



**NLC INDIA LIMITED
NLC TALABIRA THERMAL
POWER PROJECT- 3x800 MW
JHARSUGUDA, ODISHA**

**BIDDING DOCUMENT
FOR
ENGINEERING, PROCUREMENT & CONSTRUCTION**

SPECIFICATION NO : 18A03-SPC-G-001

**SECTION-B
VOLUME: II-A
LEAD SPECIFICATION**



**DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
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EPC Bidding Document

NLC India Limited
NLC Talabira Thermal
Power Project- 3x800 MW
Jharsuguda, Odisha

VOLUME: II-A
SECTION-V
GENERAL TECHNICAL REQUIREMENTS



Development Consultants Pvt. Ltd.

Vol. II-A/Section-V
General Technical Requirements

SECTION-B

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VOLUME: II-A

SECTION-V

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

- 1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.
- 1.02.00 The Bidder shall submit along with his bid the list of main codes and standards proposed to be used for the design, construction and testing of the plant. Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.
- 1.03.00 Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the Plant supplied under the specification from statutory authorities shall be the responsibility of the Successful Bidder.
- 1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern. And if they are equally stringent, the Bidder shall follow the hierarchy as follows:
- i) Local regulations
 - ii) Local codes and standards
 - iii) This Technical Specifications
 - iv) Industry codes and standards
- 1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Successful Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Successful Bidder to advise Owner of the resulting effect.
- 1.06.00 Combining or mixing of codes and standards of different institutions with respect to individual engineered components/ equipment shall not be permitted without the written approval of the Owner.

2.00.00

RESPONSIBILITY FOR DESIGN

2.01.00

The Bidder shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Successful Bidder was directly involved in the design work.

2.02.00

Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions as per the stipulation furnished elsewhere in the specification.

2.03.00

The Bidder shall carry out optimization studies for selection of pipe size and equipment wherever required. The result of such studies shall be included as part of bid proposal.

The successful Bidder shall have to carry out surge analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00

The Bid shall include a detailed discussion on the development status of and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the Bidder as reference plants.

3.00.00

DESIGN CRITERIA & OPERATIONAL REQUIREMENTS

3.01.00

Gross Capacity

The Steam Turbine Generator & Auxiliaries shall be capable of delivering Gross Capacity of not less than 800 MW on continuous basis, with rated steam parameters, design condenser pressure and 1% cycle make up. The Turbine shall be capable of running in VWO condition (105% of Gross capacity). The Boiler shall be capable of delivering 2475 T/Hr steam at rated parameter or 102% of VWO with 1% cycle make up, whichever is higher. This output shall be guaranteed and demonstrated by the Bidder for STG & auxiliaries units, as described in GCC.

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3.02.00

Equipment Sizing Margins

The equipment sizing design margins shall be used, as specified in the relevant clauses of the Design Specification.

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3.03.00

Number of Starts

The expected number of unit start-ups during 25 years of design life should be considered as minimum (Based on duration of shut down)

Cold start-up (shutdown >72 hours) : 150 starts.

Warm start-up (10 - 72 hours shutdown) : 1000 starts.

Hot start-up (2 - 10 hours shutdown) : 4000 starts.

Start-ups and load cycles together the TG & auxiliaries unit should be designed for minimum of 5150 cycles.

Following definitions shall apply for Cold start, Warm start, Hot start and Very Hot Start:

- (a) Cold Start: start after a continuous shut-down period exceeding 72 hours (metal temperatures below approximately 40 % of their fully-load values in °C).
- (b) Warm Start: start after continuous shutdown period between 10 hours and 72 hours (metal temperatures between approximately 40 % and 80 % of their fully-load values in °C).
- (c) Hot Start: start after continuous shutdown period less than 10 hours (metal temperatures above approximately 80 % of their fully-load values in °C).

3.04.00 Minimum Load

3.04.01 The Steam Generator unit will be able to operate continuously at 40% rated output load without oil support and with worst type of Coal under automatic control.

3.04.02 Mill Turndown ratio: minimum 3:1

3.05.00 House Load Operation

In the event of total load rejection and disconnection from the external network, the unit shall be able to operate safely at the 'House Load' feeding only the unit auxiliary services for an expected period of more than one (1) hour. In this case of load rejection, Boiler firing rate shall be brought down to 60% BMCR by suitably cutting out the pulverisers.

3.06.00 Mode of Operation

Modified sliding pressure operation

- a) 0 to 40% TMCR : Constant Pressure Operation
- b) 40% TMCR to 100% TMCR : Modified Sliding Pressure Operation (with throttle margin which can cater 5% load variation).
- c).100% TMCR to VWO : Constant Pressure Operation.

3.07.00 Load Change Rate and Temperature Variation

3.07.01 Load change

a)	Step load change	Minimum $\pm 10\%$
b)	Ramp Rate	Minimum $\pm 3\%$ per minute above 30 % to 50% load
		Minimum $\pm 5\%$ per minute (50% to 100% load)

3.07.02 Maximum temperature variations

- a) Under steady state condition : $\pm 5^{\circ}\text{C}$ for SH and RH
- b) During Load change
 - i) 3% per minute : $\pm 10^{\circ}\text{C}$ for SH
 - ii) 3% per minute : $\pm 10^{\circ}\text{C}$ for RH

