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**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

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GENERAL TECHNICAL REQUIREMENT FOR THE PROJECT/PACKAGE

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1.0 CODES AND STANDARDS

- 1.1 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.
- 1.2 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.
- 1.3 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 Bidder.
- 1.4 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.
- 1.5 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing, the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.
- 1.6 Successful Bidder shall furnish two (2) sets of latest of national/international codes and standards to owner.

2.0 RESPONSIBILITY FOR DESIGN

- 2.1 The Bidder shall assume full responsibility for the design of the whole and every part of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.
- 2.2 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 elsewhere, at least for continuous two (2) years in two different power stations.
- 2.3 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.
- 2.4 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.
- 2.5 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back etc are to be enclosed with the offer, to enable the Owner 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 consumptions etc shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.0 NAME PLATES (RATING PLATES)

- 3.1 Instruction plates, nameplates or labels shall be permanently attached to each main and auxiliary item of Plant in a conspicuous position. These plates shall

be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of Plant has been designed to operate.

3.2 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. Direction of flow is also to be engraved.

3.3 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.4 The size and location of nameplates shall be subject to Approval of the Engineer.

4.0 SAFETY AND SECURITY

4.1 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.

4.2 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.3 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire 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 or explosion. The recommendations of NFPA, OSHA and TAC etc as necessary shall be followed in all respects.

4.4 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.

5.0 GUARDS

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

5.2 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.

5.3 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.

5.4 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.

5.5 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 hand hold must be provided on each side of the opening or doorway.

6.0 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment shall all be of indoor installation. Layout should 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-B attached to this section.

Enclosed General Layout and other tender layout 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 powerhouse as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner / Engineer find the proposal more attractive in terms of techno-economic consideration.

- 6.1 While developing the layout of buildings the following criteria shall be given effect:
 - 6.1.1 The minimum width of clear access corridors around equipment shall be one (1) meter.
 - 6.1.2 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.
 - 6.1.3 The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification. Finished Grade Level (FGL) above Mean Sea Level (MSL) for the plant area, CHP area and for PWS area inside plant to be developed. Mean sea level for the plant is 210 m.
 - 6.1.4 The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

6.1.5	There shall be at least two (2) main access doors, one on either side of each building, of which one shall be minimum three (3) meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) 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.
6.1.6	All buildings shall have provision for toilet and associated effluent 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.
6.1.7	All rail/road crossings for pipe/cable racks shall be done with minimum Seven (7) meters headroom from top of rail/road to bottom of rack. Similarly, top cover over underground pipes/cables shall be minimum one (1) meter.
6.1.8	Cubicle for operating personnel shall be located at safe place near the equipment.
6.1.9	Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.
6.1.10	Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended.
6.2	The following requirements for equipment layout shall be complied with:
6.2.1	The regular basement floor is not acceptable in Boiler & Mill Bunker bay building. Further, local pits/trenches shall be avoided as far as possible.
6.2.2	Mills shall be located by the side of Boiler. The width of Mill/Bunker building shall be 12.5 M and the length of the same shall be 10.5 M per Mill. A clear walkway of 1200 mm (min) shall be ensured between the mills/ its foundation/ mill reject vessel edge and inner face of mill bay column. Raw coal bunker shall be circular in shape unless otherwise approved.

- 6.2.3 Interconnecting walkways (minimum 2 m width) between main plant building and boiler (on either side of boiler) at Ground, Mezzanine, Operating, PRDS and Deaerator floor levels shall be provided. Also inter-connecting platform between Boiler and Coal Tripper floor level and roof of Mill maintenance floor level, Feeder floor level, Bunker Building at Mill bay shall be provided. Number of interconnecting platforms between Boiler and Coal Bunker building for each level / floor specified above shall be two (2) on each side of Boiler i.e. four (4)/floor.
- 6.2.4 Two of the landing levels of the Goods Elevator shall preferably coincide with the feeder and tripper floor elevations. In case of difference in levels, electric hoists to shift goods from elevator floors to feeder/ tripper floors shall be provided.
- 6.2.5 Fuel Oil (F.O.) piping shall be routed over trestles. The headroom for F.O. trestle in Boiler/ESP/ID fan/Chimney area shall be 8.0 M till the road behind chimney and 7.0 M in CD bay area. The headroom for F.O. trestle in outlying area shall be 3.0 M except at rail/road crossing where the headroom shall be 8.0 M.
- 6.2.6 Clear walkways along A-row & B-row of TG building shall be provided as indicated below:
- (a) 1.5 m at all levels of AB Bay.
 - (b) 3.5 m along B-row at operating floor level for interconnection with service Building & in front of control room.
- 6.2.7 The layout of the steam turbine unit shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations.
- 6.2.8 Steam turbine and generator (except stator) and other equipments located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. For all other equipment/components, suitable handling arrangement for erection and maintenance shall be provided.

