, workshop areas and accommodation areas (Worker's camp area). These audits shall be recorded and the results should be slipped into the monthly H&S Reports. A copy of the audit report must be attached to the monthly report.			
	11.2.2 Contractors H&S Inspections H & S Inspections must be carried out on specific work areas and work places associated with the project on a weekly basis but independent thereof if they are assessed as medium or high risk areas or workplaces according to the risk register. The results of the inspections must be considered in the weekly H&S reports to be submitted to NTPC. A copy of the H&S Inspection report must be attached to the weekly report. The H&S Inspections shall be executed by the H&S Manager together with the H&S Advisor.			
	11.2.3 Contractors Health & Safety Surveys H & S Surveys shall be conducted by the Contractors' H&S Advisor on a daily basis. The date and time of the surveys must be documented but the results must not be recorded in a written report but significant findings must be communicated to the H&S Manager.			
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11.2.4 11.3 11.4 11.5 12. 13.	Contractors Management Surveys Management surveys to be undertaken by the Contractors General Manager or his representatives shall be conducted at least every 3 months. The surveys must not be done by the responsible Site Manager, H&S Manager or H&S Advisor of the particular construction site. The results shall be recorded. Reporting The results of H&S Audits and H&S Inspections must be recorded and the reports must be submitted to NTPC within 3 working days after finalisation of the audit or inspection respectively. Forms to be used for the audits and audit reports respectively, inspections and surveys will be provided by NTPC. The reports must include all relevant subjects according to the purpose of the H&S Reviews, but at least the results and the needed corrective actions. An reporting schedule for each particular construction site must be developed by the Contractor and should be submitted to NTPC for review and approval. Corrective Actions The H&S Review reports must include the need for corrective actions. The list corrective actions must include the following information: • Identified risks and non-compliances; • Needed corrective actions; • Needed personal and material resources; • Responsible person; • Date for latest finalisation. The effectiveness of the corrective actions will be subject of NTPC's H&S Audits. Compliance Reviews One week after the implementation of the corrective actions, the H&S Manager is requested to undertake a compliance review. After observation of the full compliance of the corrective actions, the H&S Manager has to report the finalisation to NTPC. SITE H&S REQUIREMENTS It shall be governed by site regulation and safety requirement as stipulated in GCC. STAYING & FOOD ARRANGEMENT FOR WORKERS The contractor may consider providing hygienic food, beverages and refreshments during period of Project construction which may enhance the productivity level of the workers. The contractor shall also arrange quarters in workers habitat area for accommodation of workers during period of stay at Lara STPP. The proper cleaning and hygiene shall be maintained in quarters. The random checks for hygiene and cleanliness shall be done by Employer and any violation on cleanliness shall not be acceptable. Employer may take action for the same as deemed fit.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-D	ERECTION CONDITIONS OF CONTRACT	PAGE 70 OF 70	

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
						help of punch marks on the membrane wall fins or any other method considered suitable by the Bidder.
SG1-10	VI/B	A-02	17.01.18	54 OF 66	...Bidder shall include in his proposal platform area of 19,000 m2 (clear of all intervening pipes, columns, actuators, instrument enclosures, racks etc. and excluding area covered by stairways)	...Bidder shall include in his proposal platform area of 20,000 m2 (clear of all intervening pipes, columns, actuators, instrument enclosures, racks etc. and excluding area covered by stairways & landings and excluding platforms required for ESP & FGD)
SG1-11	VI/A	II A-01	2.16.05	16 OF 28	Flue gas duct from economizer outlet to each SCR reactor inlet, from each SCR reactor outlet to each RAPH (Bi-sector or Trisector, as applicable) inlet ducts, SCR bypass ducts and from RAPHs (Bi-sector or Trisector, as applicable) outlet to ESP inlets.....	Flue gas duct from economizer outlet ~~to each SCR reactor inlet up to Economiser Bypass Gate including blanking plate, blanking plate with connecting projected duct at APH inlet (SCR Outlet side). Refer Typical SCR Sketch at Annex-I (Annexure-SG-04, Sub-section-IIA-02A, part-A) for scope details.~~ from each SCR reactor outlet to each RAPH (Bi sector or Trisector, as applicable) inlet ducts, SCR bypass ducts and from RAPHs (Bi-sector or Trisector, as applicable) outlet to ESP inlets.....
SG1-12	VI/B	A-02	13.02.01, (H)	42 OF 66	DAMPERS (h) At each SCR inlet duct, each SCR outlet duct & each SCR bypass duct.	DAMPERS (h) NA ~~At each SCR inlet duct, each SCR outlet duct & each SCR bypass duct.~~
SG1-13	VI/A	IV FUNCTIONAL GUARANTEE S & LIQUIDATED DAMAGES	1.01.05.01	16 OF 76	The performance test on electrostatic precipitator will commence after a minimum period of three thousand (3000) hours of cumulative operation after completion of initial operation.	The performance test on electrostatic precipitator will ~~commence after a minimum period of three thousand (3000) hours of cumulative operation after completion of initial operation.~~ be conducted soon after completion of trial operation or along with Boiler PG test whichever is earlier.
SG1-14	VI/B	A-01	1.05.22.01	39 OF 101	CHIMNEY For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. For Borosilicate lining, the top flue	CHIMNEY For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. ~~For Borosilicate lining, the top flue liner above the roof slab shall be made of C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME~~

Doc. No.: CS-9587-001R-2-TECH AMDT- 02	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW)	Amendment No. 02 to Technical Specifications Section-VI

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
					liner above the roof slab shall be made of C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner. For Titanium/C-276 lining, external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner. The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide.....	~~SB265) of minimum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness.~~ For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 150mm diameter of flue liner. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner. ~~For Titanium/C-276 lining, and external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner. The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide.....~~
SG1-15	SECTION-VI, PART-B	SUB-SECTION G-07 MDL			MDL List	MDL List Documents related to auxiliary boiler stands deleted
SG1-16	SECTION-VI, PART-B	A-02		7.01.01 (c)	Heating surfaces arrangements (a) Completely..... (b) ---seamless tubes. (c) Ensure even temperature distribution at gas and steam side by criss - crossing the steam paths between LHS and RHS.	Heating surfaces arrangements (a) Completely..... (b) ---seamless tubes. (c) Ensure even temperature distribution at gas and steam side by criss - crossing the steam paths between LHS and RHS. In case the contractor is able to limit the steam temperature imbalance between LHS and RHS to within 10°C by employing suitable furnace/ burner configuration like twin furnace, the

Doc. No.: CS-9587-001R-2-TECH AMDT- 02	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW)	Amendment No. 02 to Technical Specifications Section-VI

NTPC LIMITED

(A Govt. of India Enterprises)



**LARA SUPER THERMAL POWER PROJECT
STAGE-II (2 X 800 MW)**

TECHNICAL SPECIFICATION – MECHANICAL PORTION

FOR

RACK & PINION TYPE ELEVATOR FOR CHIMNEY

SPECIFICATION NO.: PE-TS-5081-503-A001



**BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)**

POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
SECTOR-16A, PLOT NO. 25, NOIDA, INDIA



SPECIFIC TECHNICAL REQUIREMENT

STACK ELEVATORS

SPECIFICATION NO. PE-TS-508-503-A001

VOLUME II B

SECTION C

SUB-SECTION A6

REV. 0

SECTION - C SUB SECTION – A6 STACK ELEVATORS

	SPECIFIC TECHNICAL REQUIREMENT STACK ELEVATORS	SPECIFICATION NO. PE-TS-508-503-A001	
		VOLUME II B	
		SECTION C	SUB-SECTION A6
		REV. 0	

1.	SYSTEM DESCRIPTION
1.1	The Rack and pinion type stack elevator is required for installation inside multi-flue or outside single flue chimney. The stack Elevator is normally used for the movement of the maintenance personnel and for materials such as refractory bricks, etc. for maintenance of chimney.
2.	SCOPE OF SUPPLY AND SERVICES
2.1	The scope of supply and services covered under the specification are broadly described below:
2.1.1	Two (02) Nos. Rack and Pinion type stack elevator complete with all other accessories and associated steel work.
2.1.2	Drive motor and control panel for Stack elevator
2.1.3	Control Panel
2.1.4	Equipment earthing
2.1.5	All power and control cables, trailing cables
2.1.6	Limit switches
2.1.7	Over speed governor
2.1.8	Alarm push button in the cage connected to battery operated alarm at elevator base.
2.1.9	Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase of power supply.
2.1.10	Continuous duty electrical torque motor recoil cable reels or cable trolley or any equivalent arrangement to maintain electrical power service to all electrical components of the elevator for complete travel of stack elevator.
2.1.11	One auxiliary panel shall be provided and mounted on the graded level enclosure equipped with a main ON-OFF selector switch, main contractor, breaker, relays, control transformer and fuses, tone frequency transmitter or equivalent arrangement, terminal blocks and all other accessories required for normal operation of the elevator.
2.1.12	One main control panel shall be furnished and mounted on top of the cab. Panel shall be in enclosure equipped with necessary equipment like rectifier, battery charger, tone frequency receiver, contactors, breakers, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.
2.1.13	Cab shall be controlled by semi-automatic floor selection control system. Cab shall be furnished with 240 V grounding receptacle, emergency alarm push button with normally open contact, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the main control panel to aux. Panel at ground level. Cable shall supply the cab necessary power supply requirements. Cable guides shall be installed at every 6 m intervals to avoid entanglement of this cable. Control signal between the aux. Panel at ground level, the main control panel on the cab and the landings shall be provided with tone frequency receiver or any other equivalent arrangement by trailing control cable.

	SPECIFIC TECHNICAL REQUIREMENT		SPECIFICATION NO. PE-TS-508-503-A001	
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2.1.14	Each landing assembly shall include a limit switch and push button control station installed and wired to a landing junction box.			
2.1.15	All power cable and race way shall be provided and installed by the bidder for interconnection of the main control panel, auxiliary panel and landing junction boxes. Trailing cables shall be as per relevant IS/IEC standard.			
2.1.16	Bidder shall provide, install and connect a system equipment ground to owner's chimney grounding system. Equipment grounding system shall electrically connect panels and junction boxes which contain electrical devices, motors and elevator platform and structures. Raceway system shall not be considered as an equipment ground.			
2.1.17	All enclosures containing electrical devices shall be provided with 240 V, single phase heaters with adjustable thermostat control.			
2.1.18	Cab shall be equipped with a 240 V AC interior light and duplex outlet.			
2.1.19	Cable accessories as required to install the cables in bidder's scope shall be provided by the bidders.			
2.1.20	Complete erection, testing and commissioning including all erection materials, consumables and other tools and tackles required for erection along with commissioning spares.			
2.1.21	All inserts, anchor bolts, sleeves, anchoring steel and any other items required to complete the job satisfactorily shall be in bidder's scope.			
2.1.22	First fill of lubricant and consumables shall be in bidder's scope.			
2.1.23	Satisfactory running and maintenance of elevator for a continuous period of 30 days including training of owner's operators.			
2.1.24	Supply of One complete set of special maintenance tools and tackles shall be in bidder's scope.			
2.1.25	A complete unused and new set of Mandatory Spare parts shall be supplied. The items supplied shall be of the best quality and specially protected against rusting in tropical climate. The minimum requirement of mandatory spare parts is listed in specification.			
2.1.26	Recommended spares including instrumentation for 3 years of normal operation of stack elevator. (List to be furnished by the bidder and for which order shall be placed separately by owner as per their requirements)			
2.1.27	Any other equipment or accessories not specified, but required for the satisfactory operation of chimney elevator shall be in bidder's scope.			

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3.	SPECIFIC REQUIREMENTS
3.1	The equipment supplied, erected and commissioned shall meet the technical requirements of respective Section –D and Data Sheet-A.
3.2	Bidder shall note that all QP and Field quality plans shall be subject to purchaser’s approval.
3.3	All equipment offered shall have suitable provision of termination and connection of power and control cables inclusive of cable boxes, lugs and glands, etc.
3.4	All the equipment shall be suitable for the power supply fault level and other climatic conditions as indicated in project information.
3.5	The bidder shall guarantee the rating and performance parameters of the system/equipment offered in accordance with specification requirements.
3.6	It is the responsibility of bidder to arrange license for operation of chimney elevator from statutory body of that area before handing over.
3.7	Bidder shall furnish deviation (clause wise) in the deviation schedule. In absence of dully filled deviation list, it will be presumed that offer is exactly in line with the technical specification.
3.8	Bidder shall furnish duly filled data sheet –B along with the offer. In absence of same, offer shall be treated as incomplete.
3.9	Bidder shall offer the stack elevator considering prevailing statutory and regulatory requirements of project location.
3.10	Bidder shall indicate degree of protection of various electrical equipment in the offer.
3.11	Makes of all bought out items shall subject to purchaser’s approval after award of contract.
3.12	All drawings/documents shall subject to purchaser’s approval after award of contract.
3.13	Please refer / comply customer- NTPC specification (<i>rack & pinion type elevator</i>)

	SPECIFIC TECHNICAL REQUIREMENT STACK ELEVATORS	SPECIFICATION NO. PE-TS-508-503-A001	
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DATA SHEET

1	Designation Elevator	:	Rack and Pinion Type Stack
2	Type of loading	:	Passenger cum goods
3	Quantity project requirement.	:	2 nos. for 150 M high Chimney.
4	Carrying Capacity	:	400 Kg (approximately)
5	Pay load	:	400 Kg min.
6	Operating Speed	:	40 m/min.
7	Dimension of lift and lift well/cut out	:	As per IS: 3534
8	No. of landings	:	<u>For 150 M High Chimney=</u> Four (04) nos. including ground.
9	Total vertical travel	:	As per GA dwg of chimney.
10	Electrical power supply system	:	415 V, 3 ph, 50 Hz
11	Other accessories	:	As required.

		TECHNICAL REQUIREMENTS 	
5.03.10		Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual.	
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-D-1-5 CIVIL WORKS SALIENT FEATURES AND DESIGN CONCEPT
			PAGE 21 OF 86

CLAUSE NO.	 SCOPE OF SUPPLY & SERVICES			
1.03.00	START-UP & COMMISSIONING SPARES Start-up and commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.			
1.04.00	The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares and recommended spares and indicate these in the relevant schedules of the Bid Form and Price Schedules. The general requirements pertaining to the supply of these spars is given below.			
2.00.00	The Contractor shall indicate the service expectancy period for the spares parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.			
3.00.00	All spares supplied under this contract shall be strictly inter changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.			
4.00.00	All the spares (both recommended and mandatory) shall be manufactured alongwith the main equipment components as a continuous operation as per same specification and quality plan.			
5.00.00	The contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalise order for recommended spares.			
6.00.00	Each spares part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.			
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.			
8.00.00	The contractor will provide the Employer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB SECTION-VI MANDATORY SPARES	Page 2 of 3

CLAUSE NO.	 SCOPE OF SUPPLY & SERVICES			
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.			
10.00.00	In addition to the recommended spares listed by the contractor, if the employer further identifies certain particular items of spares, the contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.			
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the contract. The Contractor shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, he shall give the Employer atleast 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub contractors, Contractor will provide the Employers, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/ procurement of such items.			
12.00.00	Material Codification The bidder to provide datasheets/ assembly drawings of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which mandatory spares to be supplied can be uniquely identified. This would facilitate the Employer to assign a unique code to each of the mandatory spare as brought out in GCC. The bidder shall extend all necessary assistance in this regard.			
13.00.00	Bidder shall not indicate "Not Applicable" against any of the spare (except for those items for which "if applicable" is specified). In case of not applicability, functionally equivalent spare to be mentioned with price in the relevant price schedules. Bidder shall not mention any remark other than price value in relevant price schedule.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB SECTION-VI MANDATORY SPARES	Page 3 of 3

LIST OF MANDATORY SPARES FOR SG & AUXILIARIES



MANDATORY SPARES FOR CHIMNEY ELEVATOR (Qty. indicated are for one (1) No. Chimney Elevator)

A.	BRAKE ASSEMBLY	Qty.
	1. Brake Assembly complete	1 No.
B.	GEAR ASSEMBLY	
	2. Gear Assembly complete	1 No.
C.	DOOR FRONT	
	3. Bearing	3 Nos.
	4. Roller	3 Nos.
	5. Bushing (if applicable)	2 Nos.
D.	LIMIT CAMS	
	6. Sensor	3 Nos.
	7. Switch arm	3 Nos.
E.	CAB	
	8. Guide roller	100% of the total ones installed each type or min. 1 no. whichever is higher
	9. Switch	3 Nos.
F.	SLIDING DOOR	
	10. Rollers (if applicable)	4 Nos. each type
G.	MACHINERY	
	11. Guide roller	2 Nos.
	12. Pinion	2 Nos.

LIST OF MANDATORY SPARES FOR SG & AUXILIARIES



	13.	Rubber inserts (if applicable)	12 Nos.
	14.	Groove ring (if applicable)	6 Nos.
	15.	Brake motor	1 No.
H.		CABLE TROLLEY BEARING (if applicable)	
	16.	Bearing	3 Nos. of each type
I.		ELECTRICAL EQUIPMENTS	
	17.	Contactors	1 No. of each type
	18.	Auxiliary transformer	1 No.
	19.	Relays	1 No. of each type & rating
	20.	Switch	2 Nos. each type
	21.	Rectifier	3 Nos.
	22.	Limit switch	3 Nos. each type
	23.	Transmitter (if applicable)	1 No. if applicable
	24.	Receiver (if applicable)	1 No. if applicable
	25.	Battery charger	1 No.
	26.	Push Buttons	3 Nos. of each type
	27.	Timers	2 Nos. of each type & rating
	28.	Main drive motor with control system	1 Set



TITLE:

**TECHNICAL SPECIFICATION
STACK ELEVATOR**

SPECIFICATION NO. PE-TS-508-503-A001

VOLUME - IIB

SECTION "D"

SUB-SECTION A6

REV. 00

DATE:

**SECTION - D
SUB-SECTION – A6**

STACK ELEVATOR

	TECHNICAL SECIFICATION STACK ELEVATOR	SPECIFICATION NO.PE-TS-481-503-A001	
		VOLUME II B	
		SECTION D	SUB-SECTION A6
		REV. 0	

1. DESIGN AND CONSTRUCTION

1.1 Stack Elevator - General

1.1.1

The stack elevator including mechanical and electrical components shall be installed outside/inside Single flue/ multi flue chimney. Since chimney is a free-standing structure, deflection of chimney top is expected during the normal operation, so the design of the elevator shall be in such a way that the elevator operation will be safe even with the expected maximum deflection of the chimney structure. The stack elevator shall lift a pay load as indicated against rated load as mentioned in Data sheet-A or its nearest as per manufacturer's present standard in addition to the weight of the car and its accessories and shall travel at a rated speed as indicated in the data sheet-A. Travel of the elevator car, number of landings and levels shall be as per Data sheet-A attached to this section.

1.1.2

Stack elevator mechanical and electrical operating devices and trailing cable shall be designed for operation indoors/out door with dusty and high humidity conditions and shall operate equally well in any ambient temperature encountered in the site conditions. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand without damage a temperature of 100oC when the elevator is not operating.

1.1.3

Cage earthing shall be done through trailing cable.

1.1.4

Stack elevator shall be attached to the chimney shell using expansion type anchor bolts drilled in to chimney shell. Elevator shall be capable of operating from the ground floor to the top platform with intermediate stops at all platforms. Landing for elevator parking shall be one (1) meter above the stack ground floor. Suitable concrete/brick steps leading to the landing for entry to cabin shall also be provided,

1.1.5

The stack elevator shall be designed in line with recommendations contained in the latest editions of the applicable codes and standards.

1.2 Equipment Specification

1.2.1 Enclosures

i.

A three-sided enclosure with one access door shall be provided at graded level. At each platform landing above graded level, a one-sided enclosure with access door shall be provided. Enclosures shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high and one coat of epoxy primer coated. Enclosure access doors shall be electrically and mechanically interlocked so that they remain closed and locked except when the Cab is at the landing. Doors shall be bi-parting and swinging type.

ii.

Base of three-sided enclosure shall be securely anchored to the grade level floor slab using expansion type anchors.

1.2.2 Mast

i.

Mast shall be provided in sections approximately 1.52 m in lengths considering of tubular sections and/or structural shapes welded together to form a frame work to which the rack is bolted. Mast shall be securely anchored to the concrete chimney walls.

1.2.3 Cab

i.

Cab frame shall be fabricated from tubular steel and enclosed with expanded metal or wire mesh.