3.08.00 Operating Capability:

- 1) The operating capability of various systems, equipment and associated auxiliaries in the scope of the Bidder is specified elsewhere in the Technical Specification.
- 2) The plant, its 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 1% 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 89 mm Hg(a) condenser pressure. 1% 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) 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.
 - e) HP-LP bypass operation under rated steam conditions with bypass valve open to full capacity and turbine on house load.
 - f) Automatic run back capability of the unit load on loss of critical auxiliary equipment, ensuring smooth and stable runback of the Steam Generator and Steam Turbine Generator equipment and systems.
 - g) Continuous TG output of 800 MW under rated steam conditions, 89 mm Hg(a) condenser pressure, 1% cycle make-up and 47.5 Hz grid frequency.
 - h) The equipment and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz.
 - i) 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 condensate tank level may be maintained through excess condensate dump line to condensate storage tank.
- 3) All the systems/equipment/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.
- 4) 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 start-up and loading of the units to full load at a fast rate. The unit shall have minimum rate of loading or unloading of 5% 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) from load variation from 100% to 50 % (and vice versa) of MCR with a minimum ramp rate of 5% per minute without affecting the design life of boiler and turbine 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% MCR to boiler minimum once through load (and vice versa) with a minimum ramp rate of 3% per minute without affecting the design life of boiler and turbine systems. Bidder shall fill the values of N1 and N2 in the relevant Attachment of the bidding document and shall demonstrate the same during initial operation. 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 equipment and control system would permit participation of the plant in automatic load frequency control.

- 5) Bidder shall furnish, within 6 (six) months from the date of placement of award / during detail engineering, following details:
- a) 'Fatigue Damage', resulting from
 - i) The number of Cold start up, Warm start up and Hot start up as defined elsewhere in the specification and
 - ii) Load cycling during defined plant life.
 - b) 'Creep damage'
 - c) Creep-Fatigue interaction curve for materials (selected for vulnerable locations) for which fatigue and creep damage have been computed along with the reference used for creep fatigue interaction curve.
 - d) The combined creep fatigue damage shall lie within acceptable limits.
 - e) Material data used for determining the fatigue and creep damage.
 - f) Code used for determining fatigue and creep along with details of its validation.
 - g) Details of specific changes in design to accommodate the defined load cycling.
 - h) 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 design 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 designs; 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 Purchaser. The performance data required 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 etc.

Results of design analysis which are required to be submitted as part of the Master Drawing List shall be tied up with the Bidder. The Bidder

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 the MDL. 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 Bidder shall be required to help Purchaser'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 Bidder during the warranty period of all pre-identified areas with stress concentration. 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 troubleshooting. Bidder shall recommend additional instrumentation that may be required for the purpose.

- 6)
- 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.

3.09.00 Functions of HP/LP Bypass System

The HP/LP bypass system is intended for use in the following situations:

- a) On hot starts to facilitate matching boiler steam to turbine metal temperatures prior to steam admission to the turbine, thus achieving a faster start up and reduced thermal stresses in the turbine.
- b) During cold starts, for Boiler temperature control and condensate conservation.
- c) On load rejection - or turbine trips, the bypass system will handle sufficient steam flow to avoid a boiler trip out thus allowing rapid reloading when fault condition clears.
- d) The HP bypass system shall serve as pressure relief in case of transient main steam pressure excursion.

3.10.00

Noise Emissions

The plant will be designed and constructed to operate with the least practicable amount of noise.

Suitable acoustical treatment will be provided to ensure that when the plant is operating at any load, the sound noise level (to a reference of 0.0002 microbar) at a distance of 1 meter from the machine or enclosure outline and 1.5 meter above floor level, under any operating condition, does not exceed the more stringent of the following values and those on the Noise Rating curve ISO 85.

An exception will be made for the plant start-up operations or other big pressure reducing devices operating during emergency periods and to the safety valves.

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) metre 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 equipment specifically listed under clause 4.03.01, Section X, Volume-II A of Technical Specification.

4.00.00

NAME PLATES/RATING PLATES/LABELS

4.01.00

Instruction plates, nameplates (rating plates) or labels shall be permanently attached to each main and auxiliary item of the Plant, including instruments, in a conspicuous position. These plates shall be of stainless steel and shall be engraved with the identifying name, type, identification number and manufacturer's serial number, together with the loading conditions under which the item of plant has been designed to operate.

4.02.00

Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Bidder shall pay specific attention to the nameplates/labels during painting, so that these are not painted over. Direction of flow is also to be engraved. All actuated valves shall be provided with labels, which shall include the valve and actuator reference number.

4.03.00

All nameplates and labels shall be in English language. All measurements shall be in S.I. units.

4.04.00

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.

4.05.00

Nameplates shall be 3 mm thick laminated white, black, white traffolyte for electrical and control panels and stamped stainless steel with lettering of a

minimum height 5 mm for other equipment of each unit. Warning labels and emergency equipment shall have red lettering in place of black. Danger labels shall have red lettering on a white background. Labels shall be of sufficient size to carry a full description of the Main Plant item and its complete KKS identifier. The size and location of nameplates shall be subject to Approval of the Owner. Lettering in all cases shall be machine-made and made to be legible after prolonged time in the range of ambient conditions prevailing at the Site.

- 4.06.00 Universal designation system utilizing six level breakdown KKS numbering system shall be followed for equipment identification. Each piece of equipment, motor, pump, valve, instrument, switchgear cabinet, junction box, control panel, panel board and associated apparatus shall be provided with tag plates indicating tag number and description. All major equipment (including the steam turbine, condenser, precipitator or fabric filter, main and auxiliary transformers, large pumps, and fans and motors) shall be provided with the data plates, indicating the name of the vendor, type, serial number, year of fabrication, main characteristics, and all further information necessary for a complete identification of the equipment.
- 4.07.00 All piping shall be painted and/or marked in accordance with the fluid contained according to a power plant color code to be proposed by Bidder and approved by Owner.
- 4.08.00 Tags shall be fitted by stainless steel self-tapping screws, stainless steel banding such that they are not readily lost or broken during routine operations and maintenance.
- 4.09.00 Surfaces of labels for cubicles and control equipment shall have a matte or satin finish to avoid dazzle. Colors shall be permanent and free from fading. Danger labels shall have red lettering on a white background. Labels shall be provided on front and rear access doors of all cubicles. Labels shall also be provided inside cubicles to assist the identification of apparatus and terminals.
- 4.10.00 All lifting beams, cranes, rails, jibs, hoists, slings, straps and other lifting equipment shall be properly tested and permanently marked with their lifting capacity.