- 6.2.9 In TG bay at crane rail level, walkway with handrails is envisaged for entire column sectional depth for full length of the building. In addition, it shall be ensured that on A-row and B-row columns, through walkway (without hindrance) of minimum 600 mm clear width is available from the face of the column to the handrail of the platform.
- 6.2.10 Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipments, piping, cabling, duct routed in the area.
- 6.2.11 Adequate space and handling arrangement shall be provided for handling/removal of pumps, heaters, heat-exchanger, fans, mills during maintenance.
- 6.2.12 Valves shall be located in accessible positions and operating/maintenance platforms shall be provided along with approach ladders & handrails for the same.
- 6.2.13 While developing the layout, all fresh air ventilation louvers shall be considered 1000 mm from floor level and directed downwards at an angle. Ventilation fans on AB bay roof shall be kept staggered and shall not be near the centerline of turbo generator set.
- 6.2.14 Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory Act and Statuary bodies/Insurance companies.
- 6.2.15 All other safety requirements as per the factories Act, Rules/regulations made under Electricity Act, 2003 and applicable codes/standards shall be observed while developing the layout.
- 7.0 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS**
- 7.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.2	Ample 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.
7.3	Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part. Suitable beams, hooks etc. for this purpose shall be provided in the Buildings.
7.4	Lifting devices like lifting tackles, slings etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.
7.5	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 ever feasible, common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.
8.0	<u>MATERIALS</u>
8.1	In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/ fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal. All materials shall be new, and shall be of the quality most suited to the proposed application.
8.2	In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or International codes of practice. Where such standards or codes of practice are not available, sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

- 8.3 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.

9.0 LUBRICATION

- 9.1 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.
- 9.2 Non ferrous capillary tubing shall be used throughout.
- 9.3 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.
- 9.4 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.
- 9.5 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.
- 9.6 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.0 LUBRICANTS AND CONTROL FLUIDS

- 10.1 The Contractor 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 Contractor for initial commissioning, first fill and till COD of unit.

10.2 The Contractor 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 Contractor 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.

10.3 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.0 OPERATION AND MAINTENANCE

11.1 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimized.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.2 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.3 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further, identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.4 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.5 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.6 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.0 **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 thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the major equipments like 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.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand. The units shall also be suitable for two shift operation, if required.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

- | | | | |
|-----|---|---|--------------|
| (a) | Cold start-up (>50 hrs. shutdown) | : | 20 per year |
| (b) | Warm start-up (between 10 to 50 hrs. of shutdown) | : | 40 per year |
| (c) | Hot start-up (Less than 10 hrs. shutdown) | : | 180 per year |

The allowable stresses shall be so selected so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall

discuss this aspect in his technical proposal.

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

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

- (a) Width of the Package (from centre-line of rails-1.6 : 3.2 Meters
metres on both sides)
- (b) Height of the package from rail top : 4.47 Meters

The above indicates the dimensions, which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder shall consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by

road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The 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 Contractor 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 Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

Specification of Packaging and Marking has been described in detail in Volume I: General Condition of Contract of the Specification.

14.0 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 substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

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

openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.0 PAINTING

15.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in

windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

The Contractor shall select shop primer for steel and iron surfaces, which will have a continuous operating temperature below 35°C, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The Owner/Engineer shall submit the colour scheme during execution of contract for approval.

15.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

15.3.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

15.3.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

15.3.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming

15.4 PAINTING SYSTEMS

The requirements for the Dry Film Thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

15.4.1 Surfaces subject to Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

- | | | | |
|-----|---------------------------|---|------------------------|
| (a) | Primer coat | : | 35 micron DFT |
| (b) | Tie coat | : | 35 micron DFT |
| (c) | Finishing coat (Two Nos.) | : | 35 micron DFT per coat |
| (d) | The total minimum DFT | : | 140 micron |

15.4.2 Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

- | | | | |
|-----|---------------------------|---|------------------------|
| (a) | Primer coat | : | 35 micron DFT |
| (b) | Tie coat | : | 35 micron DFT |
| (c) | Finishing coat (Two Nos.) | : | 25 micron DFT per coat |
| (d) | The total minimum DFT | : | 120 micron |

The Contractor shall select the type and colour of primer & finish coat after approval by the Owner.

For detail painting on building & structural steel elements, please refer **Volume VI / A & B** of this specification.

16.0 COLOUR CO-ORDINATION & FINISH

- 16.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.
- 16.2 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.
- 16.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.
- 16.4 Final colours and finishes shall be to the Approval of the Engineer.

17.0 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.1 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.

In case the Ministry of Environment & Forest stipulates any other conditions not specified hereunder while clearing the project, same shall be complied with by the Contractor.