	TECHNICAL SECIFICATION STACK ELEVATOR	SPECIFICATION NO. PE-TS-481-503-A001	
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ii. Cab floor shall be of skid resistant glass fibre reinforced plywood or approved equal. Cab shall be attached to a framed structure and form integral part with the drive mechanism located atop the cab. Framed structure shall include guide rollers and safety hooks to ensure positive engagement of the rack and pinion to prevent cab disengagement in case of roller failure. 1.2.4 Buffers i. Sufficient numbers of buffers of spring loaded/hydraulic type shall be fitted below the cab. The buffers shall be capable of stopping the cab without permanent damage or deformation to themselves or any other part of the equipment. The number of buffers shall be so fixed as to ensure proper sharing of impact loads by all of them. 1.2.5 Drive unit and safety Device i. Drive unit located on the top of the cab shall be complete with Ac squirrel cage induction motor, reduction gear, drive pinion and an over speed governor. Drive unit shall incorporate an electric disc brake and an external manual brake release. The brake on the electric motor will be of the electromagnetic single disc self-adjusting type with the mechanical compression spring being held off by the electromagnet. ii. The hoist shall be provided with a centrifugal brake to prevent accidental tripping of safety device when the cage shall be taken to the ground by gravity in case of power failure. 1.2.6 Power and Control i. All electrical components furnished with the elevator shall be completely wired, energised and checked. Necessary power distribution arrangement shall be provided by the contractor to feed the electrical power to the elevator. ii. All electrical control devices shall be in enclosures. Equipment furnished shall also include the following: - Momentary contact push button for raise lower control. - Reversing combination motor starter with a moulded case circuit breaker for the motor. Starter shall be equipped with three thermal overload relays for motor protection. Operating handle for the combination starter circuit breaker shall be accessible from inside the cab and shall also serve as an emergency stop switch. - Electrical and mechanical interlocks on cab access door and landing level enclosure doors. - Over travel protection, emergency stop push button, over speed governors. - All electrical and mechanical interlocks on cab access door and landing level enclosure doors, phase reversal protection shall be provided. - An alarm push button shall be provided in the cage connected to a battery-operated alarm at the elevator base. Simultaneous alarm shall also sound at the plant control room in the event of any fault in the stack elevator for which one potential free contact shall be provided in each elevator for audiovisual alarm in PCR for "Stack Elevator fault" indication. - Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase in the power supply.			

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h) Continuous duty electric torque motor recoil cable reels as required to maintain electrical power service to all elevator electrical components throughout the limits of travel. i) One auxiliary panel shall be furnished and mounted on the grade level enclosure. Panel shall be equipped with a main ‘ON-OFF’ isolating switch, main contactor, relays, control transformer and fuses, tone frequency transfer, terminal blocks and all other accessories required for normal operation of the elevator. j) One main control panel shall be furnished and mounted on the top of the cab. Panel shall be equipped with necessary, equipped like rectifier, battery, charger, tone frequency receiver, contactors, MCBs, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator. k) Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be cold rolled and at least 2.0 mm thick and properly braced to prevent wobbling. Degree of protection of the control cabinets shall be IP-52 as per IS:2147. Control cabinets shall be provided with hinged door(s) with padlocking arrangement. All doors, removable covers and plates shall be gasket all around with neoprene gaskets, louvers, when provided, shall have screeners and filters. The screens shall be of fine wire mesh made of brass or GI wire. Suitable cable gland plate shall be supplied fitted on to this gland plate. All cable glands shall be screwed on type and made of brass. l) Each motor to be controlled from the control cabinet shall be provided with 3 pole isolating switch. HRC fuses, contactors of AC4 duty class with thermal overload relays with single phasing preventer and other equipment required for satisfactory control motor. The isolating switch and contractor shall be rated at least 20% more than the connected motor full load current. Motors of 0.2 KW and above shall be rated for 415 V 3 Phase and below 0.2 KW will be 240 V single phase supply. m) The controllers and resistors for motors shall conform to IS-8544 (latest edition) and IS-2959 (latest edition) and shall be continuously rated for 150% full load current of the motor. Switches shall be hand operated, air breaker heavy duty, quick make, quick break type conforming to IS-4064. The rating of switch shall be so chosen as to get complete protection by associated O/L relay or fuse under all normal / abnormal conditions such as full load, overload, locked rotor, short circuit. The incoming power supply isolating switch shall be inter-locked with the control cabinet door so as to prevent opening of the door when the switch is closed. Device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions. n) All fuses shall be of the HRC cartridge type mounted on plug in type of fuse base having a prospective current rating of not less than 80 KA. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it shall be possible to change fuses with the circuit alive without danger of contact with live metal. o) Contractor shall provide dry type transformers with class B insulation for control power supply, lighting and space heating. Control supply will be 240 V AC.			



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Transformer for control supply shall be provided with a control tap at 110 V, which will be earthed. Power and control supply to individual drives and users shall be distributed with separate isolating switches and primary and secondary fuses.

- p) All push buttons shall be of push to actuate type having 2 “NO” and 2 “NC” self reset contacts. They shall be provided with integral escutcheon on plate engraved with their functions. Push button contacts shall be rated for 5 Amp at 415 V AC and 1 Amp. Inductive breaking at 250 V, DC. Mushroom type emergency push button to open the main contactor shall be provided in the operator’s cabin and two on the bridge platform within easy reach indicating lamps shall be of the filament type and low watt consumption lamps shall be provided with series resistors.
- q) Strip type space heaters of adequate capacity shall be provided inside in each cabinet.
- r) Control cabinets shall be supplied completely wired. All wiring shall be carried out with 650 V grade PVC insulated, stranded conductors. Power circuits shall be wired with stranded aluminum conductors of adequate sizes to suit the rated circuit shall be wired with stranded copper conductors of sizes not small than 1.5 Sq.mm. Control circuits shall be isolated from power circuits.
- s) Cab shall be controlled by a semi-automatic floor selection control system. Cab shall be furnished with 240 Volt grounding type receptacle, emergency alarm push button with a normally open contact rated 0.5 ampere at 220 VDC volts, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the cab main control panel to the auxiliary panel at ground level. Cable shall supply the cab with all power requirements. Cable guides shall be installed at every 6 metres to avoid entanglement of this cable. Control signals between the auxiliary panel at ground level and the main control panel on the cab. Will be provided with the tone frequency receiver. However control and interlocks from the landings shall be connected to the auxiliary panels located at ground level through fixed armoured cables. The power and control cables and training power cables shall be FRLS type.
- t) Each landing assembly shall include a limit switch for door interlock and push button control station installed and wired to a landing junction box.
- u) Cable trolley with cable guides for recoil of cable on to cable reel to maintain electrical power service to all elevator components through out the limits of travel.
- v) Contractor shall furnish, install, and connect a system equipment ground to the Owner’s existing chimney ground system. System equipment ground shall electrically connect panels and junction boxes, which contain electrical devices, motors, and elevator platforms and support structure. Raceway system shall not be considered as an equipment ground.
- w) All enclosures containing electrical devices shall be provided with 240 Volt, single-phase space heaters with adjustable thermostat control.
- x) All power cables and race way shall be furnished and installed by the Contractor for interconnection of the main control panel, auxiliary panel and landing junction boxes etc. Conductors included in the cable shall be as required to energise all electrical equipment furnished with the elevator. Transmission of

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alarm signals is done by means of tone frequency equipment. Hence communication conductors are not required.

1.2.7 Electric Motor

- i. Elevator drive motor shall be squirrel-cage induction type designed and fabricated to conform to the requirements indicated below.
- ii. Motor shall be designed for operation at the required speed: 415 Volts, 3 phase, 50 hertz. And shall be suitable for full voltage starting, S4 duty class as per IS-4722 with CDF of 25% and maximum number of 120 starts per hour in 55 Deg. C ambient temperature. Motor shall be tested at the factory to determine that it is free from electrical or mechanical defects.

1.2.8 Raceway

- i. General
 - a) Complete raceway system for the elevator shall be furnished and installed in accordance with this section and the Contractor’s shop drawings as reviewed and accepted by the Engineer-in-Charge. The Contractor shall provide drawings for acceptance showing the routing of conduit and wiring for the control circuits associated with the elevator.
 - b) Raceway system is defined to include conduit and all related materials and devices required to support, secure and provide a complete system for support and protection of electrical cable and wiring.
- ii. Materials
 - a) Raceway shall be rigid galvanized steel conduit, provided in accordance with IS-1653 (latest edition).
 - b) Steel conduit, couplings, and elbows shall be hot-dip galvanized rigid mild steel. Each length of threaded conduit shall be complete with a coupling on one end and a thread protector on the other. Thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage. Flexible conduits shall be plastic jacketed, liquid tight galvanized steel.
 - c) Galvanized iron or galvanized cast steel fittings shall be used with galvanized steel conduit. Fittings installed outdoors or in damp locations shall be sealed and gasketted. Outdoor fittings shall be of heavy cast construction.

1.2.9 PVC Insulated FRLS Cable

- i. Materials
 - a) Electrical part of this specification shall be referred for FRLS cable. Unless specified otherwise, Contractor shall submit to the Engineer-in-Charge four copies of the manufacturer’s test report on each cable furnished. Conductor accessories including terminal materials like glands, lugs etc. makers, tying materials and cable support shall be furnished and installed. Wire termination materials for conductors 10 Sq. mm and larger shall be pressure or bolted type. Terminals for conductors smaller than 10 Sq. mm shall be an insulated pressure connection in the shape of a ring.
- ii. Installation



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- a) Power and control cable shall be routed as required by the drawings. Cables pulled into the wrong conduit or cut too short shall be replaced. Cables removed from one conduit shall not be installed in another conduit.

1.2.10 Earthing

i. General

- a) Earthing system furnished and installed and include a complete earthing system for the elevator. Earthing equipment and materials shall be furnished and installed in accordance with the reference codes and standards these specifications and the contractor's shop drawings as reviewed and accepted by the Engineer-in-Charge.

ii. Materials

- a) The earthing of all electrical items being supplied by the Bidder shall be in his scope. For earthing the various equipment, conductor sizes shall be as listed below:

- MCCs Motor above 90 KW : 50 x 6 Sq.mm G.I. flat
- Motors above 30 KW, upto 75 KW and lighting panel/ control panels/auxiliary panels : 25 x 6 Sq. mm G.I. flat
- Motor above 5 KW upto 30 KW : 25 x 3 mm G.I. flat
- Motors upto 5 KW and misc. : 8 SWG GI wire
- Small item like conduits,
- Junction boxes etc..

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SUB-SECTION - A6

STACK ELEVATORS

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1.01.00 ELEVATOR PARTICULARS

- i) Load Carrying Capacity in Kg
- ii) Type of loading for which the stack elevator is designed
- iii) Type of stack elevator
- iv) Rated Load in Kg
- v) Speed in metre/minute
- vi) Chimney height in metre
- vii) Total travel height in metre
- viii) No. of floors to be served
- ix) Elevations of the floors to be served
- x) Method of control
- xi) Details of indicators and control
- xii) Weight of cab complete without load in Kg
- xiii) Weight of hoist cab in Kg
- xiv) Efficiency of Elevator

1.02.00 GROUND ENCLOSURE

- i) Size of the enclosure
(Length x breadth x height)
- ii) Material of construction
- iii) Size of landing entrance
- iv) Method of door operation
- v) Electrical & mechanical interlocking
Of the door provided.
- vi) Method of fixing enclosure to chimney
- vii) Any other details not covered above

1.03.00 LANDING ENCLOSURES

- viii) Size of the enclosure

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(Length x breadth x height)

- ix) Material of construction
- x) Size of landing entrance
- xi) Method of door operation
- xii) Electrical & mechanical interlocking
Of the door provided.
- xiii) Method of fixing enclosure
- xiv) Any other details not covered above

1.04.00 MAST

- i) Material of mast
- ii) Section of mast
- iii) Size of each piece of mast
- iv) Method of fixing of mast
- v) Type of mast

1.05.0 CAB

- i) Internal size
(Length x breadth x height)
- ii) Material of construction
- iii) Type of floor
- iv) Size of the cab door
- v) Method of operation of cab door
- vi) Electrical & mechanical interlocking provided
- vii) Escape hatch, electrically interlocked
- viii) Guide roller and safety hooks provided
- ix) Arrangement of light/fan inside the cab.
- x) Indicators & controls inside the cab.

1.06.00 ELEVATOR DRIVE UNIT

- i) Location of drive unit
- ii) Name of components of drive unit

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1.07.00 DETAILS OF ELECTRIC MOTOR

- i) Manufacturer
- ii) Equipment driven by motor
- iii) Type
- iv) Frame size, type & designation
- v) Maximum load considered for
Sizing of motor
- vi) Margin considered for sizing motor
- vii) Rated power in KW
- viii) Service factor
- ix) Speed in rpm
- x) Rated voltage in V
- xi) Current at rated voltage
 - Full load
 - Locked rotor
- xii) Insulation class
- xiii) Type of bearing and type of lubricant
- xiv) Space heater rating
- xv) Duration considered for specified
Ambient temperature
- xvi) Applicable standard to which motor conforms
- xvii) Degree of protection
- xviii) Efficiency at rated output
- xix) Power factor
- xx) Type of mounting

1.08.00 DETAILS OF REDUCTION GEAR

- i) Make

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- ii) Material of the gears and hardness in BHN
- iii) Type of gear
- iv) Gear ratio
- v) Gear power transmitted
- vi) Input and output speed

1.09.0 DETAILS OF DRIVE AND PINION

- i) Material
- ii) Hardness
- iii) Fixing arrangement

1.10.0 DETAILS OF RACK

- i) Material
- ii) Hardness
- iii) Fixing arrangement

1.11.00 SAFETY DEVICE

- i) Make
- ii) Type of safety device
- iii) Speed at which the safety device
Come into action
- iv) Method operation
- v) Other details
- vi) Remote control for testing
The safety device

1.12.00 BRAKES

- i) Manufacturer
- ii) Types of brakes provided
- iii) Method of operation
- iv) Interlocking if any
- v) Electromagnetic brake and external
Manual brake release

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vi) Degree of protection

1.13.00 CENTRIFUGAL BRAKE

- i) Make
- ii) Details
- iii) Remote control for testing
The safety device provided.
- iv) Any other details of drive unit
Not covered above.

1.14.00 BUFFERS

- i) No. and location of the buffers provided
- ii) Type of buffers
- iii) If the buffers are spring type
Furnish the following:

- Diameter of the spring in mm
- Max. Compression under extreme cond.
- No. of spring coil
- Sectional dimension
- Material of spring
- Compression /unit load

1.15.00 POWER CABLES

Fixed

Trailing

- i) Manufacturer
- ii) Type and material
- iii) Rated voltage
- iv) Rated current

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- v) Type of insulation
- vi) No. of strands
- vii) No. of cores
- viii) Short circuit current rating
- ix) Resistance per 1000 metres
- x) Applicable standards

1.16.00 CONTROL CABLES

- xi) Manufacturer
- xii) Type and material
- xiii) Rated voltage
- xiv) Rated current
- xv) Type of insulation
- xvi) No. of strands
- xvii) No. of cores
- xviii) Short circuit current rating
- xix) Resistance per 1000 metres
- xx) Applicable standards

1.17.00 CONDUITS/ACCESSORIES AND FITTINGS

- i) Material
- ii) Manufacturer
- iii) Applicable standard

1.18.00 CONTACTORS

- i) Make
- ii) Type
- iii) Applicable standards
- iv) No. of poles

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- v) Rated voltage
- vi) Rated frequency
- vii) Rated current
- viii) Closing coil
 - Rated voltage
 - Current consumption
 - Power consumption in KW
 - Insulation class for electromagnet
- ix) Rated duty
 - Rated insulation category
 - No. of operations per hour
 - Rated breaking capacity
 - Rated making capacity
 - Short time rating in sec
- ix) Limits of operation
 - Supply voltage variations (%)
 - Supply frequency variations (%)
 - Drop out voltage (%)
 - Min. pick up voltage (%)
- x) Thermal overload relay setting range available
- xi) Auxiliary contacts
 - Numbers
 - Current rating (Make and break)
- xi) Rated utilization category as per IS 2459
- xii) Max. recommended back up HRC fuse size

1.19.00 FUSES

- i) Make
- ii) Type
- iii) Continuous current

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- iv) Rated voltage
- v) Rated frequency
- vi) Rupturing capacity
- vii) Mounting details
- viii) Fixing and removing arrangement
- ix) Visual indication for fuses
- x) Applicable standards

1.20.00 INDICATING LAMPS

- i) Make
- ii) Type
- iii) Rated voltage
- iv) Rated power consumption in Watt
- v) Permissible voltage variation
- vi) Series resistance provided

1.21.00 PUSH BUTTONS

- i) Make
- ii) Type
- iii) Rating
 - Voltage
 - Continuous current
- iv) No. of aux. Contacts
 - Normally open
 - Normally closed
- v) Contact rating
- vi) Colours
- vii) Mounting arrangement

1.22.00 OVER TRAVEL LIMIT SWITCH

- i) Make
- ii) Type
- iii) Material of contacts

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- iv) Contact rating
- v) Numbers furnished

1.23.00 CONTROL TRANSFORMER

- i) Make
- ii) Type
- iii) Output rating (VA)
- iv) Ratio
- v) Class of insulation
- vi) Max. temp rise of winding over
Specified ambient temperature.
- vii) One minute power frequency test voltage
- viii) Applicable standards

1.24.00 CIRCUIT BREAKER AND ISOLATOR

- i) Make
- ii) Type
- iii) Current rating in amps
- iv) Interruption duty
- v) Max. breaking capacity
- vi) Operating voltage of tripping and closing coils
- vii) Max. permissible variation of operating voltage

1.25.00 RACEWAY

- i) Raceway as per specification
- ii) Material of
 - Indoor fittings
 - Outdoor fittings
 - Raceway support
 - Junction boxes

1.26.0 EARTHING

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- i) Earthing conductor
 - Size
 - Material
- ii) Material of earthing cable
- iii) Clamps. Bolts, washers, nuts and another
Hardware of iron steel are galvanized.

1.27.00 MOTOR STARTER

- i) Make & Size
- ii) Rating]
- iii) Mechanically latched type
- iv) Single phase prevention feature provided
- v) Degree of protection

1.28.00 DETAILS OF CONTROL PANELS

- i) No. of panels
- ii) Type of enclosures (Degree of protection)
- iii) Thickness of sheet metal
- iv) Painting
 - Colour
 - Finish
- v) Cable entry
- vi) Manufacturer

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SUB-SECTION-B – 15

ELECTRICAL HOIST, CRANE AND ELEVATOR

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.00.00 1.01.00 2.00.00 3.00.00 4.00.00	<u>ELECTRICAL HOIST, CRANE AND ELEVATOR</u> CODES AND STANDARDS All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the standards/ codes as applicable. Electric motor: The driving motors shall conform to IEC 60034 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130(B) or better insulation CAR ELECTRICAL ACCESSORIES The following accessories shall be provided: a. LED light fittings for illumination level of 100 lux on car floor. b. Portable light and alarm bell with battery and charger ventilation fan with control. c. Car control station with position indicator inside the car and at landing platforms (both visual and audio). d. Emergency stop switch. e. 5/15A, 3 pin plug socket with switch on top of lift car. f. Hand free speaker telephone set connected to plant network. g. AUTOMATIC RESCUE DEVICE (ARD)- (BATTERY DRIVE) : Contractor to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in an ELEVATOR”. h. EMERGENCY SAFETY DEVICES: The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car. OPERATIONAL REQUIRMENTS: a. Contractor shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls. b. Contractor shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual).			
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	c. Contractor shall provide electronic door detector (Infra-red curtain type). d. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the Contractor. e. For facilitating the movement of visually & hearing-impaired persons, hall lantern and car arrival chimes shall be provided f. All fixtures shall be in stainless steel face plates. g. Push buttons shall be fixed in the car for holding the doors open for any length of the time required. h. All other safety/protection/operation interlocks as required by IS:14665 (latest edition).			
4.00.00	POWER SUPPLY: Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating			
5.00.00	Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room.			
6.00.00	Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. The PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. a) Oxygen index of min. 29 (as per IS:10810 Part-58) b) Acid gas emission of max. 20% (as per IEC-754-I). c) Smoke density rating shall not be more than 60% (as per ASTM-D-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type of trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipment's in the lift machine room and that between the machine room and equipment's in the lift well and at the landings shall be wired in HDPE conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.			
7.00.00	Earthing: The elevator, EOT and crane structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
8.00.00	EOT/ Hoist and Crane Motors: Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding temperature rise limits as specified			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 2 of 5