5.00.00 SAFETY AND SECURITY

- 5.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.
- 5.02.00 Ready and safe access with clear headroom shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

5.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire hazard or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The Plant layout shall be designed to localize and minimise the effects of any fire hazard or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

5.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

6.00.00 GUARDS

6.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

6.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

6.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

6.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

6.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure handhold must be provided on each side of the opening or doorway.

7.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment shall all be of indoor installation. A broad list of buildings housing such equipment is given In Vol-II-G/1. Layout shall facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

General Layout and other tender layout drawings enclosed in Volume-II-L [Tender Drawings] show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's acceptance alter the same to suit the space requirement of the equipment offered.

While developing the layout of buildings the following criteria shall be given effect:

While preparing the detailed layout and deciding upon the transportation and construction/ erection strategy and functional requirements, the following aspects shall be ensured:

- a) The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.
- b) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores will be accommodated within the areas available in General Layout Plan.
- c) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local by-laws will be complied with.

Minimum clearances/ dimensions

- i) Clear Head room within Main : 2.4 m (Minimum)
Plant Building for pipes, ducts, structures & cable trays etc.
- ii) Clear head room in passage : 8 m
bay between TG hall and first row of boiler column i.e. CD bay
- d) Deleted
- e) Interconnecting walkways per unit:

Interconnecting platform	
Platform between main power house and Boiler	Two (2) nos. of interconnecting walkways (minimum 2.0m clear width) between TG building and boiler (on both side of boiler) at four elevations (minimum) preferably at ground, mezzanine, Operating and PRDS / De-aerator 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
Platform between boiler and Coal bunker building	Bunker Building shall be interconnected (1.5m clear width platform) with the respective steam generator at two elevations on either side of the steam generators (preferably at tripper floor level and feeder floor level) and in each level, floors shall be interconnected to boiler in front as well as in rear sides and two nos. (One on left and one on right side) for front or rear mill arrangement.

- f) All piping shall be routed at a clear height of 2500 mm (min.) from the nearest access level to clear man movement.
- g) It is envisaged that Generator stator shall be handled by strand jack arrangement/suitable crane arrangement by Bidder during erection.
- h). Cable/Pipe trestles height at rail/road crossings shall be 8 M (BOS)
- i) A walkway of 750 mm (minimum width) with pipe hand rails & toe guards shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for approach to these platforms shall be provided near roads, passage ways and turning points.
- j) Head room for man movement shall be minimum 2.5 m at ground floor in TG and boiler area and 2.1 m over all platforms. Height of trestles at approach roads to various buildings/facilities shall be 8M. In case building are located in off-site area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0 M.
- k) Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC.
- l) Deleted
- m) Rolling shutters shall be provided on 'A'-row to facilitate the movement of Generator Transformers, Station & Unit transformers to the maintenance bay. Rolling shutter shall be provided for removal of Condenser tubes.
- n) Deleted
- o) The minimum width of clear access corridors around equipment shall be 1.2 meters.
- p) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether

in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

- q) The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification.
- r) The minimum clear height available between two consecutive floor slabs shall not be less than 4.50 meters for Plant buildings and 3.50 meters for Non-Plant buildings, unless specifically mentioned. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- s) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings (G+2 and above), at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- t) All buildings shall have provision for toilet (for gents, ladies and Physically challenged) or as specified elsewhere and associated sewage discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.
- u) Top cover over underground pipes/cables shall be minimum one (1) meter. For CW/ACW Pipe, the top cover shall be minimum 1.5 M.
- v) Cubicle for operating personnel shall be located at safe place near the equipment.
- w) Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

8.00.00 OPERATION AND MAINTENANCE CONSIDERATIONS

- 8.01.00 Space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.
- 8.02.00 Lifting devices i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling of any equipment and/or part having weight in excess of 200 Kg during erection and maintenance activities. Suitable beams, hooks etc. for this

purpose shall be provided in the buildings and clear space provided below to a platform or floor which will allow normal risk free transport means to be used.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipment and accessories covered under this specification.

8.03.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

9.00.00 MATERIALS

9.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled.

All materials shall be new and shall be of the quality most suited to the proposed application.

9.02.00 Materials used for various components shall be those which have already proven operating experience in similar type of applications.

9.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.04.00 Prohibited Materials

The use of the following materials is prohibited:

- a) High alumina cement in structural elements
- b) Wood wool slabs in permanent framework to concrete
- c) Calcium chloride in mixtures for use in concrete works
- d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards.
- e) Cast iron for any oil service
- f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.
- g) Asbestos or any other fibrous form of hydrated magnesium silicate
- h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

10.00.00 LUBRICATION

- 10.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.
- 10.02.00 Non ferrous capillary tubing shall be used throughout.
- 10.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.
- 10.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant, which may drop, from operating parts.
- 10.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.
- 10.06.00 The Bidder shall supply grease gun equipment suitable to service each type of nipple fitted.

11.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

- 11.01.00 The Bidder shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Successful Bidder for initial commissioning, first fill and further topping till completion of trial operation. Contractor shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilized during the first year of operation. Further, higher quantities of lubricants, chemicals, consumables etc. as specified elsewhere in specifications shall also be supplied.
- 11.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Successful Bidder shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
- 11.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

12.00.00

PLANT LIFE AND MODE OF OPERATION

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of twenty five (25) years under the prevailing site conditions and for the type of duty as specified in relevant sections of the specification.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations. (Details are specified in the Volume-II B – Specification of Steam Generator and Auxiliaries and Volume-II C – Specification of Steam Turbine and Auxiliaries)

The units would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

13.00.00

PACKAGING & MARKING

All the equipment 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 the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

Bidder shall conduct his own route survey and transportation logistics for transportation of the equipment to project site by road/rail/sea and indicate the same in his proposal.