17.1.1 For Liquid Effluent

- (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 of State Pollution Authorities over and above the above stipulation

17.1.2 For Air Emission

- (a) Suspended Particulate Matter i.e. dust burden at Chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out).
- (b) NO_x : 365 ppm (maximum) or 750 mg/Nm³ (Equivalent NO₂).
- (c) SO₂ : As per prevailing Indian/ World Bank standards

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.

17.2 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.

- 17.2.1 Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 M away from the noise emission source.
- 17.2.2 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.
- 17.2.3 Any statutory changes in stipulations regarding noise limitation that may occur in future according to Maharashtra Pollution Control Board or Central Pollution Control Board or Ministry of Environment & Forest regulation

during tenure of the contract, the Contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

18.0 INSPECTION AND TESTING

18.1 GENERAL:

18.1.1 An indicative list of Inspection and testing requirements for each package has been given for equipments across various volumes of this specification. Bidder shall note that these testing and inspections listed herein are the minimum requirements as perceived by the Owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments / systems forming the proposed power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration. The comprehensive list of tests considered for each of the equipment/ systems shall be furnished as part of the bid.

18.2 INSPECTION AND TESTS DURING MANUFACTURE

18.2.1 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

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

18.2.3 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.

18.2.4 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 Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified six (6) copies of the Test Certificates. Distribution of six (6) copies of Test Certificates for approval will be two (2) copies to Owner and four (4) copies to Consultant. These four (4) copies will be further distributed by Consultant after approval to Owner, site and bidder. One copy will be retained with the Consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to Owner, Three (3) copies to site, Two (2) copies to Consultant, Two (2) copies to Owner's library / record.

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

18.2.6 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 Contractor shall allow for trial assembly prior to despatch from place of manufacture.

18.2.7 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.

18.2.8 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.

18.2.9 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

18.2.10 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, magnuflux 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.

18.2.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR Maharashtra Jurisdiction) shall also be made by the Bidder. In such case, Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

18.3 PERFORMANCE TESTS AT SITE

18.3.1 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected system shall be tested by the Contractor on site under normal operating conditions. The Contractor 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.

18.3.2 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.

18.3.3 The Contractor 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.

- 18.4 For details of specific tests required on individual equipment, refer to respective section of this specification.

19.0 TRAINING OF OWNER'S PERSONNEL

The Contractor 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 Tender.

19.1 TRAINING AT CONTRACTOR'S PREMISES

The Contractor shall conduct training of Thirty (30) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contract.

The total man-months for training of engineers shall be maximum Thirty (30), having following indicative break-up:

	Discipline	Number of Engineers	Number of Man-month
(a)	Operation	10 heads	10
(b)	Maintenance (Boiler & Turbine)	10 heads	10
(c)	Electrical Maintenance	4 heads	4
(d)	Control & Instrumentation	4 heads	4
(e)	Maintenance Planning	2 heads	2
		30 heads	30

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

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

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 Contractor 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 Contractor 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:

- (a) Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

- (b) Plant operation and systems training for operators including simulator training as applicable.
- (c) 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 Contractor shall provide qualified English speaking instructors and training coordinator (s) during the tenure of the training programme.

19.2 OPERATION AND MAINTENANCE TRAINING AT SITE

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the Unit.

The following instructors shall be at the Site continuously during the training:

- (a) One (1) for Steam Generator and Auxiliaries ;
- (b) One (1) for Turbine Generator and Auxiliaries ;
- (c) One (1) for Electrical Works ;
- (d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- (e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

Instructors shall also be available for Coal handling Plant, Ash Handling Plant, Water Treatment Plant and other specific areas as per requirement.

19.3 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 Contractor in the operation and maintenance of his supply and work under the direction of the Contractor 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 Contractor 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.

LIST OF STANDARDS FOR REFERENCE**ANNEXURE – A**

- | | |
|------|---|
| 1.0 | International Standards Organisation (ISO) |
| 2.0 | International Electro-technical Commission (IEC) |
| 3.0 | American Society of Mechanical Engineers (ASME) |
| 4.0 | American National Standards Institute (ANSI) |
| 5.0 | American Society for Testing and Materials (ASTM) |
| 6.0 | American Institute of Steel Construction (AISC) |
| 7.0 | American Welding Society (AWS) |
| 8.0 | Architecture Institute of Japan (AIJ) |
| 9.0 | National Fire Protection Association (NFPA) |
| 10.0 | National Electrical Manufacturer's Association (NEMA) |
| 11.0 | Japanese Electro-technical Committee (JEC) |
| 12.0 | Institute of Electrical and Electronics Engineers (IEEE) |
| 13.0 | Federal Occupational Safety and Health Regulations (OSHA) |
| 14.0 | Instrument Society of America (ISA) |
| 15.0 | National Electric Code (NEC) |
| 16.0 | Heat Exchanger Institute (HEI) |
| 17.0 | Tubular Exchanger Manufacturer's Association (TEMA) |