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8.02.00	elsewhere in this specification. VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame. However, contractor's proven practice with respect to use of insulated bearing in VFD driven motor may be accepted subject to Employer's approval. Motors shall conform to latest revision of IS 325, IS 3177 and motor subsection of this specification. Controls: a) Speed control of EOT crane shall be through Variable Voltage Variable Frequency System (VVVF) with minimum 6 (six) pulse design. b) Necessary input & output devices to be provided to reduce harmonics, as per IEEE519, at supply side of the drive at the switchgear. c) All necessary protections e.g., Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, overload etc to be provided. d) VVVF system shall be capable of generating suitable starting torque (up to 400% typical) with / without encoder, however starting current shall not exceed 150% at rated torque. e) VVVF system shall be capable to withstand up to 50 deg C ambient temp without derating. f) Provision for controlling the motion from operator cabin (in case of Turbine Hall EOT crane) as well as remote control shall be available. g) Squirrel cage Induction motor with VPI insulation shall be provided With VVVF system. h) Master controller - Desk type having following features. I. Five speed control points in each direction of hoist motion. II. Four speed control points in each direction of bridge and trolley motion. III. Release of operator's hand from the controls shall stop motion and set brakes automatically. i) Protective Panel: Shall be Provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer. j) Starter Panel: I. Separate VVVF system panels to be provided for CT, LT and hoist motion (main and auxiliary drives). II. Contactors shall be of AC 4 duty for reversing application and AC 3 duty for non-reversing application III. Switches shall be AC 23 for motor application and AC 22 for other application. IV. Fuses: HRC V. Overload relay shall be of Temperature compensated, bimetallic with single phasing preventor. k) Panel shall be fabricated out of 1.6 mm thick rolled sheet steel. IP 52 degree of protection. Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side covers. Space heaters to be provided.			
8.03.00	Radio remote Control of EOT Crane: a) The equipment should have facility to control EOT crane by radio frequency based wireless remote unit. The equipment should be supplied with transmitter unit, receiver			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 3 of 5	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
7.06.0	unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required. b) The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring. c) The remote unit should communicate up to the distance of approximately 100 meters. d) The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase. e) The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type. f) Frequency allotment for radio remote unit from Govt. of India, Dept. of Telecommunication or any other agency shall be the responsibility of supplier. g) The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately. h) The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication breakdown occurs. i) On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit. j) In case tandem operation is envisaged, a suitable selector switch shall be provided in the cabin for selection of Tandem/normal operation. k) The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane. l) The system should have very fast response time.		
	Power Supply: (a) <u>Incoming numbers:</u> I. <u>Turbine hall EOT crane:</u> Contractor shall provide two (2) numbers 415 volts, 3 phase, 3 wire supply at operating floor near A-row column at centre of bay length with a changeover switch in enclosure. II. <u>EOT crane for BFP:</u> Contractor shall provide One (1) numbers 415 volts, 3 phase, 3 wire supply for each unit at BFP floor near B-row column. (b) <u>Down shop Lead (DSL):</u> I. DSL Shall conform to IS: 282 and shall be sized to Cater to all cranes working simultaneously with 40% cyclic duration factor for load. II. Limit voltage drop at motor terminals within 2% at extreme positions. III. DSL shall be sized with a margin of 10% overload requirement. IV. Protective cover over DSL to be provided.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 4 of 5

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	V. Two (2) no. isolating switches in enclosure shall be provided at extreme ends of operating floor for disconnecting supply to DSL while maintaining the crane. DSL shall be located on 'A' -row side for Turbine Hall EOT crane. (c) <u>Transformers</u> Shall be of Dry type, with insulation class B or better. Following transformers shall be provided. (i) Control Transformers : 2x100%, 415V / 110V (ii) Lighting Transformers : One 415V/240V (iii) Hand lamp : One 415V/24V		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 5 of 5

	ELECTRICAL EQUIPMENT SPECIFICATION FOR CHIMNEY (SINGLE FLOW) LARA SUPER THERMAL POWER PROJECT	SPECIFICATION NO.
		VOLUME NO. :
		SECTION : C
		REV NO. : 00 DATE : 21.10.23
		SHEET : 1 OF 1

TECHNICAL SPECIFICATION

FOR

CHIMNEY (SINGLE FLOW)

(ELECTRICAL PORTION)

SUB-SECTION-B – 14

ELECTRICAL WORKS FOR CHIMNEY

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS			एनटीपीसी NTPC
CHIMNEY ELECTRICAL WORKS				
1.00.00	GENERAL REQUIREMENTS			
1.01.00	This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A.			
1.02.00	For specification requirement of electrical equipment and accessories such as DB, cable, cabling, lighting, earthing, lightning protection etc., contractor shall refer relevant chapters of this Technical specification in addition to following clauses mentioned in this document.			
1.03.00	The equipment shall be suitable for installation and render trouble free & continuous operation at higher ambient temperature and rigorous weather conditions prevailing at chimney. Ambient temperature for design of all equipment shall be considered as 55 degrees C.			
1.04.00	The electrical equipment/installations shall comply with the requirements of the following Rules/ Regulations as amended up to date: i) The Indian Electricity Rules/Acts. ii) National Electrical codes and Indian standards. iii) International Civil Aviation organisation Regulations. iv) National Airport Authority/DARA Regulations.			
1.05.00	Main distribution board & emergency distribution board shall be located at chimney base. Main DB shall be 415V, 3ph 4 wire and Emergency DB shall be 415 volt, 3 phase, 3 wire. Emergency DB will receive one feeder from Emergency power supply feeder and one feeder from main distribution board. Contractor shall provide auto-change over supply to healthy source on failure of any source. In case any power supply other than 415 V, 3 phase indicated above is required, the transformation for same shall be included in the Contractor's scope of work.			
1.06.00	Elevator Board shall be of metal enclosed, single front, indoor, floor mounted, free standing, fixed type conforming to IS 13947-PART-I. The Elevator board & Power panels shall be of floor/wall mounted type. The equipment shall be supplied fully assembled and wired, complete with base frame and anchoring arrangement, gland plates, internal wiring, terminal blocks and suitable for termination of external power and control cables. Overall height of Board shall not exceed 2450 mm. All board frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plates thickness shall be 3.0 mm (minimum) for hot/cold-rolled sheet steel and 4.0 mm (minimum) for non-magnetic material. All panels shall be dust and vermin proof.			
1.06.01	The Board shall be divided into distinct vertical sections, each comprising of : i) A completely enclosed busbar compartment for running horizontal and vertical busbars.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-14 ELECTRICAL WORKS FOR CHIMNEY	PAGE 1 OF 5

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS		
	ii) Completely enclosed switchgear compartment(s) one for each circuit of outgoing feeder. iii) A cable alley for power and control cables of 250 mm width. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations in cable alley shall be designed to meet Form IVb Type & (as per IEC 60439) for safety. The front of the compartment shall be provided with hinged single leaf door with locking facility.		
1.06.02	Boards shall be provided with phase & neutral busbars along entire length of board. The minimum air clearance between live parts shall be 25mm for busbars and 10mm elsewhere both for phase to phase and phase to earth. Wherever such clearance is not available, the live parts shall be fully insulated/shrouded. However, for busbars minimum 25mm air clearance shall be maintained irrespective of insulated/shrouded busbars are provided.		
2.00.00	Lighting System		
2.01.00	The lighting system shall provide adequate illumination at various platforms, stairways, landing and other areas of the chimney.		
2.02.00	The following average illumination levels shall be achieved and guaranteed by the contractor after considering maintenance factor of not more than 0.6 : a) On equipment 150 Lux b) General platform area 70 Lux c) Stairways and landings 100 Lux [minimum one (1) light fixture at each landing].		
2.03.00	Power supply for normal lighting system shall be obtained through main distribution board. 80% lighting at various platforms and 50% lighting in staircases shall be fed from normal A.C. source. 20% lighting at various platforms and 50% lighting on staircases shall be fed from emergency distribution board.		
2.04.00	3 Pin Receptacles designed for IP:55 degree of protection shall be provided at every platform level, rated for 20A, 240 V,AC. The Receptacles shall be complete with 20A, 240V, AC switch and 3 pin plug.		
2.05.00	Heavy duty welding Receptacle rated for 415V, AC, 63A shall be provided at each internal platform level.		
3.00.00	Aviation obstruction lighting system		
3.01.00	Aviation obstruction lighting system shall conform to the requirements of the latest applicable rules of International civil aviation organization (ICAO) and NAA/DARA regulations.		
3.02.00	The aviation obstruction lighting system shall be of high intensity type.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-14 ELECTRICAL WORKS FOR CHIMNEY
PAGE 2 OF 5			

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS	एनटीपीसी NTPC									
3.03.00	Photo electric controller shall be housed in rugged weather tight, IP 65 enclosure. LED's shall be provided to indicate the operation status of the unit.										
3.04.00	System controller shall be suitable for operation at specified ambient temperature and shall be wall mounted type. The enclosure shall have IP:55 degree of protection.										
3.05.00	Aviation obstruction light unit shall provide easy access to lamp and components.										
3.06.00	Four nos. of obstruction lights shall be installed at each specified elevation. The system controller is proposed to be located at 1.2 metre elevation and photo electric controller at about 40 metre elevation. Necessary cables for wiring between photocell & system controller and between system controller & obstacle lights shall be provided. Typical aviation obstruction lighting system arrangement is shown in the enclosed tender drawing.										
3.07.00	Each item shall be preassembled, routine tested optically and electrically before shipment.										
3.08.00	Bidder shall furnish the complete routine test report of the fixtures, controllers, photocells etc. Testing of aviation lights as per ICAO regulations to be carried out and routine test report to be submitted.										
3.09.00	High intensity obstacle lights shall meet the following requirements. (a) It shall be flashing white light. The effective intensity of obstacle light shall be variable and dependent on background luminance as follows. <table><tr><th>Background luminance</th><th>Effective Intensity</th></tr><tr><td>(i) Above 500 cd/m2</td><td>200000 cd ± 25% cd</td></tr><tr><td>(ii) 50 to 500 cd/m2</td><td>20000 ± 25% cd</td></tr><tr><td>(iii) Less than 50 cd/m2</td><td>4000 ± 25% cd</td></tr></table> (b) The obstacle lights shall flash simultaneously at a rate between 40 to 60 per minute. (c) The system shall also provide automatic sensing and display of system status and aviation lamp failure detection.			Background luminance	Effective Intensity	(i) Above 500 cd/m2	200000 cd ± 25% cd	(ii) 50 to 500 cd/m2	20000 ± 25% cd	(iii) Less than 50 cd/m2	4000 ± 25% cd
Background luminance	Effective Intensity										
(i) Above 500 cd/m2	200000 cd ± 25% cd										
(ii) 50 to 500 cd/m2	20000 ± 25% cd										
(iii) Less than 50 cd/m2	4000 ± 25% cd										
3.10.00	The distance between lighting elevations shall not be more than 105 Metre and lowest lighting elevation shall not be less than 70 metre.										
3.11.00	The light unit shall have adjustable bracket with level indicator to ensure accurate vertical placement of the light flash.										
3.12.00	Temporary obstruction lighting shall be provided during construction. Obstruction lights shall be provided on the uppermost part of the chimney, or the surrounding scaffolding. As construction progresses each completed level shall be provided with temporary lighting. Temporary obstruction lights shall have four fixtures located in a horizontal plane on the chimney structure to ensure unobstructed visibility of at least one obstruction light from aircraft at any normal angle of approach. Power for operation of the temporary obstruction lights shall be obtained from the construction power system. Supply circuit for these lights shall be furnished, installed and maintained by the Contractor. Temporary obstruction lights shall be operated from sunset to sunrise during each day of the contract period until such time as the Engineer issues instructions in writing to discontinue.										
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-14 ELECTRICAL WORKS FOR CHIMNEY	PAGE 3 OF 5							

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS 		
4.00.00	Earthing		
4.01.00	Earth grid system for chimney shall consist of horizontal conductors and vertical conductors. Horizontal conductor shall be of 40mm dia mild steel rod buried at a depth of 1 metre all around the chimney. Vertical rods shall be of 40 mm dia, 3 metre long mild steel driven deep in to the ground and also connecting to horizontal conductor at 20 metre interval. The chimney earth grid system shall be interconnected with main plant earth grid at minimum 2 points, through bolted removable link and earth pits.		
4.02.00	Metallic enclosures of all electrical equipments shall be earthed by two separate and distinct connections to earth grid system. The earth connections shall consist of galvanised steel strip/rod/wire, sized adequately to carry the earth fault current of the system. Two nos. main earthing conductor shall be run inside all along chimney height. Electrical equipments at every platform shall be earthed with this conductor. Cable armour shall be bonded to earthing system at both ends of the circuit. The earthing conductors and accessories located at top 12m level shall have lead cover of minimum 2mm thickness. The accessories like nuts, bolts, dash fasteners, round clamps, washers etc. to be used for top 12m level shall be made of stainless steel.		
4.03.00	Steel structures, metallic pipes etc. shall also be connected to earthing system. Connections between earthing conductor and equipments shall be of bolted type only. Earthing conductors along their run on walls shall be supported by cleating at 1 metre interval. Clamps and hardware shall be of compatible material. Minimum size of earthing conductor shall not be less than 14 SWG G.S wire. Earthing conductor shall also be run along with cable ways / each conduit run.		
4.04.00	The contractor shall provide and maintain a temporary earthing system until permanent earthing system is installed.		
5.00.00	Lightning Protection System		
5.01.00	Lightning protection system shall conform to IEC:60203. It shall comprise vertical air termination, horizontal air termination, down conductor, test links, earth connections and earth electrodes.		
5.02.00	Vertical air termination shall extend 3 metre above the top of the chimney. For each flue duct, 3 nos. vertical air terminations shall be provided. Vertical air termination shall be of 20mm dia copper rod with lead cover of 2 mm thickness.		
5.03.00	Horizontal air terminations (coronal bond) shall be of minimum 50x6 mm galvanised steel strips provided at following levels. - Top level of each flue - Roof top level around outer concrete shell - Mid height around concrete shell		
5.04.00	Horizontal air terminations and vertical air terminations shall be inter connected by down conductors. No. of down conductors shall be minimum 4, equally spaced around and on exterior surface of concrete shell. Down conductors shall be of minimum 50x6 mm galvanised steel strip. Down conductors shall additionally be connected to vertical reinforcement		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-14 ELECTRICAL WORKS FOR CHIMNEY PAGE 4 OF 5

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS	एनटीपीसी NTPC	
	rods at top and bottom of chimney at minimum four locations. Suitable precaution shall be taken at these joint connections to prevent any galvanic action. Reinforcement bars shall be made electrically continuous throughout their height.		
5.05.00	Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure.		
5.06.00	Below the test link, direct connection with 40 mm dia mild steel rod shall be made to the earth grid system. Adequate no. of vertical electrodes of 40mm dia mild steel shall be provided to obtain required earth resistance.		
5.07.00	Down conductors shall not be connected to other earthing conductors above ground level. To avoid side flashing, metallic structures like hand rails, stairs etc.in the vicinity of down conductor shall be bonded to lightning protection system.		
5.08.00	Air terminations, down conductors, coronal band and accessories located at top 12 m level shall have lead cover of 2mm thickness. Suitable bimetallic washers shall be used while connecting conductors of different materials.		
	The accessories like nuts, bolts, dash fasteners, round clamps, washers etc., to be used for top 12 metre level shall be made of stainless steel.		
5.09.00	Down conductors and horizontal air terminations shall be cleated to concrete structure at 750 mm interval.		
5.10.00	The contractor shall provide and maintain a temporary lightning protection system until permanent lightning protection system is installed.		
6.00.00	Communication system		
6.01.00	Contractor shall provide telephone cable installed in independent G.I. conduits and wired up to junction boxes with telephone socket at 0.0 M and at every internal platform for connection of telephone handset.		
6.02.00	Telephone cables shall be of minimum 0.6 mm dia annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.		
7.00.00	TESTS		
7.01.00	All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below:		
	(A) Distribution boards/panels-Degree of protection tests		
	(B) Aviation lights:		
	(1)Intensity Test		
	(2)Degree of protection test		
	(3)Dust Ingress test		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB-SECTION-B-14 ELECTRICAL WORKS FOR CHIMNEY
			PAGE 5 OF 5

SUB-SECTION-IIB

ELECTRICAL SYSTEM / EQUIPMENTS

LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC NO. CS-9587-001R-2

	SCOPE OF SUPPLY AND SERVICES 		
1.00.00	SCOPE The Bidder scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, in plant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works as indicated in this chapter. The Electrical scope shall be as described briefly in the following clauses but not limited to it. TERMINAL POINT(S): 1. 1 no. supply feeder of 415V, 3 phase, 4 wire from Main panel; & 1 no. emergency feeder of 415V, 3 phase, 3 wire from DG - Emergency board shall be supplied by BHEL. Any other voltage level (AC/DC) required will be derived by vendor. Further distribution of power shall be in vendor's scope. 2. BHEL shall provide 4 nos. riser pigtails along with below ground earthing, around the periphery of the chimney. Supply & Interconnection of earthing/ Lightning protection material, shall be in vendor's scope. Note: Supply & E&C of 'structural steel' for supporting cabling material shall be in 'Vendor's scope'.		
LARA SUPER THERMAL POWER PROJECT STAGE- II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IIB ELECTRICAL SYSTEM / EQUIPMENTS
			PAGE 1 OF 20

	SCOPE OF SUPPLY AND SERVICES	एनटीपीसी NTPC		
1.05.02	LV SWITCHGEARS AND LV BUSDUCTS The scope of work includes the following for feeding all the LV Loads of the power plant as required (a typical key single line diagram for Aux Power Supply Drawing No. 9587-999-POE-J-001 enclosed). The design and sizing criteria of the Switchboards shall be as detailed at Chapter B-0/B-06. The major LT Switchgear shall include the following: 415 Volt Switchgears 415 Volt Motor Control Centers 415 Volt AC Distribution Boards 220 V DC/110 V DC/48 V DC Distribution Boards 415 Volt AC MCCB Boxes 220/110/48 Volt DC MCCB Boxes and Local Motor Starters -for ventilation fans (up to 5.5 KW) Local Emergency Push Buttons (EPB) -for all motors except ventilation fans Telescopic Trolley for Breaker Handling MLDB/WLDB with Lighting/Welding Transformers (2 no's of MCCB both at Primary and Secondary End of Transformer shall be provided) -- Spares (MCCB Modules less than 100 A and MPCB Modules): All Switchgears, Motor Control Centres (MCCs) & AC/DC distribution boards, etc. shall have at least twenty per cent (20%) or minimum two (whichever is higher) fully equipped MCCB/MPCB modules of each rating as spares which shall be uniformly distributed over different vertical sections. Spares (MCCB modules—100A and higher/Starter/DAE-OG/DM Modules): In addition, all Switchgears, MCCs and AC distribution boards shall have as spares at least twenty per cent (20%) of starter modules/MCCB/DAE-OG/DM modules or at least one module (whichever is higher) of each rating range of the selection table, equipped for the rating of the largest auxiliary fed from that range. It is preferable to supply LT Switchgears and LT Bus ducts from one/ two manufacturers.			
1.05.03				
LARA SUPER THERMAL POWER PROJECT STAGE- II (2X300 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-III ELECTRICAL SYSTEM / EQUIPMENTS	PAGE 3 OF 20	

SCOPE OF SUPPLY AND SERVICES**1.08.00****Cabling**

The scope of the contractor for all areas including building, equipment's and switchyard system etc. covered under this package including interplant areas are: -

- (a.) Supply and installation of Laying of , LT power and control cables.
- (b.) Supply and installation of Cable trays, fittings and their accessories, along with support system.
- (c.) Supply and installation of Cable glands and lugs.
- (d.) Supply and installation of Straight-through jointing kits for, LT power and control cables.
- (f.) Supply and installation of Welding receptacles.
- (g.)
- (h.) Supply and installation of Junction boxes.
- (i.)
- (j.) Supply and installation of Miscellaneous items like M.S. sections etc. as required

	SCOPE OF SUPPLY AND SERVICES	एनटीपीसी NTPC		
	(o.) Complete cable erection includes supply and erection of all the accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, and markers, support structures, cable trays, cable termination, junction boxes etc. shall be under the scope of contractor. 1.09.00 CABLES: 1.09.01 1.09.02 LT Power and Control Cables Supply of LT Power and Control cables along with interplant control and protection cabling, necessary termination, lugs & glands as required for all systems covered under this package as per Drg. No 9587-999-POE-J-001. 1.10.00 Earthing and Lightning Protection Below and above ground earthing mat/Grounding and lightning protection for the complete buildings, switchyard, and equipment's in the Contractor's scope. Bidder's scope shall also include interconnection of Earth grid with existing grid of stage-I at various locations. All earthing in BOP area shall be treated earth pits as per latest Indian Standard and IEEE guidelines. 1.11.00 Station Lighting Bidder's scope includes the following:			
LARA SUPER THERMAL POWER PROJECT STAGE- II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-IB ELECTRICAL SYSTEM / EQUIPMENTS	PAGE 6 OF 20	

SCOPE OF SUPPLY AND SERVICES



Design and Supply of Station lighting system for the plant, buildings and equipment under Bidder's area.

Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories, Lighting Panels, Receptacles, Switch boxes, Conduits, Lighting Wires, Ceiling fans or Wall mounted fans with regulators, lighting poles, Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self-contained lighting fixture, Maintenance ladders as required.

Scope shall also cover all interior and exterior lighting such as area lighting, aviation obstruction lighting, street lighting, security lighting etc in the contractor scope of area.

LED type lighting fixtures shall be provided for Lighting Mast.

Contractor shall prepare complete lighting layout drawings of all the areas covered under this contract.

Mandatory spare parts and maintenance equipment as required.

Out of the total requirement of lighting mast envisaged for station lighting, at least Fifteen (15) Lighting Masts of (30M height) shall be supplied, erected and commissioned at locations identified by Site Engineer prior to construction phase which shall cater to construction lighting and same shall later function as permanent lighting.

LED type lighting fixtures shall be provided for Lighting Mast.

Minimum 5 number of mobile lighting mast with DG set and fuel shall be provided for construction lighting and these are non-returnable.