Each package shall have identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

14.00.00

PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces,

couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other suitable covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other suitable protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs shall be sealed and taped. Male threaded openings shall be closed with rough usage covers or plugs shall be sealed and taped. Female threaded openings shall be closed with forged steel plugs.

Returnable containers and special shipping devices shall be returned by the Bidder.

15.00.00 PAINTING

For Painting details, refer Section-XII of this Volume-IIA

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.04.00 Final colours and finishes shall be to the acceptance of the Owner.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

The Plant shall be designed meeting the latest environmental requirement issued by MoEF&CC, GOI. In the event of Ministry of Environment & Forest stipulate any other conditions not specified hereunder, the Bidder shall comply with those requirements.

17.01.01

Liquid Effluent Discharge

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A: Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement(s) of State Pollution Authorities/Central Pollution Authorities over and above the above stipulation as per the latest norms/stipulations/guidelines issued.

17.01.02

Air Quality, Stack Emissions

- a) Suspended Particulate Matter at chimney outlet - Maximum 30 mg/Nm³ .(on 6% O₂ dry basis¹)
- b) Oxides of Nitrogen (NO_x)-100 mg/Nm³ (Max)(on 6% O₂ dry basis)
- c) Sulphur di-Oxide(SO₂) -100 mg/Nm³ (Max) .(on 6% O₂ dry basis)
- d) Mercury (Hg) - 0.03 mg/Nm³ (Max)
- e) The Efflux velocity from boiler stack(s) shall not be more than 18.3 m/sec.
- f) Outlet dust emission level of bag filter installed in AHS and LHS shall be restricted to 18 mg/NM³.
- g) For The Coal Handling Plant, areas covered under Dry Fog Dust Suppression (DFDS)shall be designed to control the dust emission level in the working area measured at distance of 2m from the dust generation sources, over and above the atmosphere background dust level to shall be within 5 mg/NM³

The Bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

17.02.00

Noise Level Requirement

The plant shall be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source except for the equipment, as listed in clause no. 3.10.00 of this section.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.

- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Successful Bidder shall comply with the requirement.

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Successful Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner are set out elsewhere in this specification.

18.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

18.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Successful Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Successful Bidder shall forthwith forward to the Owner/Consultant duly certified copies of the Test Certificates in Three (3) copies for approval.

18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner/Consultant. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner/Consultant.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Successful Bidder shall allow for trial assembly prior to dispatch from place of manufacture.

18.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Owner. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

- 18.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.
- 18.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by the Successful Bidder. Successful Bidder's scope and responsibility shall also include preparation of all necessary documents in the specific formats stipulated by the statutory bodies, coordination and follow up for above approvals.
- 18.02.00 **Performance Tests at Site**
- 18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder are set out elsewhere in this specification. The completely erected System shall be tested by the Successful Bidder on site under normal operating conditions. The Successful Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 18.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 18.02.03 The Successful Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 18.03.00 Special Testing requirements for Imported Items:
- 1). All equipment, components and parts imported for use in the Power Supply System and Network shall be tested within India to check for any kind of Embedded Malware/Trojans/Cyber threat and for adherence to Indian Standards.
 - 2). All such testing 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 shall require prior permission from purchaser as per regulations stated by 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).

The above mentioned shall apply to any item imported as a Stand Alone equipment 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.

All the requirements mentioned by MOP, vide letter No. CEA/PLG/R&D/MII/2020, dated 03.07.2020 and other circulars as notified by the Government of India from time to time shall be complied.

18.04.00 For details of specific tests required on individual equipment refers to respective section of this specification.

19.00.00 TRAINING OF OWNER'S PERSONNEL

The Successful Bidder shall extend all possible assistance and co-operation to the Owner regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

19.01.00 Training at Successful Bidder's Premises

The Successful Bidder shall conduct training of engineers of the Owner on engineering, operation and maintenance of the Plant at the Successful Bidder's or Associates or Sub Vendor's premises where adequate training facilities are available during the design and manufacturing stage of the successful Bidder.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up:

Discipline	No. of Man-month
Mechanical	40
Electrical	10
Control & Instrumentation	10

	60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Successful Bidder in any Plant where the equipment manufactured by the Successful Bidder or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Successful Bidder.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Owner.

The Successful Bidder shall be responsible for the development of the Training Module and Programme Schedule, which shall be submitted to the Owner for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Owner upon completion of the training. An evaluation shall be jointly undertaken by the Successful Bidder and the Owner's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Owner for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Successful Bidder shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 Operation and Maintenance Training at Site

The Successful Bidder shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Successful Bidder's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final hand over of the Unit. Adequate number of instructors shall be employed at site for this purpose for all the packages / sub systems.

19.03.00 On-the-Job Training

During the period of pre-commissioning, commissioning and trial operation, the Owner shall provide operation and maintenance personnel to assist the Successful Bidder in the operation and maintenance of his supply and work under the direction of the Successful Bidder for the purpose of on-the-job training.

The Owner shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The successful Bidder shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

19.04.00 Training for 3D model review software

Training for Purchaser's personnel for 60 man-days (for 10 employees in minimum 2 batches of 5 each) shall be provided at Purchaser's office at Neyveli / Chennai, for the 3D Model Review Software(s) being offered under the package as stipulated elsewhere in the specification. This is in addition to the training man months detailed in clause 19.01.00 above.

ANNEXURE I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission Publications.
- t) Performance Test Code (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).

ANNEXURE I

LIST OF STANDARDS FOR REFERENCE

- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Ministry of Environment & Forests, Govt. of India.
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) National Building Code (NBC).
- jj) Indian Road Congress (IRC).
- kk) Latest guidelines of Railway Authority.
- ll) American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- mm) Sheet Metal and Air Conditioning Contractors Association (SMACNA)
- nn) Indian Society of Heating, Refrigeration and Air Conditioning Engineers (ISHRAE)

ANNEXURE-II

CRITERIA FOR LAYOUT

The guidelines will be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Plot Plan, drawing no. 18A03-DWG-M-002A, for tentative arrangement of the various facilities under this package.