18.0	Hydraulic Institute (HIS)
19.0	International Electro-Technical Commission (IEC) Publications
20.0	Power Test Code for Steam Turbines (PTC)
21.0	Applicable German Standards (DIN)
22.0	Applicable British Standards (BS)
23.0	Applicable Japanese Standards (JIS)
24.0	Electric Power Research Institute (EPRI)
25.0	Standards of Manufacturer's Standardization Society (MSS)
26.0	Bureau of Indian Standards (BIS)
27.0	Indian Electricity Rules
28.0	Indian Boiler Regulations (IBR)
29.0	Indian Explosives Act
30.0	Indian Factories Act
31.0	Tariff Advisory Committee (TAC) rules
32.0	Emission regulation of Central Pollution Control Board (CPCB)
33.0	Pollution Control regulations of Dept. of Environment, Govt. of India
34.0	Central Board of Irrigation and Power (CBIP) Publications
35.0	The Air Prevention and Control of Pollution Act
36.0	The Environmental Protection Act
37.0	The Public Liability Insurance Act

- | | |
|------|--|
| 38.0 | The Forest Conservation Act |
| 39.0 | The Wildlife protection Act |
| 40.0 | The EIA Notification, 1994 |
| 41.0 | IS: 14665-Specification for Electric Traction Lift |
| 42.0 | Any other statutory Codes/Standards/Regulation |

<u>CRITERIA FOR LAYOUT</u> <u>ANNEXURE – B</u>		
<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
1.0	<u>SITE CONDITIONS TO BE CONSIDERED</u>	
1.1	Prevalent wind direction during summer (for deciding cooling tower orientation)	See wind-rose in plot plan.
1.2	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)	See wind-rose in plot plan.
1.3	Location of	
1.3.1	Raw Water intake point	As shown in Plot Plan
1.3.2	Plant drainage outfall point (s)	In Existing Drainage/Effluent treatment Plant
1.3.3	Railway entries & exits	As shown in Plot Plan
1.3.4	Road entries & exits	As shown in Plot Plan
1.3.5	Electrical power transmission grid system	As shown in Plot Plan
1.3.6	Preferred / selected ash dump area	Velhala nearly 10 Km from the site
1.3.7	Nearest residential area	Existing Colony

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
2.0	<u>LAYOUT REQUIREMENTS</u>	
2.1	<u>MAXIMUM PERMISSIBLE SLOPE IN</u>	
2.1.1	Rail track	1 in 400
2.1.2	Road	1 in 30
2.1.3	Sides of unpaved embankment	1 in 2
2.2	<u>REQUIRED ROAD WIDTH</u>	
2.2.1	Main roads	14.00 Metres with 1.0 m wide shoulders on either side for outer roads on western and eastern side and 7 meters with 1.5 m wide shoulders for other two sides of power block.
2.2.2	Auxiliary interconnections	Minimum 4 Metres without shoulders on either side and shall vary upto 7 m subject to availability of space. For carriage way, 5 Metre wide with 0.5 Metre shoulders and 7.0 Mtre wide with 1.5 Metre shoulders.
2.2.3	Road to the power house unloading bay	
(a)	Only for entry to the unloading bay	Yes
(b)	To pass through the unloading bay	No

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
2.3	Required minimum horizontal distance between the nearest points of	
2.3.1	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
2.3.2	Electrical transformer and any other	As per the Tariff Advisory Committee Rules
2.3.3	Fire water supply installation and any building / facility subject to fire risk.	As per the Tariff Advisory Committee Rules
2.3.4	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code
2.4	Required minimum vertical clearance	
2.4.1	Under pipes/cable racks at road crossings	8.0 Metres
2.4.2	Soil coverage over underground pipes	1.0 Metre (minimum)
2.4.3	Pipe/Cable trench	Not Acceptable
2.5	Railway Wagon clearance	Rules of the Indian Railways
2.6	Minimum Clearance between any road edge and building/ structure / any fixed installation	3 Metres
2.7	Required level, above the local developed grade level, of	

<u>BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS</u>		
<u>ANNEXURE – C</u>		
<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
1.0	Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1.1	<u>HORIZONTAL, IN ALL DIRECTIONS</u>	
1.1.1	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.	1200 mm
1.1.2	Adjacent to any other plant facilities (including walls / structures)	1000 mm
1.2	<u>VERTICAL</u> (head-room clearance)	
1.2.1	Under any pipe / equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.0 Metre
1.2.2	Under any other plant facilities (including structures, pipes etc.)	2.0 Metre