SCOPE OF SUPPLY AND SERVICES



1.20.00

PAINTING FOR ELECTRICAL EQUIPMENT

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:

The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting is offered for any electrical

SCOPE OF SUPPLY AND SERVICES



equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. In case procedure is not indicated, Epoxy based paint with suitable additives shall be used. Paint shade for various Equipment shall be as follows:

9.	MV and LT Switchgear,	a) Front and Rear b) Extreme ends c) AC and DC MCCB Box	RAL 9002 RAL 5012 RAL 9002

SCOPE OF SUPPLY AND SERVICES



1.21.00

TYPE TEST

Contractor shall meet the requirements of type tests on electrical equipment's as stipulated in relevant chapters of technical specifications.

1. The Contactor shall carry out the type tests as listed in the specifications of respective equipment's. The Contactor shall indicate the charges for each of these type tests (which are not under report category) separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
2. The type tests shall be carried out in presence of the Employer's representative, for which minimum 07 days' notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
3. In case the Contactor has conducted such specified type test(s) within period as per Table-A (of clause no. 1.23.00 of this chapter) as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waive of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.
4. Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within period as per Table -A (of clause no. 1.23.00 of this chapter) from the date of bid opening. Such type tests shall be under "Report category" These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within period as per Table -A (of clause no. 1.23.00 of this chapter) from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

SCOPE OF SUPPLY AND SERVICES**Table-A**

S.No.	Equipment	Type test report validity (in years)
5.	MV Switchgear, LV switchgear, Bus ducts and Numerical relay	10
9.	HT, LT Power and control Cables	10
10.	Cable tray support	10
11.	Lighting: LED and Other equipment	10

SUB-SECTION-B – 08

LT & CONTROL CABLES

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	<u>LT Power Cables & Control Cables</u>			
	This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A".			
	CODES AND STANDARDS			
	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :			
	IS:7098 (Part -II)	Specification for Cross linked polyethylene insulated PVC sheathed cables. Part-II: For working voltages from 3.3 KV upto and including 33 KV.		
	IS : 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables.		
	IS:4905	Methods for random sampling.		
	IS : 5831	PVC insulation and sheath of electrical cables.		
	IS : 8130	Conductors for insulated electrical cables and flexible cords.		
	IS : 10418	Specification for drums for electric cables.		
	IS : 10810	Methods of tests for cables.		
	ASTM-D - 2843	Standard test method for density of smoke from the burning or decomposition of plastics.		
	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.		
IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.			
IS : 3961 IEC- 332	Recommended current ratings for cables Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUB-SECTION-B-08 HT LT AND CONTROL CABLES	PAGE 1 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS		एन टी पी सी NTPC																						
2.00.00	TECHNICAL REQUIREMENTS																								
2.01.00	All cables (HT Power, LT power and control cables) shall be Armoured type irrespective of anything contrary mentioned elsewhere in the specification.																								
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.																								
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.																								
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.																								
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmored cables, shall have distinct extruded PVC inner sheath of black color as per IS: 5831.																								
2.06.00	For single core Armoured cables, armoring shall be of aluminum wires. For multicore Armoured cables armoring shall be of galvanized steel as follows : - <table><tr><th colspan="2">Calculated nominal diameter of cable under armour</th><th>Size and Type of armour</th></tr><tr><td>i)</td><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>ii)</td><td>Above 13 & upto 25mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr><tr><td>iii)</td><td>Above 25 & upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr><tr><td>iv)</td><td>Above 40 & upto 55mm</td><td>1.4 mm thick GS formed wire/2.5mm dia GS wire</td></tr><tr><td>v)</td><td>Above 55 & upto 70mm</td><td>1.4 mm thick GS formed wire/3.15mm dia GS wire</td></tr><tr><td>vi)</td><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr></table>				Calculated nominal diameter of cable under armour		Size and Type of armour	i)	Upto 13 mm	1.4mm dia GS wire	ii)	Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	iii)	Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	iv)	Above 40 & upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire	v)	Above 55 & upto 70mm	1.4 mm thick GS formed wire/3.15mm dia GS wire	vi)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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2.06.01	The aluminum used for armoring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm-sq.mm/mtr at 20 deg.C. The types and sizes of aluminum armoring shall be same as mentioned for galvanized steel at 2.05.00 above.																								
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armoring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S. wire/ formed wire.																								
2.06.03	Distinct extruded PVC inner sheath of black color as per IS:5831 shall be provided for the cables as follows:																								
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B		SUB-SECTION-B-08 HT LT AND CONTROL CABLES																					
PAGE 2 OF 7																									

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.07.00 2.08.00 2.09.00 2.010.00 2.011.00 2.012.00 2.013.00 2.014.00 2.015.00 3.00.00 3.00.01 3.00.02	a) For all multicore cables. b) For single core Armoured cables, where armouring is not being used as metallic screen. Outer sheath shall be of PVC black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. a) Oxygen index of min. 29 (Test method as per IS 10810 Part-58) b) Acid gas emission of max. 20% as per IEC-754 (Part-I) c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843. Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets. Cable lengths shall be considered in such a way that straight through cable joints is avoided. All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated, and sizes shall be of 1Cx150, 1Cx300, 1Cx630, 3Cx150, 3Cx240 & 3Cx300 sq.mm. However for cable sizes upto 120 sq.mm. both XLPE insulated & PVC insulated LT power cables are acceptable. For LT cables, Same cable sizes to be used for same type & rating of motor i.e if there are three drives for one application, all three-drive motor should be provided with same cables sizes. However due to layout constraints no of runs of same size cable may be increased. Cores of the cables shall be identified by coloring of insulation. Following color scheme shall be adopted: i. 1 core - Red, Black, Yellow or Blue ii. 2 core - Red & Black iii. 3 core - Red, Yellow & Blue iv. 4 core - Red, Yellow, Blue and Black For reduced neutral conductors, the core shall be black. In plant repairs to the cables shall not be accepted. Pimples, fisheye, blow holes etc. are not acceptable. The cross-sectional area of the metallic screen strip/tape/wires shall be considered in sizing calculations. The eccentricity of the core shall not exceed 10% and ovality not to exceed 2%. CABLE SELECTION & SIZING Cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage c) Short circuit withstand capability Derating Factors			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUB-SECTION-B-08 HT LT AND CONTROL CABLES	PAGE 3 OF 7	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.00	Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables. The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval. CONSTRUCTIONAL FEATURES			
	4.00.04	1.1 KV Grade Power Cables (a) 1.1 KV grade XLPE power cables shall have compacted aluminum conductor, XLPE Insulated, PVC Inner-sheathed (as applicable), Armoured-PVC outer-sheathed conforming to IS: 7098. (Part-I). (b) 1.1KV grade PVC power cables shall have aluminum conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) Armoured, PVC outer-sheathed conforming to IS:1554 (Part-I). (c) 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUB-SECTION-B-08 HT LT AND CONTROL CABLES	PAGE 4 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
4.00.05	for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.																	
	CABLE DRUMS a) Cables shall be supplied in steel drums of heavy construction. The drum shall be designed on the basis of weight, diameter, bending radius and length of cable. The surface of the drum and the outer most cable layer shall be covered with waterproof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled. d) The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable excluding 630 sq.m size, and 750 meter for multicore cable & single core 630 sq.m. e) The standard drum length for Control cables with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter. f) One drum length of each cable size can be of non-standard length (not less than 250 meter) so as to match the ordered quantity subject to condition that there shall not be any joint in cable.																	
5.00.00	TYPE, ROUTINE AND ACCEPTANCE TESTS																	
5.01.00	Type Tests The reports for the following type tests shall be submitted for one size each of LT XLPE, LT PVC Power and control cables. The following type tests shall be carried out on one size each of 19/33 KV & 11/11 KV, 3.3/3.3 KV HT Cables. Size shall be decided by the employer during detailed engineering																	
<table><tr><th>S. No</th><th>Type Test</th><th>Remarks</th></tr><tr><td colspan="3">Conductor</td></tr><tr><td>1.</td><td>Resistance test</td><td>For Armour Wires / Formed Wires</td></tr><tr><td>2.</td><td>Measurement of Dimensions</td><td></td></tr><tr><td>3.</td><td>Tensile Test</td><td></td></tr></table>				S. No	Type Test	Remarks	Conductor			1.	Resistance test	For Armour Wires / Formed Wires	2.	Measurement of Dimensions		3.	Tensile Test	
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LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUB-SECTION-B-08 HT LT AND CONTROL CABLES PAGE 5 OF 7															

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC	
	S. No	Type Test	Remarks		
	4.	Elongation test			
	5.	Torsion test	For round wires only		
	6.	Wrapping test			
	7.	Resistance test			
	8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.		
	8(b)	Adhesion test	For GS wires/formed wires only		
		For XLPE insulation & PVC Sheath			
	9.	Test for thickness			
	10.	Tensile strength and elongation test before ageing and after ageing			
	11.	Ageing in air oven			
	12.	Loss of mass test	For PVC outer sheath only.		
	13.	Hot deformation test	For PVC outer sheath only.		
	14.	Heat shock test	For PVC outer sheath only		
	15.	Shrinkage test			
	16.	Thermal stability test	For PVC outer sheath only		
	17.	Hot set test	For XLPE Insulation only		
	18.	Water absorption test	For XLPE Insulation only		
	19.	Oxygen index test	For PVC outer sheath only		
	20.	Smoke density test	For PVC outer sheath only		
	21.	Acid gas generation test	For PVC outer sheath only		
	22	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only		
	LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B		SUB-SECTION-B-08 HT LT AND CONTROL CABLES

SUB-SECTION-B – 10

CABLING EARTHING AND LIGHTNING PROTECTION

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																		
1.00.00	CODES AND STANDARDS																																																					
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable. <table><tr><td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr><tr><td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmssion Line Towers.</td></tr><tr><td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr><tr><td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel fittings</td></tr><tr><td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr><tr><td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr><tr><td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr><tr><td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr><tr><td>IS:2629</td><td>Recommended practice for hot dip galvanising of iron & steel</td></tr><tr><td>IS:2633</td><td>Method for testing uniformity of coating on zinc coated articles</td></tr><tr><td>IS:3043</td><td>Code of practice for Earthing</td></tr><tr><td>IS:6745</td><td>Methods for determination of mass of zinc coating on zinc coated Iron & steel articles.</td></tr><tr><td>IS:8308</td><td>Compression type tubular in- line connectors for aluminium conductors of Insulated cables</td></tr><tr><td>IS:8309</td><td>Compression type tubular terminal ends for aluminium conductors of Insulated cables.</td></tr><tr><td>IS:9537</td><td>Conduits for electrical installation.</td></tr><tr><td>IS:9595</td><td>Metal - arc welding of carbon and carbon manganese steels – recommendations.</td></tr><tr><td>IS:13573</td><td>Joints and terminations for polymeric cables.</td></tr><tr><td>BS:476</td><td>Fire tests on building materials and structures</td></tr><tr><td>IEEE:80</td><td>IEEE guide for safety in AC substation grounding</td></tr><tr><td>IEEE:142</td><td>Grounding of Industrial & commercial power systems</td></tr><tr><td>DIN 46267 (Part-II)</td><td>Non tension proof compression joints for Aluminium conductors.</td></tr><tr><td>DIN 46329</td><td>Cable lugs for compression connections, ring type ,for Aluminium conductors</td></tr><tr><td>BS:6121</td><td>Specifcation for mechanical Cable glands for elastomers and plastic Insulated cables.</td></tr><tr><td></td><td>Indian Electricity Act.</td></tr><tr><td></td><td>Indian Electricity Rules.</td></tr></table>				IS:513	Cold rolled low carbon steel sheets and strips.	IS:802	Code of practice for the use of Structural Steel in Overhead Transmssion Line Towers.	IS:1079	Hot Rolled carbon steel sheet & strips	IS:1239	Mild steel tubes, tubulars and other wrought steel fittings	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating	IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear	IS:2309	Code of Practice for the protection of building and allied structures against lightning.	IS:2629	Recommended practice for hot dip galvanising of iron & steel	IS:2633	Method for testing uniformity of coating on zinc coated articles	IS:3043	Code of practice for Earthing	IS:6745	Methods for determination of mass of zinc coating on zinc coated Iron & steel articles.	IS:8308	Compression type tubular in- line connectors for aluminium conductors of Insulated cables	IS:8309	Compression type tubular terminal ends for aluminium conductors of Insulated cables.	IS:9537	Conduits for electrical installation.	IS:9595	Metal - arc welding of carbon and carbon manganese steels – recommendations.	IS:13573	Joints and terminations for polymeric cables.	BS:476	Fire tests on building materials and structures	IEEE:80	IEEE guide for safety in AC substation grounding	IEEE:142	Grounding of Industrial & commercial power systems	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors	BS:6121	Specifcation for mechanical Cable glands for elastomers and plastic Insulated cables.		Indian Electricity Act.		Indian Electricity Rules.
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1.02.00	Equipment complying with other Internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.																																																					
LARA SUPER THERMAL POWER PROJECT STAGE-II (2x800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 1 OF 21																																																		

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPG		
2.00.00	DESIGN AND CONSTRUCTIONAL FEATURE		
2.01.10	Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2x800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 2 OF 21

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.00.00 3.01.00 3.01.02 3.01.03 3.01.04 3.01.05 3.02.00 3.02.01 3.02.02	EQUIPMENT DESCRIPTION Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables. Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm. Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm. The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse Support System for Cable Trays Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings. Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder: - Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. - The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanized. - The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2x600 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 3 OF 21	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPG
	d) All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. e) The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. f) Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. g) Support system shall be able to withstand • weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span • Factor of safety of minimum 1.5 shall be considered			
3.02.03	The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.			
3.02.04	Four legged structure shall be provided wherever there is change in elevation and change in direction			
3.03.00	Pipes, Fittings & Accessories			
3.03.01	Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2x800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 4 OF 21

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00 3.04.01	Junction Boxes Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished: a) Impact resistance for impact energy of 2 Joules (IK07) as per BS EN50102 b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb c) Class of protection shall be IP 55 d) HV test			
3.04.02	Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.			
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3.06.00 3.07.00 3.07.01 3.09.00 3.09.01	Cable glands Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected. Cable lugs/ferrules Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections. Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code. Characteristics of crimping tool: 1) To should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender. 2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die 3) Tool should be compliant of testing according to IEC, UL and GS standards Tool shall have features such as • Auto retraction system • Manual retraction stop • Feedback signals for improper pressure • Better battery capacity and with status display • Flexible and rotating head for easy crimping Cable Clamps & Ties The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement &		
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	shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.			
3.10.00	Receptacles			
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC Insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD.			
3.12.00	Galvanising			
3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.			
3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.			
3.13.00	Welding			
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595.			
4.00.00	INSTALLATION			
4.01.00	Cable tray and Support System Installation			
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.			
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray			
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	installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.			
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated			
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.			
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.			
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.			
4.01.07	In fire prone areas, like Boiler, TG, fuel oil area and any other strategic location etc, fire retardant paint to be applied after installation cables.			
4.02.00	Conduits/Pipes/Ducts Installation			
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.			
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.			
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material			
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise			
	Conduit /pipe size (dia). Spacing			
	Upto 40 mm 1 M			
	50 mm 2.0 M			
	65-85 mm 2.5 M			
	100 mm and above 3.0 M			
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.			
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4.03.00	Junction Boxes Installation			
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.			
4.04.00	Cable Installation			
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.			
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general: a. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture. b. While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.			
4.04.03	Cables shall be laid on cable trays strictly in line with cable schedule			
4.04.04	Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every one metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer			
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4.04.15

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

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4.04.17	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.			
4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.			
4.05.00	Cable Terminations & Connections			
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer's instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site			
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.			
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.			
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.			
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, —etc along with cable numbers and coiled up after end sealing.			
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.			
5.00.00	EARTHING SYSTEM			
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts. The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 63 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All areas under contractor scope of supply shall be interconnected together			
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	by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system. All the columns shall be earthed by nearby risers and earthmat grid spacing shall be maximum 15 mts. Minimum two nos of risers shall be provided for each equipment in SG area. Separate dedicated riser shall be provided for C&I earthing purpose and also for Lightning down conductor connection purpose. Sufficient nos of risers near the equipment shall be provided as per the system requirement. Ring type earthing around the offsite building shall be provided with interconnection of with main grid at minimum two points.			
5.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.			
5.03.00	The material of the earthing conductors shall be as follows:			
	1. Conductors above ground level and in built up trenches.	-	Galvanized steel	
	2. Conductors buried in earth	-	Mild steel	
	3. Earth electrodes	-	Mild steel rod	
5.04.00	The sizes of earthing conductors for various electrical equipments shall be as below:			
	Equipment	Earth conductor buried In earth	Earth conductor above ground level & In built-up trenches	
	i. Main earth grid	Min 40 mm dia. MS rod or as per actual calculation whichever is more	65 x 8mm GS flat	
	ii. 33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	—	65 x 8mm GS flat	
	ii. 415 V MCC/ Distribution boards / Transformers	—	50 x 6mm GS flat	
	v. LT Motors above 125 KW	—	50 x 6mm GS flat	
	25 KW to 125 KW	—	25 x 6mm GS flat	
	1KW to 25 KW	—	25 x 3mm GS flat	
	Fractional House power motor	—	8 SWG GS wire	
	v. Control panel & control desk	—	25 x 3 mm GS flat	
	vi. Push button station / Junction	—	8 SWG GI wire	
	vii. Columns, structures, cable trays and bus ducts enclosures	—	50 x 6mm GS flat	
	vii. Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat	
5.05.00	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid			
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5.06.00	at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible Insulated cable. Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground.			
5.09.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.			
5.10.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.			
5.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.			
5.12.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.			
5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.			
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.			
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement along with each earth pit, in order to facilitate measurement of earth resistance as & when required.			
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.			
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5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.																																															
5.20.00	Other Requirements of Earthing System: <table><tr><td>Standard/Code</td><td colspan="3">IEEE 80, IS 3043</td></tr><tr><td>Earthing System</td><td colspan="3"></td></tr><tr><td>Life expectancy</td><td colspan="3">40 Years</td></tr><tr><td>System Fault Level</td><td colspan="3">System Fault Level 63 KA for 1 sec</td></tr><tr><td>Soil resistivity</td><td colspan="3">Actual as per site conditions</td></tr><tr><td>Mln. Steel corrosion</td><td colspan="3">0.12mm/year</td></tr><tr><td>Depth of burial of main earth conductor</td><td colspan="3">600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.</td></tr><tr><td>Conductor joints</td><td colspan="3">By electric arc welding, with resistance of joint not more than that of the conductor.</td></tr><tr><td colspan="4">Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection</td></tr><tr><td>Surface resistivity</td><td>- Gravel</td><td colspan="2">3000 ohm-meter</td></tr><tr><td></td><td>- Concrete</td><td colspan="2">500 ohm-meter</td></tr></table>				Standard/Code	IEEE 80, IS 3043			Earthing System				Life expectancy	40 Years			System Fault Level	System Fault Level 63 KA for 1 sec			Soil resistivity	Actual as per site conditions			Mln. Steel corrosion	0.12mm/year			Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.			Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.			Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection				Surface resistivity	- Gravel	3000 ohm-meter			- Concrete	500 ohm-meter	
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6.00.00	LIGHTNING PROTECTION SYSTEM																																															
6.01.01	Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards.																																															
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system.																																															
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.																																															
6.02.00	Down Conductors 1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode. 2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. 3. All joints in the down conductors shall be welded type. 4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval. 5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm. 6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. 7. Lightning conductors shall not pass through or run inside GI Conduits. 8. Testing link shall be made of galvanized steel of size 25x 6mm. 9. Pulser system for lightning shall not be accepted. 10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.																																															
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7.00.00 7.01.00 7.01.01	TESTS Type Test reports shall be furnished for the following Type tests on Cable Trays support system a) Test 1A: On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals: i. Working load II. Working load + point load iii. Off load iv. Proof load + point load v. Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied b) Test 1B Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2 Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load Intervals. i. Working load ii. Working load + point load iii. Off load iv. Proof load + point load v. Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side Test 3: Tests on Channel Fixed on Beam/Floor		
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	A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below: a) Test 3A: A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded Test 4 : Channel Insert Test A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall then be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals. i. Working load ii. Working load + point load iii. Off load iv. Proof load + point load v. Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied. Test 5 : Channel nut slip characteristics (what ever applicable) Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting. A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM		
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	Test 6 Weld Integrity Test After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any. 7.02.02 Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above. 7.03.00 Routine/ Acceptance Tests 7.03.01 Routine Tests a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification b) Physical & dimensional check on all equipments as per approved drawings/standards c) HV/IR as applicable d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard 7.03.02 Acceptance Test a) Galvanising Tests as per applicable standards b) Welding checks c) Deflection tests on cable trays One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm d) Proof load tests on cable tray support system i. Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test. ii. Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done. iii. Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test The procedure for carrying out tests at "d" above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity e) The above acceptance tests shall be done only on one sample from each offered lot.	
8.00.00 8.01.01 8.01.02	COMMISSIONING The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance Cables i. Check for physical damage ii. Check for insulation resistance before and after termination/jointing	
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	ii. HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning v. Check of continuity of all cores of the cables v. Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor. vi. Check for correct polarity and phasing of cable connections vii. Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. vii. Check for provision of correct cable tags, core ferrules, tightness of connections			
8.02.00	Cable trays / supports and accessories 1. Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2. Check for continuity of cable trays over the entire route. 3. Check that all sharp corners, burrs, and waste materials have been removed from the trays supports. 4. Check for earth continuity and earth connection of cable trays.			
8.03.00	Earthing and Lightning protection system 1. Earth continuity checks. 2. Earth resistance of the complete system as well as sub-system.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	3. The following clearances shall be maintained for LT Switchboard. a.) Front Clearance i) For one Row of Swgr - 1.5M (Min) ii) For two Rows of Swgr - 1.5/1.75M depending upon the depth of panels etc b.) Back Clearance i) For single front - 1.0M (Min) ii) For double front - 1.5M (Min)			
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	c.) Side Clearance:Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel. c) Minimum clear working space around the equipment 1200mm d) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided e) The cable entry and exit from switchgear room shall be from 1.5 mtr (minimum) above FGL f) Wash basin with mirror shall be provided in battery room.			
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SUB-SECTION-B – 11