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction during summer (for deciding Cooling Tower orientation)	See wind-rose in plot plan.
2. Prevalent wind direction(s) during dry seasons (for deciding the location of coal stock pile and ash dump/unloading areas, minimising the pollution effect due to dust, ammonia handling and storage system minimising the hazard)	See wind-rose in plot plan.
3. Location of:	
a) Water intake point.	From West
b) Water discharge point.	Not applicable
c) Plant drainage outfall point(s).	Towards South East
d) Railway entries & exits.	Not Applicable
e) Road entries & exits.	From North/South
f) Electrical power transmission grid system.	Towards South East
g) Preferred/selected ash dump area.	Towards South
h) Nearest residential area.	Towards North-East.
i) Ammonia Handling System	Towards North

ANNEXURE-II

CRITERIA FOR LAYOUT

ITEM	SPECIFICATION REQUIREMENT
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	Not applicable
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main Plant access road 10.0 Metres with 1.5 m wide shoulders on either side.	
b) Primary roads with access for 500 T crane	10.0 Metres with 1.5 m wide shoulders on either side.
c) Primary roads without access for 500 T crane	7.5 Metres with 1.5 m wide shoulders on either side
d) Access ways	7.5 m/4.0 m with 1.5 m / 1.2 m wide shoulders on either side respectively as mentioned in civil spec..
e) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes.
• To pass through the unloading bay	No.
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other building/facility	As per the Tariff Advisory Committee Rules.
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d) Inflammable liquid (fuel oil, Ammonia etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code.

ANNEXURE-II

CRITERIA FOR LAYOUT

ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres.
b) Soil coverage over underground pipes for CW/ACW piping	1.0 Metre (minimum) 1.5 M
c) Outdoor Pipe/Cable trench (if required)	150 mm above FGL
d) Minimum height of equipment (switchgear, cabinet etc.) above floor for HT cable entry	500 mm
e) Minimum height of equipment (switchgear, cabinet etc.) above floor for LT cable entry	300 mm
5. Railway Wagon clearance	Not applicable
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	Building edge = 6.0 Metres.& Other services = 3.0 meters
7. Required level, above the local developed grade level, of	
a) Top of all roads	250 mm.
b) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

ANNEXURE-II

CRITERIA FOR LAYOUT

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

1.0 BROAD GUIDELINES FOR LAYOUT PLAN

General layout plan indicating the available spaces for proposed project is as shown in the tender drawing placed in Volume-L of the tender specification. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.

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:

- i) The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.
- ii) The entire construction activity shall take into account the commissioning of the units.
- iii) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder within the areas available in General Layout Plan.
- iv) 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:-

FFL of Main Plant Building	-	El. 0.00M
Top of paving for Transformer Yard	-	El. (-) 0.10M
FFL of offsite building	-	500 mm above FGL of respective area

- v) All the buildings and facilities shall be approachable by the fire tenders.
- vi) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws shall be met by the Bidder.
- vii) DG Set Exhaust Pipes (Height & Orientation) shall be designed as per Environmental Regulations.

ANNEXURE-II

CRITERIA FOR LAYOUT

1.1 Main Plant Control Room

Two (2) nos. Main Plant Control rooms (MPCR) - one control room for unit #1 & common facilities and other control room common for units #2 & #3, shall be provided by the Bidder.

Main Plant Control Rooms / Control Equipment Room/ RIO rooms for each unit shall be provided with air-conditioning by the Bidder.

2.0 MAIN PLANT LAYOUT REQUIREMENT

Introduction

The proposed location of main plant block is indicated in the Plot plan drawing enclosed in Volume-II L of the tender specification, however Bidder has to develop layout keeping the location/orientation of the main power block, power evacuation corridor, make-up water corridor, same as indicated in bid document. Bidder shall develop his own layout for the equipment offered and the same to be clearly brought out in the bid under the scope of Bidder. However, while developing the layout the Bidder must give due considerations for the following requirements:

The unit control equipment's room shall be located in the TG building towards boiler side at operating floor level.

The unit control equipment room shall be multi-level and shall essentially house but not be limited to the followings:

- i) Unit control panels in control equipment rooms, operator's consoles etc. for all modules. MPCR shall not have any internal column inside the room. Large span roof beams for control room to be adopted and designed.
- ii) Computer room with engineering work stations & associated workstations, PADO etc.
- iii) Station In charge.
- iv) Batteries shall be at mezzanine floor level.
- v) Cabling and all other facilities associated with the above system.
- vi) SWAS room in TG building.

The Control Rooms, unit control equipment room (CER), computer room with programmer station, PADO room, UPS room, SWAS (Dry Panel) room shall be provided with Air conditioned areas.

ANNEXURE-II

CRITERIA FOR LAYOUT

Washroom/Toilet facilities for ladies & gents separately shall be provided. Further, no vertical bracings, pipes, cable shafts etc. shall be routed through control room or control equipment room area. Design of control room interior including lighting, roof, flooring and decoration will also be provided by the Bidder

2.1 Operating floor inside the main plant building shall match with top level of TG deck.

2.2 Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

- i) Unit and generator transformers, station transformers, and all Auxiliary transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

Oil capacity of individual transformer separating distance (in liters)	Clear (in Meters)
5,000 to 10,000	8.0
Above 10,000 to 20,000	10.0
Above 20,000 to 30,000	12.5
Over 30,000 or more	15.0

- ii) In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters or more but individual oil capacity of less than 5000 liters, the separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.