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
1.3	For all areas where any equipment (including trucks, trolleys and other material handling equipment) move or manoeuvre.	Minimum 500 mm clear in all direction from the outer edges of the equipment
1.4	Minimum clear hand space required for	
1.4.1	The application of thermal insulation	100 mm
1.4.2	Welding work	150 mm
1.4.3	Bolt tightening	150 mm
2.0	<u>FLOORS, PLATFORMS, STAIRCASE, LADDERS, WALLS, DOORS & WINDOWS</u>	
2.1	Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.2	<u>OPERATION & MAINTENANCE REQUIREMENT</u>	
2.2.1	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

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
2.2.2	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
2.3	Minimum access opening required (with rolling shutter) transportation,	3.5 M wide x 4 M high or wherever entry of truck, for material depending upon the envisaged equipment size to be handled.
2.4	Plinth level of all buildings, above the local developed for power house building.	300 mm
3.0	<u>OTHER MAINTENANCE REQUIREMENT</u>	
3.1	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking / lowering assembly, dismantling of building end walls / structures etc. shall be kept.	Yes

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
3.2	Maintenance of the internals / impellers of all important equipment, like Boiler Feed Pumps, Feed Water Heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, Cooling Water Pumps, Coal Mills, Air Compressors, Blowers, Heat Exchangers, Fuel Oil Pumps, Filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3.3	Overhauling and handling of the casings for the above items	Shall be possible without disturbing / dismantling any piping / ducting not directly connected to them.
3.4	Crane Approach Wherever required, the unobstructed approach of the crane hook / other hoisting equipment hook to various plant & equipment shall be possible.	Yes
4.0	<u>CENTRAL CONTROL ROOM</u> All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
5.0	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.	
5.1	However, as a guide line, following features are given:	
5.1.1	False ceiling and false flooring shall be provided.	
5.1.2	Uniform height, colouring schemes for cabinets etc. shall be available.	
5.1.3	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
5.1.4	No opening shall be provided from Boiler side.	
5.1.5	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
5.1.6	Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	

<u>SR. NO.</u>	<u>ITEM</u>	<u>SPECIFICATION REQUIREMENT</u>
5.1.7	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
5.1.8	Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
5.1.9	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
6.0	Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

SPECIFIC LAYOUT CONSIDERATIONS

ANNEXURE-D

While developing the layouts, the following major layout parameters shall be ensured, as a minimum:

<u>SR.NO.</u>	<u>PARAMETER</u>	<u>REQUIREMENTS</u>
1.0	AB bay, BC & CD bay widths	36.0 M, 12.0 M & 12.0M
2.0	Arrangement of TG set	Longitudinal
3.0	Floor levels in AB bay	0.0 M, 9.0 M, 17.0 M
4.0	Floor levels in B-C bay	0.0 M, 9.0 M, 17.0 M 24.0M, 28.0 M 32.8 M, 38.0 M
5.0	Level of operating floor	17.0 M
6.0	Level of mezzanine floor	9.0 M
7.0	HT/LT Switchgear and MCC location	HT Switchgear at 3.5 M and LT Switchgear & MCC at 12.0 M in AB bay
8.0	Area of unloading bays	750 sq. M
9.0	Lay down Area (Minimum on operating floor) with EOT Crane approach	750 sq. M.
10.0	Minimum clear working space around the equipment	1200 mm
11.0	Location of Deaerator	In BC bay at EL. 38.0 M

<u>SR.NO.</u>	<u>PARAMETER</u>	<u>REQUIREMENTS</u>
12.0	Location of Heaters	HP Heaters/LP Heaters at Operating Floor/ Mezzanine Floor respectively in B-C Bay.
13.0	Location of BFP	TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay.
14.0	Location of Boiler MCC	At 28.0 M in BC bay
15.0	Clear Head room within Main plant Building for pipes, structures & cable trays, ducts etc.	2.5 M
16.0	Number of Fire Escape staircases in the main plant with fire doors at each landing	Minimum Four (4)
17.0	Minimum width of all staircases landings	1500 mm
18.0	Passenger Elevators	One (min)
19.0	Clear approach width in front and rear of ESP	10 M (Height = 8 M)
20.0	Head Room for pipe/cables trestles at rail, road crossing	8.0 M
21.0	Minimum straight length in Flue gas duct at ESP outlet for Opacity meters.	As required for accurate dust measurement within the battery limits.
22.0	Elevation of ID Ducts entering Chimney	12.75 M (Min.) (Bottom of steel)

4431/2020/PS-PEM-MSX P



DOCUMENT TITLE:

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: IIA

REV. NO. 00

DATE:

GENERAL TECHNICAL REQUIREMENT OF AC AND VENTILATION SYSTEM

**1x660MW BHUSAWAL TPS
HVAC SPECIFICATION**

1. SYSTEM DESCRIPTION

1.1 Dry type Mechanical ventilation shall be provided for non AC area with combination of RE unit fan, Wall mounted axial fan, Louvers and dampers.