LIGHTING

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1.00.00	GENERAL			
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Station Lighting system equipment.			
2.00.00	CODES AND STANDARDS			
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.			
2.02.00	Lighting Fixtures and Accessories			
	IS:1913	General and safety requirements for luminaries.		
	IS:2148	Flame proof enclosures of electrical apparatus.		
	IS:1534	Ballast for fluorescent lamps.		
	IS:1777	Industrial luminaire with metal reflectors.		
	IS:2418	Tubular fluorescent lamps for general lighting services.		
	IS:4013	Dust-tight electric lighting fittings.		
	IS:8224	Electric Lighting fittings for Division 2 areas.		
	IS:10276	Edison screw lamp holders.		
	IS:10322	Luminaires.		
	IS:13021	AC Supplied Electronic Ballasts for tubular fluorescent lamps.		
	IS 16103	LED Luminaire Standards		
2.03.00	Lighting Panels, Switch-boxes, Receptacles and Junction Boxes			
	IS:2147	Degree of protection provided by enclosures for low-voltage switchgear and control gear.		
	IS:1293	Plugs & socket outlets of rated voltage upto and including 250volts & rated current upto and including 16 Amps.		
	IS:2551	Danger notice plates.		
	IS:13947	Low voltage switchgear and control-gear		
	IS:3854	Switches for domestic and similar purposes.		
	IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC.		
	IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
2.04.00	Conduits, Pipes and Accessories			
	IS:2667	Fittings for rigid steel conduit for electrical wiring.		
	IS:3837	Accessories for rigid steel conduits for electrical wiring.		
	IS:9537	Conduits for electrical installations.		
2.05.00	Lighting Wires/Cables			
	IS:694	PVC insulated cables for working voltages upto and including 1100 V		
	IS:3961	Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables).		
	IS:8130	Conductors for insulated electric cables and flexible cords.		
2.06.00	IS:10810	Methods of tests for cables.		
	LED Luminaries			
	16101:2012	General Lighting. LEDs and LED modules Terms and definitions		
	16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.		
	16102(Part 2):2012	Self Ballasted LED Lamps for General Lighting Services. Part-2 Performance Requirements.		
	16103(Part I):2012	LED modules for General lighting Safety Requirements.		
	15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules		
	16104:2012	d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.		
	16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.		
	16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products		
	16107:2012	Luminaires Performance		
	16108:2012	Photo-biological safety of Lamps and Lamp Systems		
IS 513	Cold rolled low carbon steel sheets and strips			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
2.07.00	IS 12063	Classification of degree of protection provided by enclosures.		
	IS 14700	Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2) for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.		
	IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.		
	IS 15885	Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 18004 – 1 and 2) for LED modules.		
	IS 4905	Method for random sampling		
	Electrical Installation Practices & Miscellaneous			
	IS:1944	Code of practice for lighting of public thorough fare		
	IS:3646	Code of practice for interior illumination.		
	IS:5572	Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation		
	S:6665	Code of practice for industrial lighting.		
	.	National Electrical Code		
	-	Indian Electricity Rules.		
		Indian Electricity Act		
	IS:5	Colour for ready mixed paints & enamels.		
	IS:280	Mild steel wires for general engineering purposes.		
	IS:374	Electric ceiling type fans & regulators.		
	IS:732	Code of practice for electrical wiring installations.		
	IS:1255	Code of practice for Installation and maintenance of power cables Upto and including 33KV rating.		
	IS:2062	Steel for general structural purposes		
	IS:2629	Recommended practice for hot-dip galvanizing of iron and steel.		
	IS:2633	Methods for testing uniformity of coating of zinc coated articles.		
	IS:2713	Tubular steel poles for overhead power lines.		
IS:3043	Code of practice for earthing			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	IS:5216	Guide for safety procedures and practices in electrical work.		
	IS:5571	Guide for selection of electrical equipments for hazardous areas.		
	BS:6121	Mechanical cable glands		
3.00.00	LIGHTING SYSTEM DESCRIPTION			
3.01.00	The Illumination of various Indoor and outdoor areas in the main plant & offsite area shall be provided as described here. The lighting system of various areas shall comprise of the following systems as identified in Annexure-B:			
	(a)	Normal AC Lighting System		
	(b)	Emergency AC Lighting System		
	(c)	DC Lighting System		
3.02.01	Normal AC Lighting System			
	Normal AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs)/Switch board MCC.			
3.02.02	Emergency AC Lighting System			
	This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.			
3.03.00	DC Lighting System			
3.03.01	At strategic locations in the main plant, a few lighting fixtures fed from 220V, DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LDBs which in turn will be fed from DC lighting panels.			
3.03.02	The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.			
3.03.03	Emergency DC lighting is to be provided, through self-contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/offsite buildings wherever DC supply system is not available. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.			
3.03.04	For Coal Handling plant/FGD Plant Area 18W, 220V DC Lighting fixture shall be provided in underground portion of conveyor, each switchgear room, control room, office room, pump house, each drive floor of TPs, staircases of various TPs and buildings and each local control area. DC lighting fixtures shall be fed from 220V DC LDB which in turn will be fed from CHP DC system. The supply			
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4.00.00	to the DC lighting panels shall be automatically switched ON in case of loss of normal AC supply.			
	DESIGN PHILOSOPHY 1. A comprehensive illumination system shall be provided in the entire project areas under bidder's scope. 2. All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel. 3. The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting, including Transformer yard & Switch yard area, aviation obstruction lighting, Street lighting, security lighting, etc. The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings. 4. The Illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. The Lux levels to be adopted for various area are indicated at Annexure - A. (placed at the end of this Chapter). 5. Different Lighting Systems envisaged for various plant areas are indicated in Annexure-B: While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations. For CCR room Dimmable and Tunable downlighter fittings to be provided. 6. LED Luminaires: LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas & aviation lighting etc. conventional/LED type luminaires shall be used. However, aviation light in Lighting Mast shall be of LED type. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type. The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 100 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be "cool day light" (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. The LED luminaries shall have a minimum life of 25000 burning hours with 80% of lumen maintenance at the end of the life. LED shall conform to the LM 80 requirements. The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires			
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	shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire. The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires. Care shall be taken In the design that there is no water stagnation anywhere In the housing of luminaire. The entire housing shall be dust and waterproof protection as per IS 12063.																							
7.	Driver Circuit LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer. LED Drivers shall have following control & protections: - • Suitable precision current control of LED. • Open Circuit Protection • Short Circuit Protection • Over Temperature Protection • Surge Protection																							
8.	Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fixtures located in non air conditioned area. <table><tr><td>(a.)</td><td>Office area (air conditioned)</td><td>:</td><td>0.8</td></tr><tr><td>(b.)</td><td>Office area (non air conditioned) and other indoor area</td><td>:</td><td>0.7</td></tr><tr><td>(c.)</td><td>Dust prone indoor and outdoor area</td><td>:</td><td>0.6</td></tr><tr><td>(d.)</td><td>Coal Handling area, Ash Handling Conveyor /Transfer Points etc.</td><td>:</td><td>0.5</td></tr><tr><td>e.)</td><td>Boiler Area</td><td>:</td><td>0.6</td></tr></table> Reflectance Factor:- Ceiling :0.8 Wall : 0.5 Floor : 0.2 Reflectance factor for CHP areas such as Bunker floor, TPs etc and AHP outdoor areas :- Ceiling :0.3 Wall :0.3 Floor :0.1				(a.)	Office area (air conditioned)	:	0.8	(b.)	Office area (non air conditioned) and other indoor area	:	0.7	(c.)	Dust prone indoor and outdoor area	:	0.6	(d.)	Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5	e.)	Boiler Area	:	0.6
(a.)	Office area (air conditioned)	:	0.8																					
(b.)	Office area (non air conditioned) and other indoor area	:	0.7																					
(c.)	Dust prone indoor and outdoor area	:	0.6																					
(d.)	Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5																					
e.)	Boiler Area	:	0.6																					
9.	(i) All outdoor fixtures shall be weather proof and of min. IP65 degree of protection. (ii) For Indoor type of fixtures:- (a) Surface/Pendent mounting: - IP 54 class of protection. (b) Recess Mounting (False ceiling):- IP 20 class of protection.																							
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10.	(a) Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketed to achieve specified degree of protection. Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection. (B) All MCBs/Isolators/Switches/Contactors etc. shall be mounted inside the panel and a fibre glass sheet shall be provided inside the main door such that the operating knobs of MCBs etc., shall project out of it for safe operation against accidental contact. (c) Terminal blocks shall be 1100 V grade, clip-on stud type, made up of polyimide 6.6 or better suitable for terminating multicore 35 or 70 Sq. mm. stranded aluminium conductor incoming cable and 10 Sq. mm. stranded aluminium conductor for each outgoing circuits voltage. All terminals shall be shrouded, numbered and provided with identification strip for the feeders. (d) MCB's shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have short circuit interrupting capacity of 9 KA rms. MCB knob shall be marked with ON/OFF Indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held in ON position. MCB terminal shall be shrouded to avoid accidental contact. (e) Contactors of AC lighting panels shall be 3 no's, 63 A, single pole continuous duty MCB, with neutral link, load make-break type suitable for 415 V, 3 phase 4 wire system. (f) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication. (g) Programmable Digital Timer shall be Electronic Astronomical Almanac Time switch with battery backup of min. TEN years, 4 Digit LED display, 24 hours range, manual override facility, 10 Amp 3 relay output, with NO/NC Contacts suitable for operation on 240V single phase AC supply. (h) Each lighting panel (LP-3) shall be fed from a 415V/42V, 3 phase-4 wire, 3 KVA transformer. The transformer shall be located inside the lighting panel itself. Transformers shall be dry type, natural air cooled with class F insulation or better. Impedance of transformer shall be 5%. Transformers shall be tested as per IS:11171. Off-circuit tap changer with +/- 5% in steps of +/- 1.25% tapping shall be provided. One minute power frequency withstands voltage for lighting transformer shall be 2.5 KV. (i) Lighting Panels shall have 20% spare outgoing feeders and shall be of following types:-			
	TYPE	INCOMER FEEDER	OUTGOING FEEDERS	DETAIL OF CONTENTS
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X900 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUBSECTION-B-11 STATION LIGHTING	Page 7 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	LP-1	3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)	18Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
	LP-2	3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)	9 Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
	LP-3	1 No., 4A fuse 3 KVA transformer,40A TPN MCB	24 Nos., 16A, 45V MCB	IP 55 degree of protection. Incomer shall be suitable for receiving 4Cx16 sq. mm cable and outgoing circuit shall be suitable for 2Cx16 sq. mm cable.
	LP-D1	1No. 220V,32 A, DP Isolator (2Cx35sq.mm cable)	6Nos.,16A, 220V DP Switch & Fuse	220V,32A DC Fuse, etc. outdoor type IP:55 degree of protection.
	11.	Wires of different phase shall normally run in separate conduit.		
	12.	Power supply shall be fed from 415 / 240 V normal AC supply, emergency AC supply and 220V DC supply through suitable number of conveniently located lighting distribution boards (LDB) and lighting panels (LP). AC lighting supply shall be isolated from main supply by 2x100% isolation transformers of max. rating of 50 KVA for 10/15 nos. outgoing feeder with changeover switch facility. The isolation transformer shall be fed from two different bus sections of MCC and fault level restricted to 3 KA at Lighting Panels.		
	13.	Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. Further 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X900 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B		SUBSECTION-B-11 STATION LIGHTING
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3ph, 415V AC receptacle shall be provided in each floor of off-site buildings/ structures. Receptacles boxes shall be fabricated out of 2 mm thick MS steel hot dip galvanized or of not less than 2.5 mm thick die-cast aluminium alloy or fabricated out of 2 mm thick CRCA sheet with electro static powder coating. IP-degree of protection shall be applicable to receptacles Type 'RA &'RC' only. Minimum no of receptacle in TG and SG area shall be provided as per Annex-I, of chapter B-10. Receptacles shall be of following types:				
Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size	
RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor	
RB	16A, S.P240V AC	6A+16A6 Pin decorative Piano-key Type Switch	NTPC appd.make	1-4 way, suitable for loop-in loop- out of upto 10 sq.mm. Al. Conductor	
RC	20 A, SP24 V AC(Industrial)	20A, 3 pin24 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 2 core -16 sq.mm. Al. Cable.	
	14. In the hazardous areas like Hydrogen generation plant, fuel oil handling areas or any other gas/ liquid fuel storage/ handling areas In bidder's scope, lighting shall be flame proof. 15. The type of fixtures, LP, JB, and receptacle used In Hydrogen generation plant building shall be suitable for group II C as per IS: 2148 or class I, Division II as per NEC 70-428. 16. All fluorescent lamps shall be have "Cool day light" colour designation. The mirror optics type fluorescent fixtures shall have no iridescence effect. Fixtures with better efficiency and upgraded proven system may also be considered In candescent lamps may be used only with DC Lighting. 17. Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	18.	Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.		
4.01.00	NOT USED.			
4.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.			
4.03.00	Fans & Regulator			
4.03.01	Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height. The ceiling fans shall be suitable for operation on 240 V +/-10%, 50 Hz, AC supply comprising of class 'E' or better insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced AL blades (3 Nos.), down rod, BEE 5 star rated,die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white or with electro static powder coating. Power factor of fans shall not be less than 0.9. Fan regulators shall be stepped electronic type suitable for operation on 240V +/-10% AC supply.			
4.04.00	Junction Boxes, Conduits, Fitting & Accessories, Pull Out Boxes: Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55. All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate. Conduits, Pipes and Accessories Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered. Conduits in walls and ceilings in buildings with RCC and masonry structure such as Administrative, Service, Canteen, Time Office, Auditorium, IT building etc shall be concealed.Rigid steel conduits shall be heavy duty type,hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Flexible conduit shall be water proof and rust proof made of heat resistant TERNE coated steel. Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc.. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection. Pull out box & its cover shall be hot dip galvanized.			
4.05.00	Lighting Wires			
4.05.01	Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
4.06.00	& grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5 sq.mm. for copper and 4 sq.mm. for aluminium. Lighting Poles			
4.06.01	The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole. The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.			
4.08.00	Lighting fixtures shall generally be group controlled directly from lighting panel. However, in office areas, control shall be provided through switch boxes. Each switch shall control a maximum of three fluorescent fixtures.			
4.09.00	A.C. normal, AC emergency and DC system wiring shall run throughout in separate conduits. Wires of different phase shall run in different conduits.			
4.10.00	Lighting panels, etc. shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single phase receptacles etc. shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run alongwith each conduit run. Cable armours shall be connected to earthing system at both the ends.			
5.00.00	TESTS			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B	SUBSECTION-B-11 STATION LIGHTING	Page 11 of 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC															
5.01.00	For LED Fixture a) The contractor shall carry out the type tests as listed in this specification on the following types of LED fixtures to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of bid document and the same shall be considered for the evaluation of the bids. LED fixtures (Type test shall be conducted on one rating each of following type of LED fixtures. Rating for test conduction shall be decided by the employer during detailed engineering) a) High bay fixture. b) Wall glass fixture. c) Street light fixture d) Surface mounted type fixture. e) Recessed mounted type fixture. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.																		
5.02.00	For all other Station lighting equipment:																		
5.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.																		
5.04.00	Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S																		
5.05.00	Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval. <table><tr><th>SL NO.</th><th>DESCRIPTION</th></tr><tr><td>i.</td><td>Lighting fixtures of each type</td></tr><tr><td>ii.</td><td>Lighting panel of each type (Degree of Protection)</td></tr><tr><td>iii.</td><td>Junction Box of each type.</td></tr></table> Type test reports for LED as per standards for following shall be submitted for approval. <table><tr><td>1. Visual and Dimension check</td></tr><tr><td>2. Proof of procurement of LEDs</td></tr><tr><td>3. Safety tests</td></tr><tr><td>a) Marking</td></tr><tr><td>b) Construction</td></tr><tr><td>c) Provision for Earthing</td></tr><tr><td>d) External and Internal wiring</td></tr></table>				SL NO.	DESCRIPTION	i.	Lighting fixtures of each type	ii.	Lighting panel of each type (Degree of Protection)	iii.	Junction Box of each type.	1. Visual and Dimension check	2. Proof of procurement of LEDs	3. Safety tests	a) Marking	b) Construction	c) Provision for Earthing	d) External and Internal wiring
SL NO.	DESCRIPTION																		
i.	Lighting fixtures of each type																		
ii.	Lighting panel of each type (Degree of Protection)																		
iii.	Junction Box of each type.																		
1. Visual and Dimension check																			
2. Proof of procurement of LEDs																			
3. Safety tests																			
a) Marking																			
b) Construction																			
c) Provision for Earthing																			
d) External and Internal wiring																			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC	
	e) Protection against electrical shock f) Endurance and Thermal g) Insulation resistance & electrical strength h) Resistance to heat fire & tracking i) Resistance to Humidity 4. Fire Retardant test 5. Performance tests (electrical, Photometric color and Life) 6. Burn-in Test 7. Power Cycling 8. Temperature rise test 9. Emission Tests a) Radiated & conducted emission b) Harmonics & flickers 10. Immunity tests				
	In addition, following test reports to be submitted for LED chip/LED luminaire: a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer. b) LM 80/IS: 16105 report. c) LM 79/IS: 16106 report.				
	5.06.00	Acceptance Test and Routine Test			
	5.06.01	All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.			
	5.06.02	Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. Switch boxes shall be made of 1.6 mm thick MS sheet with 3 mm thick decorative, Perspex cover. Switch box shall be hot dip galvanized.			
	Switch boxes shall be of following types :				
	TYPE No.	Switch	Fan Regulator*	Socket	
	SWB 1	5 A - 2 Nos.	-	-	
	SWB 2	5 A - 3 Nos.	-	5A - 1.No.	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनडीपीसी NTPC
	SWB 3*	5 A - 5 Nos.	1	5A - 1.No	
	SWB 4*	5 A - 7 Nos	3	5A - 1.No.	
	SWB 5**	5 A - 5 Nos	-	5A - 1.No.	
	* Space provision shall be kept for fan regulator In switch boxes.				
	** Shall have the provision for mounting the 16 A contactor.				
5.07.00	Galvanizing Tests				
5.07.01	The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.				
5.07.02	In addition following tests shall be conducted as acceptance tests.				
	(a)	Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.			
	(b)	The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.			
	(c)	In addition, the plating thickness shall be determined microscopically/ chemically or electronically.			
6.00.00	COMMISSIONING CHECKS				
	1.	On completion of installation work, the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice.			
	2.	The Project manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.			
	3.	The Installation shall be then tested and commissioned In presence of the Project manager.			
	4.	The contractor shall provide all, men material and equipment required to carry out the tests.			
	5.	All rectifications repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over the lghing installation shall be effected only after the receipt of written instruction from the Employer/his authorized representative.			
	6.	The testing shall be done In accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	(a) Insulation Resistance. (b) Testing of earth continuity path. (c) Polarity test of single phase switches. (d) Functional checks. 7. The lighting circuits shall be tested in the following manner: (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth. (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.			
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QUALITY PLAN		CUSTOMER : BHEL		PROJECT TITLE : 2X500MW NTPL TUTICORIN FGD		SPECIFICATION NO. : PE-RC-999-509-E003 REV-02				
SHEET 1 OF 2		BIDDER/ VENDOR : M/S NAMDHARI INDUSTRIAL TRADERS PVT LTD.		STANDARD QP NO. : PE-QP-999-509-E001, REV. 01		SPECIFICATION TITLE : EARTHING & LIGHTNING PROTECTION MATERIALS				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	EARTHING		EXTENT OF CHECK	ITEM : EARTHING & LIGHTNING PROTECTION MATERIALS		DOC. NO. AGENCY	REMARKS	
			TYPE/ METHOD OF CHECK	CAT.		REFERENCE DOCUMENT	ACCEPTANCE NORM			FORMAT OF RECORD
1	2	3	4	5	6	7	8	9	10	11
1.0	RAW MATERIAL									
1.1	MILD STEEL (FLATS & RODS) AS PER SPECIFICATION	1.CHEMICAL & PHYSICAL PROPERTIES	MA	VERIFICATION, OF TCS	100%	IS:2062	IS-2062	MILL TC	3	1/2 Refer note in Remark at Sl. No.3
		2.DIMENSIONS	MA	MEASUREMENT	100%	IS - 1730	IS - 1730	QC RECORD	3/2	-
		3.SURFACE FINISH	MA	VISUAL	100%	IS : 1079	IS : 1079	QC RECORD	3/2	-
1.2	ZINC	1.CHEM.COMP.	MA	CHEM. TEST	SAMPLE	IS - 209	IS - 209	QC RECORD	3/2	1/2
2.0	IN-PROCESS									
2.1	CUTTING, DRILLING	1.DIMENSIONS	MA	MEASUREMENT	100%	APP. DATA SHEET/ APP. DRAWING	APP. DATA SHEET/ APP. DRAWING	QC RECORD	2	1
		2.SURFACE FINISH	MA	VISUAL	100%	FREE FROM DEFECTS & SLAG	FREE FROM DEFECTS & SLAG	QC RECORD	2	1
		1.CLEANING PICKLING, RINSING, & FLUXING	MA	VISUAL	PERIODIC IN EACH SHIFT	IS-2629	IS-2629	QC RECORD	2	-
2.2	SURFACE PREPARATION	2.SURFACE QUALITY	MA	VISUAL	100%	IS:2029	IS:2029	QC RECORD	2	-
BHEL										
PARTICULARS			BIDDER/VENDOR							
NAME										
SIGNATURE										
DATE										
LEGEND : 1 - BHEL/ CUSTOMER			2 - VENDOR		3 - SUB-VENDOR		P - PERFORM		W - WITNESS	
							BIDDER: SVENDORS COMPANY/ SEAL		V - VERIFICATION	