3.0 Layout requirements for Electrical MCC/switchgear rooms

- i) The following clearances shall be maintained for HV/MV Switchboard.

a. Front Clearance

- 1). For one Row of Swgr - 2.0 M (Min)
- 2). Between HV/ MV and LV SWGR (front to front). - 2.5 M (Min)
- 3). For two Rows of Swgr (Front to Front clearance) - 2.5 M (Min)

ANNEXURE-II

CRITERIA FOR LAYOUT

- b. Back Clearance - 1.0 M (Min.)
- c. Side Clearance Min. 1000 mm,
- ii) The following clearances shall be maintained for LT Switchboard.
 - a. Front Clearance
 - 1). For one Row of Swgr - 2.0 M (Min)
 - 2). For two Rows of Swgr (rear to front) - 2.0 M
 - 3). For two Rows of Swgr (Front to Front clearance) - 2.0 M (min)
 - b. Back Clearance
 - 1). For single/double front - 1.0 M (Min)
 - c. Side Clearance
Min. 1000 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 1000 mm + width of panel (2 nos. per bus section).

HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.
- iii) Height of HV/ MV/LT Switchgear Room (bottom to roof beam)
 - a) With Bus Duct - 4.5 M (min)
 - b) Without Bus Duct - 4.0 M (min)

4.0 EQUIPMENT LAYOUT REQUIREMENT

- 4.1 A preliminary layout of the Main Plant along with other auxiliaries, accessories and facilities are enclosed with the Tender Specification. A preliminary cross sectional drawing of the Main Plant is also enclosed. The drawings have been enclosed for Bidder's reference. These drawings are shown after considering the following aspects.
- i) AB bay width as 31 M (minimum) and BC bay width as 12 M.(minimum)
 - ii) Double LP Turbine.

ANNEXURE-II

CRITERIA FOR LAYOUT

- iii) Double Condenser
- iv) Exhausting the steam from Drive Turbine to Main condenser
- v) The locations of TDBFPs and MDBFP are in BC bay.
- vi) Dual Pressure condenser

4.2 While developing the layouts the Bidder shall give consideration for inclusion of following major layout parameters.

A. Steam Generator Area

Sl.No	Area	Description
1)	Pitch (estimated)	152.0 Meters
2)	Minimum distance between C row of Power house and 1st row of Boiler column(i.e. 1st row of bunker building considering side bunker arrangement)	12.0 Meters
3)	Minimum clearance to be maintained between Adjacent boiler/bunker bay columns and Control Tower building of powerhouse	10.0 Meters.
4)	Minimum distance between last column of boiler and 1st column of ESP	30.0 Meters
5)	Estimated distance between D-row of Boiler Column and chimney centerline.	322.0 Meters.
6)	Minimum clear space required at all working and walking areas for operating & maintenance personnel	

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	i) Horizontal, in all directions a) Adjacent to any electrical equipment, electrical cables, running (rotating/ reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C. b) Adjacent to any other plant facilities (including walls /structures)	1500 mm. 1000 mm.
	ii) Vertical (head-room clearance) a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items. b) Under any other plant facilities (including structures, pipes etc.)	2.2 Meters. 2.5 Meters.
	iii) For all areas where any equipment. (including trucks, trolleys and other material handling equipment) will move or maneuver	Minimum 500 mm from the outer edges of the equipment.
	iv) Minimum clear hand space required for a) The application of thermal insulation b) Welding work c) Bolt tightening	100 mm 150 mm 150 mm
7)	Floors, platforms, staircase, ladders, walls, doors & windows	
	Statutory Requirement	As per the regulations of OSHA, IBR, Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, PESO, Local Municipal Rules, etc.as applicable.

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8)	Operation & Maintenance Requirement	
	i) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
	ii) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
9)	Other Maintenance Requirement	
	i) Maintenance of the internals/impellers of All important equipment, like mills, all fans of the boiler draft plant, DMCW cooling water pumps, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
	ii) Overhauling and handling of the casings for the above items	Shall be possible without disturbing / dismantling any piping /ducting not directly connected to them.
	iii) Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes

B. Steam Turbine Generator Area

All equipment of steam turbine generator units and ancillary plant shall be installed indoor except the CST:

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Sl. No.	Area	Description
1.	Total TG building length	452 M (minimum) (Total 43 columns with two numbers expansion joint at two places).
2.	No. of unloading bays	Two transverse bays at 0.0 m elevation shall be provided for unloading and maintenance at one end of main plant building. Two additional bay shall be provided between units 1 & 2 and between units 2 & 3 for maintenance at ground floor. Width of maintenance bay shall be 10.5 M (minimum). Further additional bays may be provided as per system/layout requirements.
3.	AB bay & BC bay width	31M (minimum) & 12M (minimum)
4.	CD bay width	In case of Side Bunker arrangement - 12 M (minimum) In case of Inline Bunker arrangement- 3.5 M (minimum)
5.	Minimum Clear passage/Pipe cum cable rack width between boiler and turbine bay.	12 M (minimum)
6.	Arrangement of TG set	Longitudinal
7.	No. of minimum floor levels in AB bay. Elevations / Equipment locations shown are indicative.	i. 0.00 M - Finished floor level ii. 0.00 M – Cable Vault iii. 3.5 M – HT switchgear iv. 9M - Mezzanine floor v. 12.3 M LT switchgear vi. 18M - TG floor (Operating Floor)