1.2 Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of AC area and control room. Split AC shall be 2 x 60 % or 3 x 40 % capacity for Air conditioned area depending upon Total cooling load. Heat load calculation for selection of Split AC shall be submitted by vendor for approval which shall have minimum 10 % design margin over the theoretical capacity. Split AC shall be selected meeting criteria for Cooling load and dehumidified air.

Split AC shall be complete in all respect with isolation switch, i.e MCB of suitable rating as required, socked, voltage stabilizer, cordless remote with battery, cabling between indoor and outdoor unit and up to nearest available power supply source, all supporting structure and refrigerant piping as per actual site condition, drain piping up to nearest drain etc.

split ac shall be of best rating as per latest BEE based on ISEER

2. DESIGN INPUT / CRITERIA

2.1 Design ambient condition shall be as follows:

Design Temperature	Summer	Monsoon	Winter
DBT (Deg. C)	50	29.4	15.6
WBT (Deg. C)	27	27.2	11.1

2.2 The number of air change per hour in mechanically ventilated area shall be as follows:

a) General area (including pump houses) : 20

b) Battery room : 30

and area where gaseous fumes/ vapours are generated

c) Switchgear/MCC rooms, pump houses, Toilet, pantry : 20

Inside temperature shall be maximum 3 deg. C above the design ambient temperature during summer for Mechanically ventilated areas.

Selection of ventilation air quantity shall be higher value calculated based on air change rate or heat load.

2.3 All ventilation system shall operate on 100 % fresh air. All mechanically ventilated areas shall be positively ventilated (except battery room, fume generating area, Toilet and pantry) by means of supply air fan fitted with filters and /or gravity operated back draft dampers and exhaust fans. MCC room shall necessarily be in pressurized condition. Supply air fan serving the electrical area shall be provided with both pre filter and fine filter and for other

**1x660MW BHUSAWAL TPS
HVAC SPECIFICATION**

areas, supply fan shall be provided with pre filter only. Battery room shall be kept under negative pressure by exhaust ventilation system so as to prevent escaping of fumes outside. Exhaust ventilation shall be provided for fume generating area, battery room, pantries, toilet etc.

- 2.4** All ventilation equipment shall be designed for continuous duty.
- 2.5** For exhaust ventilation system, wall mounted air intake louvers shall be provided for fresh air entry.
- 2.6** 100 % redundancy shall be provided for ventilation fans of Battery room.
- 2.7** Air conditioned areas like various control room shall be maintained at $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and relative humidity of $50\% \pm 5\%$.
Non Critical air conditioned areas like offices shall be maintained at $24^{\circ}\text{C} (\pm 1^{\circ}\text{C})$ and relative humidity not exceeding 60%
- 2.8** Lighting load shall be minimum 20 Watts/ m² or actual whichever is higher for AC system.
- 2.9** The occupancy for general area shall be minimum one person per 10 m² and for conference room the same shall be one per 3 m². In the control rooms, the occupancy shall be considered one person per 25 m² (minimum) higher for AC system
- 2.10** All the equipment of Air Conditioning system shall be designed for continuous duty

3. BRIEF SCOPE

- 3.1** Axial flow fan units
As per MAHAGENCO Specification, clause number 6.1.2.2, 6.1.5, 6.1.6.1 to 6.1.6.3, Volume III-G, bid specification number DG/BSL U-6/2011/T-1.
- 3.2** ROOF EXTRACTOR UNIT:
As per MAHAGENCO Specification, clause number 6.1.2.3, Volume III-G, bid specification number DG/BSL U-6/2011/T-1. All roof exhauster shall be of direct driven axial flow type. Roof exhauster shall have multi-bladed impeller with a short duct casing while wall exhauster shall have coned inlet suitable for free discharge of air into atmosphere. Necessary mesh shall be provided at inlet of fan to arrest any material falling down. For foundation bolt, Aluminium plate shall be provided locally at the bolting area to avoid moisture from entering the bolting area. All roof exhausters shall be provided with gravity operated type back draft damper.

RE unit fans shall consist of following accessories:

- a) Fan wheel, housing
- b) Electrical drive motor with coupling

**1x660MW BHUSAWAL TPS
HVAC SPECIFICATION**

- c) Mounting brackets
- d) Gravity operated backdraft damper
- e) Short duct mounting
- f) Grouting frame
- g) Disconnection switch etc.
- h) Hood shall be provided to protect from rain and other contingencies
- i) Anchor bolts, nuts, bolts and lose fittings
- j) Any other equipment / material necessary to ensure safe and satisfactory operation of each unit

3.3 Filter

As per MAHAGENCO Specification, clause number 6.2.1 to 6.2.5, Volume III-G, bid specification number DG/BSL U-6/2011/T-1.