BHEL		CUSTOMER : BHEL		PROJECT TITLE : 2X500MW NTP, TUTICORIN FGD		SPECIFICATION NO. : PE-RC-999-509-E003 REV-02	
QUALITY PLAN		RIDER/ VENDOR SYSTEM		STANDARD OF NO. : PE-OP 999 509 E001 REV. 01		SPECIFICATION TITLE : EARTHING & LIGHTNING PROTECTION MATERIALS	
COMPONENT OPERATION		TYPE/ METHOD OF CHECK		ITEM : EARTHING & LIGHTNING PROTECTION MATERIALS		DOC. NO. : AGENCY	
SL. NO.	CHARACTERISTIC CHECK	CAT.	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
2.3	GALVANISING	MA	TEMPERATURE INDICATOR	CONTINUOUS	IS - 2629	QC RECORD	11
	2. GROSS	MA	VISUAL	PERIODIC	IS - 2629	QC RECORD	
	3. RATE OF IMMERSION	MA	VISUAL/ MEASUREMENT	100%	IS - 2629/ MFRS PRACTICE	QC RECORD	2
	4. SURFACE QUALITY	MA	VISUAL	100%	IS - 2629	QC RECORD	
	1. CHEMICAL	MA	CHEMICAL	1 No. LOT/SIZE	IS-2622	LAB TC	
	2. DIMENSIONS	MA	MEASUREMENT	IS 2500 (PART 1) LEVEL S-4	APP. DATA SHEET/ APP. DRAWING	INSP. REPORT	1
	3. SURFACE FINISH	MA	VISUAL	IS 2500 (PART 1) LEVEL S-4	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN, ETC.	INSP. REPORT	
	4. MASS OF ZINC COATING	MA	CHEM. TEST	Refer Remarks	IS-6745 / APP. DATA SHEET	INSP. REPORT	1
	5. UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	Refer Remarks	IS-2633	INSP. REPORT	2
	6. THICKNESS OF ZINC COATING	MA	ELCOMETER	Refer Remarks	APP. DATA SHEET	INSP. REPORT	1
	7. ADHESION	MA	MECH. TEST	Refer Remarks	IS-2629	INSP. REPORT	2
Note: Items like Pipes/ Flexible Copper Braid/ GI wire/ GS Rod/ Shielding Mast/ Test Itrk will be cleared based on COC (certificate of Compliance)							
BHEL							
PARTICULARS							
NAME							
SIGNATURE							
DATE							
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION							



No. of units to be selected in a sample			Acceptance No.	
(1)	(2)	(3)	(4)	(5)
Upto 25	3			(3)
26-100	5			0
101-150	8			0
151-500	13			1
501-1000	20			2
1001-10000	32			3
above	50			5

Note: If the number of defective units in a lot exceeds the acceptance number as specified in col (3) of the table, the lot shall be rejected. Also accepted

Note: sample for chemical test shall be selected by BHEL & testing shall be done at NABL/ govt. approved Sampling plan for galvanization test: Inspection shall be as per table 2 of IS 4759 and same is mentioned below:

Galvanization is to be done at galvanization plant listed in annexure-2 to quality plan.

ANNEXURE - 1

The Quality Plan shall include all the Quality Control Measures and Checks adopted by the Vendor to ensure that the material/component/assembly/services supplied by him meet/will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, processes, manufacture, assembly, packing and despatch. The following guide lines may be noted:

Item 1- Serial Number

Column 1-	Serial Number
Column 2-	Component/Operation- The component and/or operation being checked shall be given here.
Column 3-	Characteristics check- The characteristics being checked shall be given here, e.g., chemical composition, mechanical properties, leak tightness, surface defects etc..
Column 4-	Category - 'CR' stands for critical characteristic 'MA' stands for major Characteristic 'MI' stands for minor characteristic
Column 5-	Type/Method of check e.g. chemical analysis tensile testing, hydraulic test, visual examination radiography etc.
Column 6-	Extent of check, such as, 100, 10, 1 percent etc.
Column 7-	Reference Documents - Documents, such as technical specification, drawings, standard specifications (IS, BS ETC.) procedure, etc. according to which check is done.
Column 8-	Acceptance Norms - Standards etc. according to which acceptability or otherwise of the characteristics being checked is decided.
Column 9-	Format of Record - Formats, log sheets, reports, etc. in which the observations are recorded. Standard log sheets, reports, formats etc. of the Vendors shall be numbered and such reference numbers shall be included here.
Column 10-	Agency - The agency which performs the test/instruction shall be written in sub-column 'W' The agency which verifies test certificates/inspection records and carries out audit check of the components/operation shall be written in sub-column 'V'
The agencies are codified as 1, 2 & 3	
'1'	stands for (BHEL)
'1' *	means the operation shall be cleared by BHEL before the start of the next operation.
'2'	Stands for Vendor
'3'	stands for sub-Vendor of the Vendor and so on.
Example :	
Entry	'3' in column 'P' means test/inspection to be performed by sub-Vendor's QC
Entry	'2' in column 'W' means test/inspection to be witnessed by Vendor's QC
Entry	'1' in column 'V' means verification shall be done by BHEL and next stage to be started only after the hold point is cleared by BHEL
Column 11-	Remarks - Any special remarks shall be given here.

NOTES :

1. In absence of correlation with the test certificate(s) (e.g. material identification) samples shall be drawn by BHEL and all tests as per relevant specifications shall be carried out in their presence or in recognized Government Laboratory.
2. When materials and components are initially identified and stamped by BHEL QS engineer, the identification marks shall be preserved till despatch. Wherever this is not possible, the identification mark shall be transferred to the components in the presence of BHEL QS Engineer unless otherwise agreed.
3. For castings and forgings integral test specimens shall be provided, When this is not possible for casting, they shall be poured in the presence of BHEL QS Engineer unless otherwise, If witnessing of test by BHEL is called for.
4. When welders qualified by reputed inspection agencies or statutory bodies are not available, qualification tests shall be conducted in the presence of BHEL QS Engineer.
5. This Quality Plan is liable to be modified as per the requirements of approved drawings and changes in technical specifications/drawings. If there are contradictions in respect of column 7 & 8 between this Quality Plan and the approved drawings specifications, the latter shall prevail.
6. Wherever inspection by BHELs Purchaser/Third Party/Statutory authorities are mandatory, this shall be complied with.
7. Inspection reports, log sheets, test reports/certificate. etc. shall be furnished to BHEL at the appropriate stages or at the time of final inspection, as required.
8. This Quality Plan is also applicable to spares, if any, under scope of supply of Vendor.
9. The quality plan shall be submitted in minimum 4 copies with a soft copy of the same or in line with contract requirements.

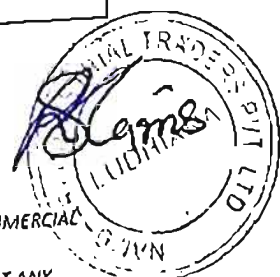


ANNEXURE-2 to Quality Plan
(LIST OF BHEL- PEM APPROVED GALVANIZERS)

SL. NO.	ITEM	VENDOR NAME	ADDRESS
1	Galvanising	Jenco Industrial Corporation	Chincholi Bunder Khkar Road Near Link Road
2	Galvanising	National Galvanizing Company	Devruwadi Malad (W) Mumbai 400064
3	Galvanising	Sigma Galvanising Pvt. Ltd.	66, Barrackpore Kamarhatt Trunck Road Calcutta-700058
4	Galvanising	B.P. Projects PVT LTD	Plot No.C-169, TTC, MIDC Ind Area Navin Mumbai-400705
5	Galvanising	Standard Galvanisers	167A, Vivekananda Road Kolkata-700006
6	Galvanising	Steel Products	Makardah Road, Kabar Para, Bankra, Howrah -711403
7	Galvanising	Unitech Fabricators & Engineers Pvt. Ltd.	National Highway No. 6, Chamrail, Kona, Howrah-711114
8	Galvanising	Shivam Engineers & Fabricators	Village- Ajab Nagar, P.O. -Molla Simla, P.S. - Singur, Dist - Hooghly, Pin-712223
9	Galvanising	B.G. Shirke Construction Technology Pvt. Ltd	A0-282-284, Industrial Area, South Side of G.T. Road, Ghaziabad, U.P.
10	Galvanising	Galbro.Ispat Galvanizers Pvt. Ltd.	72-76, Mundhawa, Pune - 401 036
11	Galvanising	Eros Metals	GUT 11 AND 12, OPP. KUDUS STEEL ROLLING MILL, WADA, THANE, MUMBAI
12	Galvanising	Industrial Perforation (India) Pvt. Ltd.	G-97, MIDC, Bhutibori, Nagpur
13	Galvanising	Indmark Formtech Pvt. Ltd.	Ganganagar, Katakhal, Kolkata-700132
14	Galvanising	Namdhari Industrial Traders Pvt. Ltd.	Phase - 3, E - 11 / 1, M. I. D. C., Chakan, Pune - 410 501, Maharashtra, India.
15	Galvanising	Neha Galvaniser	Village Latton Dana, Chandigarh Road, Ludhiana
16	Galvanising	Patny Systems (P) Ltd.	Jalan Industrial Estate, Gate No-1, 1st Right Chalse Lane, Near N.G-6, Jangalpur, PO Domjur Howrah - 700071,
17	Galvanising	Parmar Metal Company	Unit-IV, Sy No. -228/9, Plot No. 6, IP Kuchavaram, Toopran(M) Dist.- Medak, Telegana - 502336
18	Galvanising	Passive Infra Projects Pvt.Ltd.	Survey No.207, Veraval (Shapar) Dist. Rajkot, India.
19	Galvanising	Rukmani Electrical & Fabricators Pvt. Ltd.	8th KM Stone Sampla Kharkhoda Road Hassangarh, Rohtak, Haryana
20	Galvanising	DMP Projects Pvt.Ltd.	Uria Industrial Area, Uria Sarora Road, Raipur- 493 221 (Chhattisgarh)
21	Galvanising	Vinfab Engineers India Private Limited	Oulagarh Industrial Park, PS-Sankrail, Howrah -711302
22	Galvanising	Saral Projects & Processors	Gut no. 224/1 & 2 Bhiwandi Wada State Highway, Village khupri, Dist. Thane, Maharashtra -421303
23	Galvanising	Brahampuri Steels Limited.	B-1, Industrial Area, Site-II, Amawan Road Rae Bareilly
24	Galvanising	India Gratings Pvt. Ltd.	172 (F) Industrial Area, Jhotwara, Jaipur-302013
25	Galvanising	M/s AVAIDS TECHNOVATORS PVT LTD	F-S, MIDC Jejuri, Pune-412303

NOTES:

1. ANY CHANGE IN THE ABOVE LIST SHALL BE INFORMED AT THE TIME OF SPECIFIC PROJECT REQUIREMENT AND NO COMMERCIAL IMPLICATION SHALL BE ALLOWED ON THIS ACCOUNT.
2. IT SHALL BE THE RESPONSIBILITY OF THE VENDOR TO GET THE MATERIAL GALVANIZED FROM THE ABOVE LIST WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL.



ENDORSEMENT SHEET FOR QP REFERENCE / STANDARD / FIELD QUALITY PLAN (RQP / SQP/RFPQ/SFQP)			
TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION			To be filled in by NTPC
PROJECT NAME	3x800 MW NTPC PATRATU STPP EXPANSION, PHASE-1		
CONTRACT NO.:	434		
MAIN SUPPLIER	M/S. BHARAT HEAVY ELECTRICALS LTD., PEM, NOIDA		
MANUFACTURER WORKS & ADDRESS	M/S INDUSTRIAL PERFORATION (INDIA) PVT LTD , 327, R.N. GUHA ROAD DUM DUM , KOLKATTA-700028		
GALVANIZER WORKS & ADDRESS	M/S INDUSTRIAL PERFORATION (INDIA) PVT LTD , KATAKHAL GANGANAGAR 24-PGS NORTH KOLATA-700132		
ITEM /EQUIPMENT / SYSTEM/ SUB-SYSTEM DETAILS i.e. MODEL TYPE/SIZE/RATING etc.	CABLE TRAY & ITS ACCESSORIES (LADDER & PERFORATED TYPE)		
APPROVED QP NO.:	RQP/SQP/RFPQ/SFQP 0000-999-QOE-S-021 , T01 DATED 06.02.04		
Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)			
I. That the item/ component is identical to that considered for QP approval. ☒			
II. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same do not affect the contents of QP.			
III. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same affect the QP slightly, as indicated below / in attached sheet—			
NOTES: 1. Kindly refer Annexure-A for NTPC approved galvanizer list. 2. Kindly refer Annexure-B for additional Notes.			
SIGN.: (Main Supplier)	DATE :	 SIGN.: (Manufacturer) DATE:	
		NTPC (Reviewed /Approved by/ Date & Seal)	

ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) GALVANIZED CABLE TRAYS (Pefibrated & Ladder type) & ACCESSORIES		STANDARD QUALITY PLAN CONFORMING TO CODE :				Q.P. NO. 0000-999-QOE-S-021		REV.: 1 DATE: 06.02.04		REVIEWED BY APPROVED BY	
COMPONENT & OPERATIONS		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENT	
SL. NO.		3		4		5		6		7	
2		1 In Black Condition		Major		Visual		100% Random		Manufacturer's Plant Std	
1		a) Weld Quality		Major		Visual		IS-4759-1996		IS-2629-1985	
		b) Burs		Major		Visual		IS-4759-1996		IS-2629-1985	
		2 After Galvanizing		Major		Visual		IS-4759-1996		IS-2629-1985	
		2.1 General Physical inspection including Galvanizing Quality/ Defects, Dieromating, White rusting etc.		Major		Visual		IS-4759-1996		IS-2629-1985	
		2.2 Dimensional check & Sheet Thickness		Major		Measure ment		-do-		NTPC/Main Supplier Approved Drawing	
		2.3 Galvanizing tests		Critical		Measure ment		-do-		IS-4759-1996	
		a) Coating thickness measurement survey by Elcometer		Critical		Measure ment		-do-		IS-4759-1996	
		b) Mass of zinc coating		Critical		Measure ment		-do-		IS-4759-1996	
		c) Uniformity of zinc coating/dip test		Critical		Measure ment		-do-		IS-4759-1996	
		d) Adhesion test		Critical		Visual		-do-		IS-2629-1985	
		2.4 Deflection Test		Critical		Measure ment		1 sample from each size type/ lot		*F*	
FINISHED CABLE TRAYS & ACCESSORIES		1 In Black Condition		Major		Visual		100% Random		Manufacturer's Plant Std	
		a) Weld Quality		Major		Visual		IS-4759-1996		IS-2629-1985	
		b) Burs		Major		Visual		IS-4759-1996		IS-2629-1985	
		2 After Galvanizing		Major		Visual		IS-4759-1996		IS-2629-1985	
		2.1 General Physical inspection including Galvanizing Quality/ Defects, Dieromating, White rusting etc.		Major		Visual		IS-4759-1996		IS-2629-1985	
		2.2 Dimensional check & Sheet Thickness		Major		Measure ment		-do-		NTPC/Main Supplier Approved Drawing	
		2.3 Galvanizing tests		Critical		Measure ment		-do-		IS-4759-1996	
		a) Coating thickness measurement survey by Elcometer		Critical		Measure ment		-do-		IS-4759-1996	
		b) Mass of zinc coating		Critical		Measure ment		-do-		IS-4759-1996	
		c) Uniformity of zinc coating/dip test		Critical		Measure ment		-do-		IS-4759-1996	
		d) Adhesion test		Critical		Visual		-do-		IS-2629-1985	
		2.4 Deflection Test		Critical		Measure ment		1 sample from each size type/ lot		*F*	

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION

** M: MANUFACTURER/SUB-SUPPLIER, C: CONTRACTOR/NOMINATED INSPECTION AGENCY, N: NTPC, INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE

"CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN "N" AS "W".

FORMAT NO.: QS-01-QALP-10/F3-R0

1/1

ENGG DIV./QAI

ANNEXURE-A to Quality Plan

LIST OF NTPC APPROVED GALVANIZERS (FOR NTPC PROJECTS)

S. NO.	ITEM	VENDOR NAME
1	Galvanising	MJ Engg., Delhi
~~2~~	~~Galvanising~~	~~Jamna Metal, Delhi~~
3	Galvanising	A.V. Engg., Kolkata
4	Galvanising	Inar Profiles, Vishakapatnam
5	Galvanising	Anand Udyog, Mumbai
6	Galvanising	Techno Engg., Chandigarh
7	Galvanising	Steelite Engg., Mumbai
8	Galvanising	National Galvanizer, Kolkata
9	Galvanising	Unistar Galvanizer, Kolkata
10	Galvanising	B.P. Projects, Kolkata
11	Galvanising	Bajaj, Pune
12	Galvanising	Electrocare Industries, Mumbai
13	Galvanising	B.G. Shirke, Pune
14	Galvanising	Gurpreet Galvanizer, Hyderabad
15	Galvanising	Sigma, Mumbai
16	Galvanising	Radhakrishnan Shetty, Chennai
17	Galvanising	Karamtara, Mumbai
18	Galvanising	Poona Galvanizers, Pune
19	Galvanising	Neha Galvanizer, Kolkata
20	Galvanising	Unitech Galvanizers, Hoogly
~~21~~	~~Galvanising~~	~~DMP projects, Kolkata~~
~~22~~	~~Galvanising~~	~~Patny Systems, Medhak~~

NOTES:

- 1 **ANY CHANGE IN THE ABOVE LIST SHALL BE INFORMED AT THE TIME OF SPECIFIC PROJECT REQUIREMENT AND NO COMMERCIAL IMPLICATION SHALL BE ALLOWED ON THIS ACCOUNT.**
- 2 **IT SHALL BE THE RESPONSIBILITY OF THE VENDOR TO GET THE MATERIAL GALVANIZED FROM THE ABOVE LIST WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL.**



ANNEXURE-B
3X800 MW NTPC PATRATU STPP
QUALITY PLAN FOR CABLE TRAY & ACCESSORIES

NOTES:

1. BHEL reserves the right for conducting repeat test, if required.
2. Latest revisions/year of issue of all the Standards indicated in the QP shall be referred at the time of inspection.