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8.	No. of minimum floor levels in B-C Bay. Elevations / Equipment locations shown are indicative.	i) 0.00 M - Finished floor ii) 2.0 M BFP Drive Turbine iii) 9.0 M HP heaters 6A & 6B and LP heaters 2 & 3 iv) 9M – Cable Vault v) 12.3 M UPS & Battery Charger vi) 18M Common Control Room, HP heaters – 7A/7B & 8A/8B vii) 24.0 M or above as applicable to house Deaerator storage tank, Air washer room, Aux PRDS viii) 33.0 M –Deaerator tower, , SW/PW tanks, Note: Providing concrete floor to the entire length of main plant building at 33 M level in BC Bay is optional to Bidder. However, Bidder shall provide concrete floor wherever required.
9.	No. of minimum floor levels in C-F Bay. Elevations / Equipment locations shown are indicative.	i) 0.0 M – AC Plant , SWAS Room, Inert Gas room ii) 9.0 M – Battery Room iii) 14.0 M – Cable Spreader Room iv) 18.0M – Control Equipment Room v) 24.0 M – Cable Spreader Room vi) 27.0 M – Boiler MCC Room vii) 31.0 M- DMCW O/H tank, NaOH solution tank, Air handling units, cooling towers/ softening units for centralized AC system

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10.	Clear walk ways in AB & BC bay & Interconnection with Service Building	Minimum 1.5 m width walkway at all the levels in AB bay on the A row side & B row side. 3.0 m along B-row at operating floor level for interconnection with service building. The Inter-connection platform shall be of Covered type.
11.	Clear Head room in AB & in BC bay	Pipes, cables & equipment's shall be such that a clear head room of not less than 2.5 m above the walkways/ working area is available.
12.	Control Room in BC bay	i) Two (2) nos. Main Plant Control rooms (MPCR) - one control room for unit #1 and common facilities and other control room common for units #2 & #3 as shown in the layout drawing. ii) Location of Control room shall be in B-C bay at operating floor level. iii) Location of Control equipment room shall be on operating floor level in C to F bay as shown in the drawing..
13.	Location of Deaerator (indicative)	In B-C bay at 24.0 M
14.	Location of service water tanks, Potable water tanks (indicative)	In B-C bay at 33.0 M
15.	Location of Condensate Polishing unit(Service vessel)	Preferably in BC bay at 0.00 M
16.	Location of Condensate Polishing unit (Regeneration system)	Outside TG building as shown in General layout drawing
17.	Location of LP chemical Dosing unit (CWT, AVT & OT)	Preferably at 0.00 M.

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18.	Interconnecting platform between main plant building and boiler	As mentioned in Clause 7.00.00.(e) , Section V
19.	Lay down area for maintenance and overhauling.	The layout of the Steam Turbine Generator unit shall permit sufficient lay down area in the operating floor of the respective unit 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.
20.	Passenger cum goods Lift in TG hall (2000 kg)	2 numbers shall be provided in TG building (as shown in plot plan).
21.	Passenger Lift in Service Building (8 persons)	One number shall be provided in the Service Building
22.	Service Building	Please refer Civil Volume II-G/1 & G/2
23.	DG Shed	DG sets with acoustic & weatherproof enclosure shall be installed outside on RCC foundation, with shed and sides open. 4 nos. of 2000 kVA (minimum) DG sets and shall have sufficient space for maintenance, operator & Panels. The tentative Location of DG sets shall be as shown in the plot plan.
24.	AC plant room	These shall be kept as per the tender drawing.
25.	CST (Condensate Storage Tank)	This shall be kept as per the tender drawing.
26.	Clear Head room in Main Plant Building for pipe, Structures & cable trays etc.	2.5 M

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27.	Basement, Pits & Trenches in Main Plant building	Not Acceptable. However in exceptional cases Bidder shall bring out such requirements in his bid and get the approval of the Owner.
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4.3 The following clearances to be maintained for C&I DDCMIS/PLC cabinets:

- i) Clearance from back - 1200 mm
- ii) Clearance from front - 1200 mm
- iii) Clearance from side wall - 1000 mm

The above clearances are minimum requirement and may increase with increase in door swing of the cabinets.

4.4 The cable vault space below the HT / LT switchgear room and Control 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.

i)	Minimum clear working space Around the equipment	1200mm
ii)	Minimum width of all staircase	1500 mm for all indoor stairs and 1200 mm for outdoor stairs.
iii)	Clear head room in Passage bay between TG hall And first row of boiler column i.e. CD bay	8m
iv)	No. of Fire Escape staircases	As per NBC Part-4-Travel Distance. However, the Fire escape staircases in the main plant with fire doors quantity shall meet the requirement of NBC Part-4. Adequate space and provision for handling/ removal of pumps, motors, heaters, heat-exchanger, fans, Switchgear Panels, Transformers during maintenance shall be provided.
v)	Independent floor drains with separate down comers shall be provided where fire protection system are provided.	

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vi)	In TG bay at crane rail level, chequered plate walkway of minimum 600 mm clear width from face of the column to the hand rail on crane side to be provided for entire A-row & B-row column sectional depth for full length of the building.
vii)	Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipment's, piping, cabling, ducts routed in the area. Adequate space and provision for handling/removal of pumps, motors, heaters, heat- exchanger, fans, Switchgear Panels, Transformers during maintenance shall be provided.
viii)	Valves including actuators and instrument tapping's shall be located in accessible positions and operating/maintenance platform for the same shall be provided. All piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement.
ix)	Steam turbine and Generator and other equipment's 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 handling generator stator, rotor withdrawal of Generator etc., during erection, the same shall be under the scope of Bidder and described in written out document and attached with the bid. In case auxiliaries such as BFP are not in the reach of TG hall EOT crane, then separate EOT crane with proper maintenance area shall be provided along with all tools required for removal, assembly & handling of BFPs.
x)	Routing of cable trays & piping including piping & ducting (a) Trestle height in outdoor area shall be 3.0M (BOS) (b) Cable/Pipe trestles height at rail/road crossings shall be 8M (BOS). (c) The pipes including fire water pipes shall be routed over ground either on pedestals or on trestle in plant area. No trenches for pipes shall be envisaged as far as possible. (d) Head room below cable/ pipe rack in transformer yard area for movement of 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. (e) A walkway of 750 mm (minimum width) with hand rails & toe guards shall be provided all along length of the trestle