3.4 SPLIT AC UNITS

As per MAHAGENCO specification, clause number 6.11.1 to 6.11.10, volume III-G, section 2, bid specification number DG/BSL U-6/2011/T-1.

3.5 VENTILATION PHILOSOPHY FOR DIFFERENT AREA

Building/ Area	Ambient Air Temperature (°C)	Indoor Temperature		Humidity Control (% RH)	Minimum Design Ventilation rate (AC/H)	Filtration Efficiency (%)	Pressurisation	Redundancy	Noise Criteria
		Maximum °C	Minimum °C						
Water treatment plant	Normal	Ambient Temp. plus 3	—	None	30	None	Negative	Multiplicity	85 dB (A)
Switchgear room	Extreme	Ambient Temp. plus 3	—	None	20	90%	Pressurised	2 x 50%	_DO_
Battery	Extreme	Ambient Temp. plus 3	—	None	30 or as Required for hydrogen dilution	None	Negative	2 x 100%	85 dB (A)
pump house	Extreme	Ambient Temp. plus 3	—	None	20	None	positive	None	85 dB (A)

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4. SPECIFIC REQUIREMENTS: -

RE / wall mounted fans/ wall mounted louver/ wall mounted damper shall be selected so as to have motor rating (for fans) and wall / slab opening as under. Feeder suitable for following ratings shall be selected.

1.	Roof extractor units with 15 mmwc static pressure.		
	Capacity	Motor rating	Roof / Slab opening
a.	50,000 CMH	5.5 KW	1320mm
b.	40,000 CMH	5.5 KW	1320mm
c.	20,000 CMH	2.2 KW	1140mm
2	Axial flow supply fans with 30 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	2.2 KW	800mmx800mm
b.	7,500 CMH	1.5 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	500mmx500mm
3	Axial flow supply fans with 20 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	1.5 KW	800mmx800mm
b.	7,500 CMH	1.1 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	600mmx600mm
4	Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	2.2 KW	900mmx900mm
b.	10,000 CMH	1.5 KW	800mmx800mm

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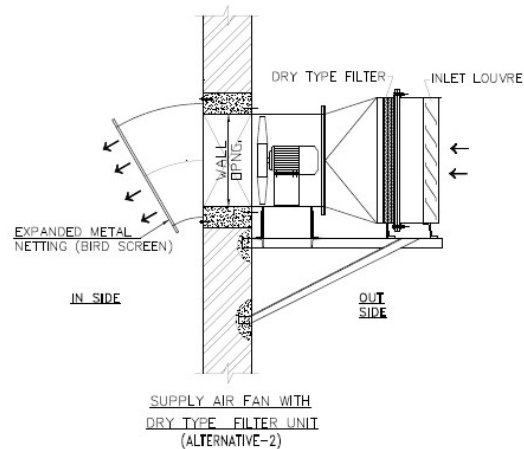
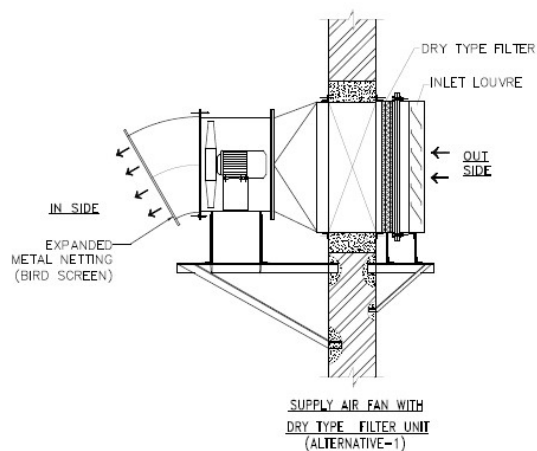
c.	7,500 CMH	1.1 KW	700mmx700mm
d.	2,000 CMH	0.55 KW	500mmx500mm
5	Axial flow exhaust fans with 10 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	1.1 KW	900mmx900mm
b.	10,000 CMH	0.75 KW	800mmx800mm
c.	7,500 CMH	0.55 KW	700mmx700mm
d.	6,000 CMH	0.55 KW	600mmx600mm
e.	2,000 CMH	0.37 KW	500mmx500mm
6	Exhaust fan (propeller type) with 5 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	1200 CMH	100 W	380 mm circular
7.	Louver	NA	900 mm x 1300 mm (h)
8.	Damper	NA	700 mm x 550 mm (h)

	1x660MW BHUSAWAL TPS HVAC SPECIFICATION	
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5 GENERAL