ENDORSEMENT SHEET FOR QP REFERENCE / STANDARD / FIELD QUALITY PLAN (RQP / SQP/RFP/SFQP)			
TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		 NTPC	To be filled in by NTPC
PROJECT NAME	3x800 MW NTPC PATRATU STPP EXPANSION, PHASE-1		
CONTRACT NO.:			
MAIN SUPPLIER	M/S. BHARAT HEAVY ELECTRICALS LTD., PEM, NOIDA		
MANUFACTURER WORKS & ADDRESS	M/S INDUSTRIAL PERFORATION (INDIA) PVT LTD , 327, R.N. GUHA ROAD DUM DUM , KOLKATTA-700028		
GALVANIZER WORKS & ADDRESS	M/S INDUSTRIAL PERFORATION (INDIA) PVT LTD , KATAKHAL GANGANAGAR 24-PGS NORTH KOLATA-700132		
ITEM /EQUIPMENT / SYSTEM/ SUB-SYSTEM DETAILS i.e. MODEL TYPE/SIZE/RATING etc.	CABLE TRAY SUPPORT SYSTEM – BOLTABLE		
APPROVED QP NO.: RQP/SQP/RFP/SFQP	3120-104A-01-QVE-007	REV. NO: 00	DATED : 14.01.2019
Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)			
I. That the item/ component is identical to that considered for QP approval. ☒			
II. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same do not affect the contents of QP.			
III. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same affect the QP slightly, as indicated below / in attached sheet—			
NOTES: 1. Kindly refer Annexure-A for list of NTPC approved galvanizers. 2. Kindly refer Annexure-B for additional Notes.			
SIGN.: (Main Supplier)		SIGN.: (Manufacturer)	
DATE :		DATE:	
			
		NTPC (Reviewed /Approved by/ Date & Seal)	

ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) GALVANISED FLEXIBLE CABLE TRAYS SUPPORT SYSTEM		STANDARD QUALITY PLAN				Q.P. NO. 0000-999-QOE-S-38 REV. 00 DATE: 01.09.04 PAGE 1 OF 2 VALID UPTO: 31.08.07		REVIEWED BY S.D. SINGH O.P. NIRANJAN L.J. SINGH		APPROVED BY ANTIL NTPC, New Delhi			
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	Flexible cable trays Support Structure	3. 1. In Black Condition a) Weld Quality b) Burs	4. Major	5. Visual	100%	6. Random	7. Manufacturer's Plant Std No Burs	8. Manufacturer's Plant Std No Burs	9. Inspection Report -do-	10. P	11. V	12. V	13. 11
2.	Finished Galvanized	2. After Galvanizing 2.1 General physical inspection including Galvanizing Quality/Defects, Dicotomating, White Rusting etc. 2.2 Dimensional Check & Thickness Check 2.3 Galvanizing Tests a) Coating thickness measurement survey by Elcometer b) Mass of zinc coating c) Uniformity of zinc coating/dip test d) Adhesion Test	Major	Visual	100%	5 Sample/L of	IS-2629-1985 IS-4759-1996	IS-2629-1985 IS-4759-1996	-do-	P	W	W	0
			Major	Measurement	-do-	-do-	NTPC/Main Supplier Approved Drg.	NTPC/Main Supplier Approved Drg.	-do-	P	W	W	
			Critical	Measurement	IS-4759-1996	-do-	IS-4759-1996 IS-3203-1982	IS-4759-1996 IS-3203-1982	-do-	P	W	W	
			Critical	Measurement	-do-	1 coupon sample of each thickness	IS-6745-1972 IS-4759-1996	IS-6745-1972 IS-4759-1996	-do-	P	W	W	
			Critical	Measurement	-do-	-do-	IS-2633-1986 IS-4759-1996	IS-2633-1986 IS-4759-1996	-do-	P	W	W	
			Critical	Visual	-do-	-do-	IS-2629-1985	IS-2629-1985	-do-	P	W	W	

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION

**M: MANUFACTURER/SUB-SUPPLIER, C: Main Supplier: NTPC, N: NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE

"CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN "N" AS "W"

FORMAT NO. QS-01-QA/P-10/F3-R0

1/2

ENGG. DIV./QA&I



ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.)		STANDARD QUALITY PLAN		Q.P. NO. 0000-999-QOE-S-38		REVIEWED BY		APPROVED BY	
		CONFORMING TO CODE: Design as per NTPC Specification		REV. NO. DATE: 01.09.04 PAGE 2 OF 2 VALID UPTO: 31.08.07		S.D. SINGH O.P. NIRANJAN I.J. SINGH		ANIL CHAKRA MPC, New	
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY
					M	C/N			M C N
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
		Proof Load Test as per note 6 Followed by Die Penetration Test (For 600 mm and above cable tray support system)	A	Meas/Visual	One Sample from each offered lot	NTPC Technical Specification/ No visible cracks should develop on the weld part on the weld part	NTPC Technical Specification/ No visible cracks should develop on the weld part on the weld part	Inspection Report	P W

Note:

- The supplier to ensure procurement of steel from main producers like SAIL/TISCO, Rastriya Ispat/Ispt Ind. Jindal/Esster/Lloyds/IS Co. and Zinc from Hindustan Zinc Ltd.
- Welding shall be done by qualified welders as per supplier system.
- Material shall be galvanized at NTPC approved sources only.
- Pre-treatment of cable trays support system shall be carried out in seven tank process as per IS-2629. All the process parameters e.g. Concentration, temperature, density etc. to be maintained and recorded by the galvaniser.
- The process of pre-treatment shall be verified by NTPC on surveillance basis during inspection of Galvanised Flexible Cable Trays support system.
- (i) Test on Main support Channel shall be done if only C1 channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test as per tech. Spec.
(ii) Test on Main Support Channel shall be done with C2 Channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2 A of type tests. Then test at (i) above shall not be repeated.
(iii) Nut slip characteristic test (It shall support minimum load of 350 Kg. Before Nut Slips with bolt torque of 65 NM). This test shall be same as test 5 B of type tests.
(iv) The procedure for carrying out above test shall be as per details given in Type Tests Specification.

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION
 **M: MANUFACTURER/SUB-SUPPLIER, C: Main Supplier, N: NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE
 "CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN "N" AS "W"

FORMAT NO. QS-01-QA1-P-10/F3-R0

2/2

ENGG. DIV /QA&I

ANNEXURE-A to Quality Plan

LIST OF NTPC APPROVED GALVANIZERS (FOR NTPC PROJECTS)

S. NO.	ITEM	VENDOR NAME
1	Galvanising	MJ Engg., Delhi
~~2~~	~~Galvanising~~	~~Jamna Metal, Delhi~~
3	Galvanising	A.V. Engg., Kolkata
4	Galvanising	Inar Profiles, Vishakapatnam
5	Galvanising	Anand Udyog, Mumbai
6	Galvanising	Techno Engg., Chandigarh
7	Galvanising	Steelite Engg., Mumbai
8	Galvanising	National Galvanizer, Kolkata
9	Galvanising	Unistar Galvanizer, Kolkata
10	Galvanising	B.P. Projects, Kolkata
11	Galvanising	Bajaj, Pune
12	Galvanising	Electrocure Industries, Mumbai
13	Galvanising	B.G. Shirke, Pune
14	Galvanising	Gurpreet Galvanizer, Hyderabad
15	Galvanising	Sigma, Mumbai
16	Galvanising	Radhakrishnan Shetty, Chennai
17	Galvanising	Karamtara, Mumbai
18	Galvanising	Poona Galvanizers, Pune
19	Galvanising	Neha Galvanizer, Kolkata
20	Galvanising	Unitech Galvanizers, Hoogly
~~21~~	~~Galvanising~~	~~DMP projects, Kolkata~~
~~22~~	~~Galvanising~~	~~Patny Systems, Medhak~~

NOTES:

- 1 ANY CHANGE IN THE ABOVE LIST SHALL BE INFORMED AT THE TIME OF SPECIFIC PROJECT REQUIREMENT AND NO COMMERCIAL IMPLICATION SHALL BE ALLOWED ON THIS ACCOUNT.
- 2 ~~IT SHALL BE THE RESPONSIBILITY OF THE VENDOR TO GET THE MATERIAL GALVANIZED FROM THE ABOVE LIST WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL.~~

Any issue specific to Manufacturer and BHEL shall be taken up separately with BHEL. This should not be made a part of QP.



ANNEXURE-B
3X800 MW NTPC PARTRATU STPP
QUALITY PLAN FOR CABLE TRAY SUPPORT SYSTEM-BOLTABLE

NOTES:

1. BHEL reserves the right for conducting repeat test, if required.
2. The latest revisions/year of issue of all the Standards indicated in the QP shall be referred at the time of inspection.

ITEM : LIGHTING FIXTURES (Conventional and LED type)		STANDARD QUALITY PLAN						REVIEWED BY		APPROVED BY	
		CONFORMING TO CODE : As applicable						Rev No.: 08 Date: 02/11/15 VALID UPTO: 01/11/18		SWAPNESHWAR MISHRA VIKRAM TALWAR SUNIL MAJANI	
Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTITY OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NUMERALS	FORMAT OF RECORD	REMARKS	
					GM	GM					
1	2	3	4	5	6	7	8	9	10	11	12
Note: 1). Lighting fixture supplier to ensure that constructional features of the lighting fixture (conventional & LED type) are as per NTPC specification requirements. 2). Lighting fixture supplier to maintain all quality control records identified in this QP whether it is identified for NTPC verification or witness or no.											
Conventional type Lighting Fixture											
A	Bought out items / in-process checks										
1	Lamps	Make, rating & type	Major	Visual	1 sample per type	1 sample per type	NTPC specification requirements for rating & type, Make to be BIS approved with CML number	NTPC specification requirements for rating & type, Make to be BIS approved with CML number		V	-
1.1	Electronic Ballast (if applicable)	a) Certificate of compliance	Major	Visual	-	-	NTPC specification requirements	Certificate of compliance by ballast manufacturer / lighting fixture supplier that ballast meets all NTPC specification requirements	Certificate of compliance	V	-
		b) THD and pf check	Major	Electrical	Min 1 std.	-	NTPC specification requirements	THD <= 10%, pf >= 0.9 for PFH type and pf >= 0.95 for other type of fluorescent lighting fixtures	Inspection report	P/V	-
1.2	Castings	Freedom from defects	Major	Visual	Min 1 std.	-	NTPC specification requirements	Castings shall be free from any defects such as blow holes, surface blisters, cracks and cavities etc.	Inspection report	P/V	-
1.3	Sheet metal forming and fabrication	Freedom from defects	Major	Visual	Min 1 std.	-	NTPC specification requirements	sheet metal fabrication / forming etc should be as per manufacturer drgs	Inspection report	P/V	-
1.4	Pre-treatment and powder coating	Pre-treatment process checks, Powder coating finish, thickness, uniformity of coating and adhesion	major	Visual, chemical & mech	Min 1 std.	-	Manufacturer standard, NTPC specification requirements	Nominal coating thickness 50 microns or more	Inspection report	P/V	-

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER / SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC; P: PERFORMANCE; W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "4" AS "W".

Format No.: QS/01-QAI-9-10/F3-00

Engg. Div./CA&I



ITEM: LIGHTING
FIXTURES
(Conventional and LED type)

STANDARD QUALITY PLAN

QP.No: 000-999-Q0 :-S-062

REVIEWED BY

APPROVED BY

Rev No: 00

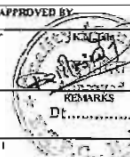
SWAPNESHWAR MISHRA

Date: 02/11/15

VIKRAM TALWAR

VALID UPTO: 01/11/18

SUNIL MALANI



Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	M C N				REMARKS
					GM	GCN								
3	Acceptance Tests on conventional Lighting fixture	a Details of lot offered and Certificate of compliance that lighting fixture supplier has inspected the offered lot as per their own standard	Major	Visual	-	-	lighting fixture supplier to submit the details of lot offered for NTPC inspection (Type of lighting fixtures, their batch number, sub-vendor name, quantity)	COC	List	P	V	V		The list may be used by NTPC for sample selection
		b Lamp make	Major	Visual	100%	100%	Make to be BIS approved with CML number	Make to be BIS approved with CML number	Certificate of compliance	V	V	V		
		c Constructional features including: Internal wiring, terminal block, earthing terminal, safety chain (if applicable)	Major	Visual	1 sample per type	1 sample per type	NTPC specification and NTPC approved data sheet/drg	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W		
		d Electronic Ballast (if applicable for offered lighting fixtures) THD and pf check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	THD <= 10%, pf >= 0.9 for FFL type and pf >= 0.95 for other type of fluorescent lighting fixtures	Inspection report	P	W	W		At lighting fixture supplier test lab
		e Resistance to moisture test in case of lighting fixtures having IP 34 and above rating	Major	Mechanical	1 sample per type	1 sample per type	NTPC approved data sheet	IS 10322 Part 1	Inspection report	P	W	W		
		f Resistance to dust (applicable if IP 54 and above)	Major	Optical	Mnfr std.	Mnfr std.	NTPC approved data sheet and accepted type test reports	Certificate of compliance	Certificate of compliance	P/V	V	V		P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		g Photometry check	Major	Optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports	Certificate of compliance for the batch : that offered lighting fixture LOR : not to be less than 90% (refer IS 16107) with reference to type test reports	Certificate of compliance	P/V	V	V		P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		h Dimensions	Major	Visual	1 sample per type	1 sample per type	NTPC specification and approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W		
		i HV & IR test	Major	Visual	1	1	IS 10322 part 1	IS 10322 part 1	Inspection report	P	W	W		# As per Table 1 (Inspection Level S2) and Table 2 CAQL 2.5 to IS 2500

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/ SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC
P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "N" AS "W".

Format No.: QS-01-QAI-P-10/F3-R0

Engg. Div./QA&I



ITEM : LIGHTING
FIXTURES
(Conventional and LED type)

STANDARD QUALITY PLAN

Q.P.NO:0000299-Q05-S-462

REVIEWED BY

APPROVED BY

Rev No.: 01

SWAPNESHWAR MISHEA

VIKRAM TALWAR

Date: 02/11/15

SUNIL MALANI

REMARKS

VALID UP TO: 01/11/18

FORMAT OF RECORD

REMARKS

a	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTITY OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD				REMARKS
					On	GCN			1	2	3	4	
1													
	LED type Lighting fixture												
	Bought out items / in-process checks												
	LED Chip	LED chip efficacy	Major	Visual	Mnfr Std	Mnfr Std	NTPC Spec/ Appd. Data sheet/ LM 81 report	NTPC Spec/ Appd Data sheet	LM 81 report		V	V	At the time of final inspection
		LED chip CRI and CCT	Major	Visual	Mnfr Std	Mnfr Std	NTPC Spec/ Appd. Data sheet/ LM 81 report	NTPC Spec/ Appd Data sheet	LM 81 report		V	V	At the time of final inspection
		Reported TM21 (L80) lifetime of LED chip	Major	Visual	Mnfr Std	Mnfr Std	NTPC Spec/ Appd. Data sheet/ LM 81 report	NTPC Spec/ Appd Data sheet	LM 81 report		V	V	At the time of final inspection
1	LED Driver	a Compatibility with LED module/chip, controls & protection features as per NTPC spec	Major	Visual	-	-	NTPC spec requirements	Certificate of compliance by LED driver manufacturer / lighting fixture supplier that driver meets all NTPC specification requirements	Certificate of compliance		V	V	
		b THD and pf check	Major	Electrical	Mnfr std.	-	NTPC specification	THD < 13% and pf >= 0.9	Inspection report		V	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
	Castings	Freedom from defects	Major	Visual	Mnfr std.	-	NTPC specification requirements	Castings shall be free from any defects such as blow holes, surface blisters, cracks and cavities etc.	Inspection report		V	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
	Sheet metal forming and fabrication	Freedom from defects	Major	Visual	Mnfr std.	-	NTPC specification requirements	sheet metal fabrication / forming etc should be as per manufacturer standards and good engg practices	Inspection report		V	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
	Pre-treatment and powder coating	Pre-treatment process checks, Powder coating finish, thickness, uniformity of coating and adhesion	major	Visual, chemical & mech	Mnfr std	-	Mnfr standard, NTPC specification requirements	Nominal coating thickness 50 microns or more	Inspection report		V	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier

LEGEND: * RECORDS, IDENTIFIED WITH "MCK" (V) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/ SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC
P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "N" AS "W".

Form No.: QS-01-QA/P-10/F3-R0

Engg. Div./QA&I



**ITEM : LIGHTING
FIXTURES**
(Conventional and LED type)

STANDARD QUALITY PLAN

QP.NO-0008-999-QCE-S-062

REVIEWED BY

APPROVED BY

Rev No.: 00

SWAPNESHWAR MSHRA

Date: 02/11/15

VIKRAM TALWAR

VALID UPTO: 01/11/16

SUNIL MALANI

REMARKS

Dt:

REMARKS

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENT	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS			
					6 M	CON				M	C	N	
1	2	3	4	5	6	7	8	9	10	11	12		
B	Acceptance Tests on LED Lighting fixture	a Details of lot offered and Certificate of compliance that lighting fixture supplier has inspected the offered lot as per their own standard	Major	Visual		-	lighting fixture supplier to submit the details of lot offered for NTPC inspection (Type of lighting fixtures, their batch number, sub-vendor name, quantity)	-	List	P	V	V	The list may be used by NTPC for sample selection
		b LED chip make	Major	Visual		-	NTPC accepted type test reports (LM80/LM79) report	Certificate of compliance	Certificate of compliance	V	V	V	
		c Constructional features including: Internal wiring, terminal block, earthing terminal, safety chain (if applicable)	Major	Visual	1 sample per type	1 sample per type	NTPC specification and NTPC approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W	
		e Resistance to moisture test in case of lighting fixtures having IP X4 and above rating	Major	Mechanical	1 sample per type	1 sample per type	NTPC approved data Sheet	IS 10/22 Part II	Inspection report	P	W	W	
		f Resistance to dust (applicable if IP5X and above)	Major	optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports	Certificate of compliance	Certificate of compliance	P/V *	V	V	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		f Photometry check	Major	optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports, LM 79, IS 16106, IS 16107	Certificate of compliance for the batch that offered lighting fixture LOR and lighting fixture efficacy i; not be less than 90% (refer IS 16107) with reference to type test reports	Certificate of compliance	P/V *	V	V	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (/) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/ SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC
P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "N" AS "W".

Format No.: QS-01-QAI-P-10/13-R0

Engg. Dir./QA&I

Sl No		COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK		QUANTITIES OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	REVIEWED BY				APPROVED BY
					Visual	Electrical	1 sample per type	1 sample per type			Q.P.NO-2000-999-QCE-S-062	Rev No.: 00	Date: 01/11/15	VALID UPTO: 01/11/18	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
		g	Dimensions	Major	Visual	sample per type	1 sample per type	NTPC specification and approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W		
		i	LED driver: THD and pf check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	THD < 10% and pf >= 0.9	Inspection report	P	W	W	At lighting fixture supplier test lab	
		j	LED driver: Precision current control check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W		
		k	LED driver: Open circuit protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W		
		l	LED driver: Short circuit protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W		
		m	LED driver: Over temperature protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W		
		n	LED driver: Overload protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W		
		o	LED driver: Surge protection compliance check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	Certificate of compliance that surge protection is provided	Certificate of compliance	V	V	V		

PACKING SPECIFICATIONS- LIGHTING FIXTURES, LAMPS & MISC. ITEMS ANNEXURE-I

PACKING

1. The material shall be packed to ensure protection against damage during transit, storage for prolonged periods and handling.
2. Lighting Fixtures, Lamps, Receptacles, Switchboards, 24V Supply modules, 24V sockets, Junction Boxes, Exit signs shall be clean and dry prior to packaging.
3. All items specified at sl. No.2 above shall be supplied in packed cartons. The tapes used for packing shall not bleed, leave residue, or damage the item when removed.
4. Fixtures & other lighting material shall be wrapped in weather proof material such as polythene sheets, air bubble sheets/ thermocol etc. The lighting fixtures shall be placed in a corrugated paperboard/ fibreboard container/ mono carton.
5. The mono cartons shall be wrapped or bagged or tied in place in master cartons. The master carton shall be taped and then wrapped with cushioning material.
6. The dimensions of cartons shall be as per manufacturer's recommendations.
7. For items like step ladder, wheel mounted ladder and flexible conduits, packing shall be as per manufacturer standard.

Note: In case Manufacturer has a different packing standard which is **equivalent or better** same to be submitted for approval during contract stage.

CLAUSE NO.	QUALITY ASSURANCE		
	LED Luminaire quality requirements: 1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same. 2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same. 3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same. 4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same. 5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI 6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer. Notes: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2. Make of all major Bought Out Items will be subject to NTPC approval.		
TALCHER THERMAL POWER PROJECT STAGE-III (2X660 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC.NO.: CS-4540-001A-2	SUB-SECTION –E-44 STATION LIGHTING	Page 2 of 2

CAT-I

ENDORSEMENT SHEET FOR Q.P.