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	for maintenance of cables. Ladders/staircase for approach to these platforms shall be provided near roads, passage ways and turning points. (f) Clear Head room for man movement shall be minimum 2.5m at ground floor in TG building area and 2.1m over all platforms for other areas. (g) Height of trestles at approach roads to various buildings/facilities shall be 8 M. In case building are located in off-site 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. (h) Separate cable tray for optical fiber cable / UTP cable shall be provided wherever applicable. (i) The layout shall be developed so as to meet the requirements of the Cabling philosophy indicated separately (Cabling, Earthing & Lightning Protection).
xi)	Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC.
xii)	All cranes including TG EOT cranes shall be provided with approach ladders at least at two places. For the approach to the walk way along B row of TG EOT crane 2 nos. staircase from 24m level (BC BAY) shall be provided, with door in the B Row wall. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms at girder level as well as provision of suitable platforms shall be considered by the Bidder.
xiii)	For Ventilation requirement from A-row side of TG building, Air Washer room for installation of Air washer units along with pumps shall be considered at suitable location as shown in the general layout drawing. Further, for the remaining Ventilation requirement, Air Washer room for installation of Air washer units along with pumps in BC bay at 24m level (tentatively) for each unit shall be considered. All fresh air ventilation louvers shall be approx 1000 mm from floor level and directed downward at an angle.
xiv)	From the common centralized AC plant separate AHUs (Air handling units) shall be provided for Main plant, & Service building as shown in the general layout drawing/elsewhere in the specification. For further details relevant section of Technical Specifications may be referred.
xv)	All equipment operating maintenance platform including supporting structures such as grating platform in the oil equipment room,

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	control fluid equipment room, valve room, Deaerator, Gland Steam Condenser, Flash tank and for other equipment supplied and erected by the Bidder.
xvi)	Suitable 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. Further rolling shutters at different location shall be provided in TG hall for the movement of material. Rolling shutters shall also be provided along "C" row in TG hall wherever required.
xvii)	All pipe lines shall be routed on pedestals except at road/rail crossings where pipe culverts shall be provided. CW and ACW piping shall be laid below ground as per general layout drawing.
xviii)	A suitable rail track and associated facilities like jacking pads, mooring posts etc. shall be provided to facilitate the movement of Generator Transformers, Station Transformer, Unit Transformers and Unit Auxiliary Transformers to the maintenance bay. These rail tracks shall be accessible from the equipment unloading area of TG bay by a rail track.

5.0

Lay down area for maintenance and overhauling.

- i) The layout of the Steam Turbine Generator 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.
- ii) In case any special arrangement for rotor maintenance is required, the same shall be provided by the Bidder.
- iii) 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.
- iv) 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.
- v) The Bidder shall also furnish general arrangement drawings indicating the lay down arrangement of major unit assemblies (provided as spares) in the TG hall with access from EOT crane..

6.0

Local Pits/trenches in Main Plant building are to be avoided. However pits/sumps which are unavoidable such as CW (Circulating Water System)

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pits etc. shall be provided with required dewatering arrangements by means of permanently installed drainage pumps and piping up to the ETP. Bidder shall provide required sump pumps/drainage pumps/submersible pumps & Piping etc.

- 7.0** Pump shall be permanently fixed in the pits/sumps. If the pit depth is shallow, vertical top mounted sump pumps shall be provided and in deep pits self-priming drainage pumps (horizontal type) at floor level or alternatively submersible type pumps may be provided.
- 8.0** Each pit/sump shall generally be provided with two numbers (2x100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through level measurement devices to be installed in the pit/sump so that the pumps shall start automatically and empty the pit.
- 9.0** The general design and construction features of Vertical sump pumps and Submersible pumps are furnished elsewhere.
- 10.0** In addition to the above, suitable drainage arrangement of different floors of Main Plant building and Service building, DG set area, Air Conditioning & Ventilation buildings shall be provided. These drains shall be led to the station sumps on the A row and B/C row sides. Sump pumps shall be provided as per the stipulations in Volume II-K of the technical specification. Bidder shall also provide piping, fittings etc. for taking this drain/oily waste water to ETP.
- 11.0** Bidder to furnish the detailed erection strategy along with the bid for major equipment's located in TG hall.
- 12.0** 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 bid submitted by the Bidder.
- 13.0** Valves shall be located in accessible positions.
- 14.0** Provision of monorails with chain pulley blocks/HOT cranes along with hoist, as required shall be kept.
- 15.0** Approach for removal of equipment for maintenance shall be provided.
- 16.0** A/C and ventilation ducts, Bus ducts, and Critical Piping routes to be identified at conceptual stage.
- 17.0** No cable trenches, under-ground cable vaults and pipe trenches are acceptable in Main Plant as well as interplant cable routing unless otherwise approved by the Owner.

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- 18.0** All the pipes and cables within the Plant boundary shall be routed above ground except the Circulating Water Piping and ACW piping (part).
- 19.0** All other safety requirements as per the factories act shall be observed while developing the layout.
- 20.0** Battery rooms shall be properly ventilated to release gases produced. An easily accessible wash basin with eye washer shall be provided in the battery room.
- 21.0** Pipelines shall be routed in such a way to avoid interference with other pipes and their hangers and supports, structure, equipment, electrical conduits, cable trays, ventilation ducts etc. The pipe routing shall also take into account the availability of structural members for providing suitable supports and hangers. Hot and cold premises of the system shall be suitably isolated/ segregated from each other. Routing of oil lines over steam lines shall be avoided. Also the electrical premises shall be fully segregated from system piping.
- 22.0** Piping layout shall have adequate flexibility to absorb all thermal expansion without causing undue stress in the pipelines.
- 23.0** All piping shall be grouped where practicable and shall be routed to present a neat appearance.
- 24.0** The piping shall be arranged to provide clearance for removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance. Availability of access to valves and specialties shall be properly indicated on the layout drawing.