REFERENCE / STANDARD / FIELD QUALITY PLAN (RQP / SOP / RFQP / SFQP / SFQP)

TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		NTPC		To be filled in by NTPC
PROJECT NAME	REVIEW & ENDORSEMENT BY NTPC			
CONTRACT No.	PROJECT SPECIFIC Q.P. NUMBER ALLOTTEL			
MAIN SUPPLIER	Q.P. No.: 4410-001-213-QVE-Q-002			
MANUFACTURER WORKS & ADDRESS	REV. No.: 00 DATE: 04.07.2016			
ITEM/ EQUIPMENT/ SYSTEM/				
SUB-SYSTEM DETAILS i.e. MODEL TYPE/ SIZE/ RATING etc				
APPROVED Q.P. No.: RQP/SOP/RFQP/SFQP	0000-999-QQE-S-0041	REV. No.: 00	DATE: 03/02/2012	
Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)				
I. That the item/ component is identical to that considered for Q.P. approval. OR				
II. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same do not affect the contents of Q.P. OR				
III. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same affect the Q.P. slightly, as indicated below/ in attached sheet.				
		The Q.P. is enclosed for this project with changes as indicated.		
		DISTRIBUTION OF ENDORSEMENT OF A) RQP/SQP: 1. MAIN SUPPLIER (with a copy of Q.P.) 2. MANUFACTURER 3. RIO 4. COA-SPL 5. COA-O/C B) RFQP/SFQP: 1. MAIN SUPPLIER (with a copy of Q.P.) 2. MANUFACTURER 3. NTPC FOA (with a copy of Q.P.) 4. NTPC Erection (with a copy of Q.P.) 5. COA-SPL 6. COA-O/C		
SIGN.: (Main Supplier)		SIGN.: (Manufacturer)		
DATE:		DATE:		
		NTPC (Reviewed / Approved by / Date & Seal)		

FOR REFERENCE ONLY

FOR REFERENCE ONLY



Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7093 Part-I AND NTPC TECHNICAL SPECIFICATION)				REVIEWED BY INDERJIT SINGH VIKRAM TALWAR RAJEEV GARG		APPROVED BY H. A. K. GARG								
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantity of check	M	C/N	Reference Document	Acceptance Norms	Record Format	D*	M	C	N	Agency	Remarks
1	2	3	4	5	6			7	8	9		10			11	
Instructions: 1) Cable manufacturer to maintain records to show co-relation of raw materials to finished cables. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.																
A	Raw material/ Bought out Items															
1.01	Aluminium	1. Make	MA	Verify	100%	-	-	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	-	-		
		2. Resistivity	MA	Elect	As per Cable Mfr's Sd	-	-	IS 5082	IS 5082	-do-		P	-	-		
1.02	PVC / XLPE/compound for insulation	1. Make	MA	Verify	100%	-do-	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	-do-		V	V	-		
		2. Type/ Grade	MA	Verify	100%	As per manufacturer norms	100%	NTPC ADS	NTPC ADS	-do-		V	V	V		
		3. All acceptance test as per manufacturer norms including thermal stability test for PVC insulation	MA	Verify	As per manufacturer norms	As per manufacturer norms	100%	NTPC ADS	NTPC ADS	-do-		V	V	V		Refer note 1
1.03	PVC Compound for inner sheath	1. Make	MA	Verify	100%	-do-	-do-	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	-do-		V	V	V		
		2. Type/ Grade	MA	Verify	100%	-do-	-do-	NTPC ADS	NTPC ADS	-do-		V	V	V		
1.04	Steel wire / Frayed Wire (As applicable)	1. Make	MA	Verify	100%	-do-	-do-	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	-do-		V	V	V		
		2. Dimension	MA	Meas	1 sample from each store / lot	-	-	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	-do-		P	-	-		
1.05	PVC compound for sheath	3. All acceptance test as per IS 3975	MA	Verify	As per IS 3975	-	-	IS 3975	IS 3975	Supplier		V	V	-		
		1. Make	MA	Verify	As per manufacturer norms	100%	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	V	-		
		2. Type/ Grade	MA	Verify	100%	As per manufacturer norms	100%	NTPC ADS	NTPC ADS	QCR		V	V	V		
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	QCR		V	V	V		Refer note 1

LEGEND:- RECORDS IDENTIFIED WITH "TICK" UNDER COLUMN "P" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-MANUFACTURER/SUPPLIER, CMAIN SUPPLIER, NTPC, PPERFORM WITHINSSA, VERIFICATION AS APPROPRIATE, CHP, NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"
FORMAT NO:QS-01-QAT-P-1003-R1

FOR REFERENCE ONLY

Sl. No	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	Characteristics	Class	Type of check	Quantity to check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	N				D*	M	C	N	
1	Component & Operations	4	Thermal Stability	Chem	One sample / Batch	---	NTPC ADS	NTPC ADS	QCR	9	P	---	---	---
		5	Oxygen Index	Chem	---	---	NTPC ADS/IS 10810 Part 58	NTPC ADS/IS 10810 Part 58	---	---	P	---	---	---
1.06	Wooden Drum	6	Acid Gas Emission	Chem	One sample / Batch	---	NTPC ADS/IEC 60754	NTPC ADS/IEC 60754	QCR	---	P	---	---	---
		1. Dimension	Meas	Manuf Std	---	---	IS 10418	IS 10418	---	---	P	---	---	---
		2. Anti-leakage treatment	MI	Chem	Cable manuf std	---	CABLE MANUF. STD	CABLE MANUF. STD	QCR	---	V	---	---	---
1.07	Steel Drum	1. Dimension	MI	Meas	---	---	---	---	---	---	P	---	---	---
		2. Surface finish	MI	Meas	---	---	---	---	---	---	P	---	---	---
B	Process & Stage Inspection													
2.01	Wire Drawing	1. Surface finish	MA	Visual	One sample/Section of each size	---	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR	---	P	---	---	---
		2. Wire Diameter	MA	Meas	---	---	NTPC ADS	NTPC ADS	---	---	P	---	---	---
		3. Tensile test	CR	Mech	---	---	---	---	---	---	P	---	---	Refer SI No. 3 (3/3/11)
2.02	Bunching / stranding	4. Wrapping test	CR	Mech	---	---	---	---	---	---	P	---	---	---
		1. No. of wires	MA	Meas	---	---	NTPC ADS	NTPC ADS	---	---	P	---	---	---
		2. Dia of wire	MA	Meas	---	---	---	---	---	---	P	---	---	---
		3. Dimension of Conductor	MA	Meas	---	---	---	---	---	---	P	---	---	---
		4. Direction of lay	MA	Visual	---	---	---	---	---	---	P	---	---	---
		5. Recard of strand breakage / welding during conductor stranding	MA	Verify	---	---	IS 8130	IS 8130	---	---	P	---	---	---
		6. Surface finish	MA	Visual	---	---	---	---	---	---	P	---	---	---
		7. DC Resistance	CR	Meas	---	---	IS 8130/NTPC ADS	IS 8130/NTPC ADS	---	---	P	---	---	---
2.03	Insulation extrusion	1. Surface finish	MA	Visual	One sample/Section of each size	---	NTPC spec	SHOULD BE SMOOTH, NO POROSITY IS PERMITTED.	QCR	---	P	---	---	XLPE/PVC compound shall be preferably loaded in an extruder by section method.

FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-1 AND NTPC TECHNICAL SPECIFICATION)				OP NO. 0000-999-QOE-S 041 REV-00 DATE: 01-02-12 Page 3 of 11 VALID UP TO: 02-02-15				REVIEWED BY: RIDEHIT SINGH VIKRAM TALWAR RAJEEV GARG				APPROVED BY: [Signature] A.P.R. GARG			
Sl No	Component & Operations	Characteristics	Class	Type of check		Quantity of check		Reference Document	Acceptance Norms	Record Format	Remarks						
				5	Visual	M	C/R				D*	M	C	N			
1		3	4			6	7	8	9								
		2. Colour of cores	M/A	Visual	One sample/Section g of each size	-do-	-	NTPC ADS	NTPC ADS	QCR		P	-	-			
		3 Thickness	CR	Meas	-do-	-do-	-	NTPC ADS	NTPC ADS	-do-		P	-	-			
		4 Spark Test	CR	Elect	100%	100%	-	CABLE MANUF. STD.	No FAILURE	-do-		P	V	V			
		5. Hot Set	CR	Mech	One sample/Section g of each size	-do-	-	IS 7098- Part I	IS 7098- Part I	-do-		P	-	-			
2.04	Laying up	1 Core sequence	M/A	Visual	-do-	-do-	-	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	-do-		P	-	-			
		2. Direction of lay	M/A	Visual	-do-	-do-	-	-do-	-do-	-do-		P	-	-			
		3. Dia over laid up core	M/A	Meas	-do-	-do-	-	NTPC ADS	NTPC ADS	-do-		P	-	-			
2.05	Tracer Sheath	1 Colour	M/A	Visual	-do-	-do-	-	-do-	-do-	-do-		P	-	-			
		2. Surface Finish	M/A	Visual	100%	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	-do-		P	-	-			
		3 Thickness	M/A	Meas	One sample/Section g of each size	-do-	-	NTPC ADS	NTPC ADS	-do-		P	-	-			
		4 Dia over tracer sheath	M/A	Meas	-do-	-do-	-	-do-	-do-	-do-		P	-	-			
2.06	Armouring (As Applicable)	1 Dimension 2 No. of wires / strip	M/A	Meas	-do-	-do-	-	-do-	-do-	-do-		P	-	-			
		3. Direction of lay	M/A	Visual	-do-	-do-	-	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	QCR		P	-	-			



APPROVED
Checked and Approved.

Date: 17-Dec-2018

*Approval doesn't absolve the EPC contractor of its responsibility as specified in the Contract.

FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 PART 1 AND NTPC TECHNICAL SPECIFICATION)		Reference Document		REVIEWED BY INDERJIT SINGH VIRAM TALWAR RAJEEV GARG		APPROVED BY [Signature] [Signature] [Signature]		Remarks	
Sl. No	Component Operations	Characteristics	Class	Type of check	Quantity of check	Acceptance Criteria	Record Format	3	4	5	6
1	2	4. Coverage & Quality of armouring	MA	Meas	100%	Min area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space & there shall be no cross over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire / formed wire. The breaking load of armour wire joint shall not be less than 95% of that of armour wire / formed wire (As per NTPC specification)	QCR	9	10	11	
2.07	Outer Sheath	5. Dia over wire/armouring	MA	Meas	One sample/Station of each size	NTPC ADS	-do-				
		1. Surface finish	MA	Visual	100%	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)	-do-				PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2. Colour of sheath	MA	Visual	One sample/Station of each size	NTPC ADS	-do-				
		3. Dia over outer sheath	MA	Meas	-do-	NTPC ADS	-do-				
		4. Thickness of outer sheath	CR	Meas	-do-	-do-	-do-				Drawn no. on cable may be embossed part
		5. Embossing quality	MA	Visual	100%	Drawn no. IS 1554-1, IS 7098-1 Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)	-do-				
		6. Sequential marking	MA	Visual	Full length	Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (As per NTPC specification)	-do-				
4	Finished Cables	All type tests as per NTPC specification	CR	Doc	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Part) & IS 7098-1	-do-				
3.01	Type test reports clearance from NTPC engineering										



LEGEND:- *RECORDS IDENTIFIED WITH "TICK" UNDER COLUMN "P" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-MANUFACTURER/SUPPLIER, CABLE SUPPLIER, NTPC, P:PERFORM WITHINNESS, VERIFICATION AS APPROPRIATE, CRP: NTPC SHALL IDENTIFY IN COLUMN "P" AS "W" P
FORMAT NO:QS-01-QAL-P-10/03-13

FOR REFERENCE ONLY

Page 5 of 11

Item: 1.1 KV Power
(XLPE & PVC)
Insulated
cables

STANDARD QUALITY PLAN
(CONFORMING TO CODE: IS 1554 PART 1, IS 7098
Part-1 AND NTPC TECHNICAL SPECIFICATION)

OP NO. 0000-895-QOE-S041
REV-10 DATE: 01-02-12
Page 5 of 11
VALID UP TO: 02-02-15

REVIEWED BY
INDRMIT SINGH
VIRAJ TALWAR
RAJESH GARG

APPROVED BY
A. S. Garg
NTPC

Sl. No.	Component & Operations	Characteristics	Class	Type of check	Quantity of check M	C/N	Acceptance Criteria	Record Format	Remarks
3.02	Routine Tests	1. High Voltage test at room temperature 2. Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	Refer note 3
3.03	Acceptance Tests	1. CID of Cable 2. Laying of core 3. Core identification 4. Colour of outer sheath 5. Inner sheath thickness 6. Inner sheath colour	MA CR CR MA CR MA	Meas. Visual Visual Visual Meas Visual	Each type & size of cables as per sampling plan of IS 1554 (Part I) & IS 7098- Part I	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	Refer note 2
3.03 (H)	Armour wires/ Fibred wires (if applicable)	1. Dimension 2. No. of wires/ fibred wire 3. Tensile test 4. Elongation test 5. Torsion test (for round wires only) 6. Wrapping test 7. Resistance test	CR CR CR CR CR CR CR	Meas Meas Meas Meas Meas Meas Meas	Each type & size of cables as per sampling plan of IS 1554 (Part I) & IS 7098- Part I	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	Refer note 2

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APPROVED
Checked and Approved.

Date: 17-Dec-2018

*Approval doesn't absolve the EPC
contractor of its responsibility as
specified in the Contract.

FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated cables		STANDARD QUALITY PLAN (CONFORMING TO CODE IS 1554 PART 1, IS 1098 Part-I AND NTPC TECHNICAL SPECIFICATION)		QIP NO. 0000-999-DOE-S-041 REV-00 DATE: 03-02-12 Page 6 of 11 VALID UP TO: 02-02-15		REVIEWED BY INDERIT SINGH VIKRAM TALWAR RAHEB GARG		APPROVED BY A.K. GARG DEPT. CHIEF ELECTRICAL	
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantity of check	Reference Document	Acceptance Norms	Record Format	Remarks
					M	C/N			
1	2	8. Mass of Zinc coating	CR	5 Mass	6		NTPC ADS/IS1554(Part I)/IS3075	9 Test certificate	11
		9. Uniformity of Zinc Coating	CR	Chem	-do-		-do-	-do-	
		10. Adhesion test	CR	Mech	-do-		-do-	-do-	
		11. Freedom from defects	CR	Visual	-do-		-do-	-do-	
3.03 (iii)	Conductor	1. Resistance Test	CR	Elect	-do-		-do-	-do-	
		2. Tensile test (For aluminum conductor only)	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part I) & IS 1098(Part I)		NTPC ADS/IS 8130	NTPC ADS/IS 8130	
		3. Wrapping test (For aluminum conductor only)	CR	Mech	-do-		-do-	-do-	

to be reviewed as per SI No. 2.01 for Tensile test & wrapping test (for Aluminium) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2



marked to be reviewed as per SI No. 2.01 for Tensile test & wrapping test (for Aluminum) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2

FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE IS 1554 PART 1, IS 7098 Part-1 AND NTPC TECHNICAL SPECIFICATION)			OP. NO. 0000-999-00E-S04.1 REV-00 DATE: 03-12-12 Page 7 of 11 VALID UP TO: 02-12-13			REVIEWED BY INDERJIT SINGH VIKRAM TALWAR RAJEEV GARG			APPROVED BY A.K. Garg		
Sl No	Component & Operation	Characteristics	Class	Type of check	Quantity of check M	C/N	Reference Document	Acceptance Criteria	Record Format	Remarks			
1													
3.03 (IV)	PVC/XLPE PEI insulation on XLPE PVC Sheath	1. Thickness of insulation & PVC Sheath	CR	Meas	6		NTPC ADS/IS 1554(Part I) & IS 7098 Part I	8 NTPC ADS/IS 1554(Part I) & IS 7098 Part I	9 Test Certificate	11			
		2. Tensile strength & elongation at break of insulation & outer sheath (before ageing)	CR	Meas			NTPC ADS/IS 1554(Part I) & IS 7098 Part I		Test Certificate	Refer Note 3 Also			
		3. Tensile strength & elongation at break of insulation & outer sheath (after Ageing)	CR	Meas						Refer Note 3			
		4. Insulation resistance (Volume resistivity method)	CR	Elect									
		5. High voltage test at room temperature	CR	Elect									
		6. Hot Set test for XLPE insulation (only)	CR	Phys									
		7. Thermal stability on PVC insulation and outer sheath	CR	Chem									



FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE IS 1554 PART 1, IS 7093 Part 1 AND NTPC TECHNICAL SPECIFICATIONS)		QIP NO. 0000-999- COE-S-041 REV-001 DATE: 03-02-12 Page 8 of 11 VALID UP TO: 02-02-15		REVIEWED BY INDERJIT SINGH VIRAM TALWAR RANDEEP		APPROVED BY S. K. Garg Approved Director	
Sl. No.	Component & Operation	Characteristics	Class	Type of check	Quantity of check	Reference Document	Acceptance Norms	Record Format	Remarks
					M	C/N			
1	2	3	4	5	6	7	8	9	11
		8. Oxygen index test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes	NTPC ADS IS10810 Part 38	NTPC ADS	-do-	
		9. Smoke density rating test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes	NTPC ADS & ASTM D2843	NTPC ADS	-do-	
		10. Acid gas generation test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes	NTPC ADS & IEC 60754-1	NTPC ADS	Test Certificate	
		11. Flammability test on completed cable	CR	Chem	Refer Note 4	NTPC ADS & IEC 60332 Part 3 (Category-B)	NTPC ADS	-do-	
		12. Surface finish & length measurement	CR	Visual & Meas	One length of each size	(1) Drum no. (2) IS1554-1/IST1098-1 Cable size: Voltage grade & Wires - 50LS at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (3) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible			Sample, Fish parrots, Shaw Hole etc. not permitted. Repairing on order sheet not permitted.
		13. Sequence of cores armour coverage gap between two consecutive armour finished wire	CR	Visual & Meas	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space & there shall be no cross over / overlapping of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire / formed wire		-do-	
4	Packing	1. Sealing	MA	Visual	100%	(1) IS1554-1 (Part 1) & IS 7098-Part 1 (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC rubber caps secured by "U" nails		QCR	
4.01	Identification	NTPC Sealing	MA	Visual	100%	Sealing shall be visible		QCR	



FOR REFERENCE ONLY

REVIEWED BY
INDERJIT SINGH
VIRAM TALWAR
RAJEEV GARG

CP NO. 0000-999-QOE-S041
REV-00 DATE: 03-02-13
Page 9 of 11
VALID UP TO: 03-02-15

STANDARD QUALITY PLAN
(CONFORMING TO CODE IS 1554 PART 1, IS 7095
PART 1 AND NTPC TECHNICAL SPECIFICATION)

Item: 1.1 KV
Power (XLPE &
PVC) Insulated
FRLS cables

Quantum of check
M C/N

Type of check
4 5 6

Class

3

Characteristics

2

Sl. No

1

Acceptance
Norms

Record
Format

Agency
M C N

Remarks

8 9 10 11

Notes:

1) If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)

2) (a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/
Regional Offices :- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection.
2(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices, :- Routine Test are to be witnessed by Main Contractor & NTPC. This is in add on to manufacturer internal test report to be verified by NTPC at the time of final inspection.
3) Refer table on page 10 & 11 of 11 for Sampling & Acceptance criteria.

4) For PVC Insulated LT power cable :- For cables with OD less than equal to 30 mm, any size of cable may be clubbed together.
For cables where OD is more than 30 mm, clubbing to be done for cables having similar ODs.
For XLPE Insulated LT Power cable: Clubbing to be done for cables having similar ODs.

LEGEND:
NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF
STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical,
COC- certificate of conformance

GOINDO INDUSTRIES

734 Cotton Street

CHENNAI

Page 9 of 11

LEGEND:- "RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMNS "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
"M" MANUFACTURER'S SUPPLIER, "C" MAIN SUPPLIER, "NTPC" P-PERFORM W-WITNESS VERIFICATION AS APPROPRIATE. CR: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"
FORMAT NO: QS-01-QALP-1073-RA

FOR REFERENCE ONLY

Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part 1 AND NTPC TECHNICAL SPECIFICATION)		QP NO. Q000-999-Q0E-S-041 REV-001 DATE: 13-02-12 Page 10 of 11 VALID UP TO: 02-02-15		REVIEWED BY INDRJEET SINGH VIKRAM TALWAR RAJEEV GARG		APPROVED BY [Signature] [Signature]		
Sl. No.	Component & Insulation	Characteristics	Class	Type of check		Quantity of check		Acceptance Norms	Record Format	Remarks
				M	C/N	M	C/N			
1	2	3	4	5	6	7	8	9	10	11
Sampling & Acceptance Criteria										
Criteria		Manufacturer experience prerequisite		Condition		Testing procedure		Remarks		
Samples as per relevant IS from every size/ type of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report.		In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices		In case of sizes/ type which meet the criteria		1 Sample of PVC insulation & outer sheath per type of cables offered which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours. 1 Sample of XLPE insulation per type of cables offered which have met the criteria, will be put on ageing test as per IS 7098. After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. This test shall be witnessed by NTPC.		In case the samples do not meet the requirement in accelerated ageing test then 1 sample of that size/ type will be put on ageing test as per IS.		
				In case of size /type which do not meet the criteria		Particular size/ type will be put on ageing test as per IS. This test shall be witnessed by NTPC.				



FOR REFERENCE ONLY

 Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE IS 1554 PART 1, IS 7698 Part-I AND NTPC TECHNICAL SPECIFICATION)		OP. NO. 0000-999, QOE-S-041 REV-00 DATE: 03-02-12 Page 11 of 11 VALID UP TO: 02-02-15	REVIEWED BY INDERJIT SINGH VIKRAM TALWAR RAJEEV GARG	APPROVED BY APPROVED D.K. Jang				
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document		Acceptance Norms	Record Format	Agency
1	2	3	4	5	6	7	8	9	10	11
				In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices	In case of size /type which meet the criteria	1 Sample per type out of all sizes which have met the criteria, will be put on aging test and witnessed by NTPC as per relevant IS				----
					In case of size/ type which do not meet the criteria	Particular size / type will be put on ageing test as per IS. This test shall be witnessed by NTPC				----



9.

CHIMNEY LIGHTING – Aviation Obstruction Lighting

	a. Power Supply Card	6 nos
	b. Electronic Flasher Card	3 Nos
	c. Photocell Control Unit	3 Nos
	d. Spare lamp/tube with holder for Aviation Obstruction Lighting fixture	12 Nos