- a. Basis of design, all calculations including heat load calculations for summer seasons, equipment selection criterion, schemes/G.A. dwg and documents like data sheet/ technical particulars etc. are subject to Customer approval during detail engineering stage.
- b. Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- c. All commissioning spares & consumables for trouble free operation shall be provided.
- d. Inserts or any support arrangement for fixing fans, split AC shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- e. Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- f. All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis enclosed.
- g. All openings required in brick wall for installing the axial supply and exhaust fans, propeller fans, Split AC, louvers and damper openings etc shall be done by BHEL as per opening sizes indicated above. Any opening requirement on account of change in size of equipment over and above the opening size indicated above, same shall be done by vendor along with finishing of opening and painting as per finished wall. Grouting of fans along with anchor fasteners shall be done by vendor. The openings shall be finished properly. In case openings are done once the wall have been painted, repainting, to match with the existing wall paint shall also be done by the vendor. Sealing of duct opening shall be in scope of vendor.
- h. All codes and standards shall be as per contract specifications
- i. Supports required for supporting the fan and/or filter section for FA fans shall be under bidder's scope

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6 LIST OF MAKES

Sl. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA (SITAL) / KRUGER / MARATHON / C DOCTOR/ HYDERABAD POLUTION CONTROL/ SK SYSTEM/ ADVANCE VENTILATION/ PATEL AIR
NOTE		
NOTES: 1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL		

7 MANDATORY SPARE LIST

S. no.	Description	Quantity
1	Roof exhauster fans (for each type, rating and capacity)	1 Lot (5 % of total population or one (1) whichever is higher)

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2	Supply air fans (wall mounted) (for each type, rating and capacity)	1 Lot (5 % of total population or one (1) whichever is higher)
3	exhaust air fans (wall mounted) (for each type, rating and capacity)	1 Lot (5 % of total population or one (1) whichever is higher)
4.	SPLIT AIR CONDITIONERS	
4.1	Fan –motor bearing for outdoor unit	Lot (One set for each rating of SAC unit)
4.2	Vibration Isolators	Lot (One set each for outdoor unit & Indoor unit for each SAC unit)
4.3	Filter	Lot (One set for each SAC unit)
4.4	Expansion Valve	Lot (One set for each rating of SAC unit)
4.5	Any other spare parts recommended by the Manufacturer	Lot (As recommended by the Manufacturer)

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6.1.2.2	Axial flow wall mounted exhaust fans, Tube axial type supply fans (mounted on duct/roof) and Bifurcator exhauster, complete with all accessories.	
(a)	Fan wheel, housing.	
(b)	Electrical drive motor with coupling	

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(c) Mounting brackets. (d) Gravity operated backdraft damper, wherever specified. (e) Coned inlet. (f) Grouting frame etc. 6.1.2.3 Roof Exhausters, complete with all accessories as mentioned. (a) Fan wheel, housing (b) Electrical drive motor with coupling (c) Mounting brackets. (d) Gravity operated backdraft damper (e) Short duct mounting (f) Grouting frame. (g) Disconnections switch, etc. (h) Hoods shall be provided to protect from rain & other contingencies Anchor bolts, nuts, bolts and loose fittings as necessary for all items above. Any other equipments and/or material necessary to ensure safe and satisfactory operation of each unit. 6.1.3 Standards and Codes Unless otherwise specified, it is intended that bidders shall offer standard equipment for this specification. Materials of construction, construction of components, performance testing of equipment, erection and commissioning etc. shall be in accordance with the latest edition of the appropriate standards as mentioned elsewhere in this specification.		

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6.1.5 General design requirement

The equipment supplied shall be suitably constructed for safe and proper operation under all conditions described or implied in this specification without undue strain, vibrations, corrosion or other operating difficulties.

All parts subjected to substantial temperature changes shall be designed and supported so as to permit free expansion or contraction without resulting in leakage, distortion and excessive strains in the equipment. Parts subjected to wear corrosion or other deterioration or requiring adjustment, inspection or repairs shall be accessible and have reasonable convenience for removal, replacement and repair. All such parts shall be of suitable material or suitably lined for keeping maintenance to a minimum. All close fitting parts that are interchangeable shall be machined to gauge.

(a) Centrifugal and axial flow fans

All the centrifugal fans shall be of DIDW or SISW as required. The fan shall have end suction and discharge in the direction as required. All centrifugal fans shall be coupled to the drive motors with V-belts.

All roof exhausters and wall mounted supply fans shall be of direct driven axial flow type. Roof exhausters shall have multi-bladed

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impeller with a short duct casing while wall exhausters shall have coned inlet suitable for free discharge of air into atmosphere. Necessary mesh shall be provided at inlet of fan to arrest any material falling down. It is desirable that all centrifugal fans shall be designed to operate within 9% and 25% of system throttling line. The axial flow fan impeller shall be cast in one piece finished all over and carefully balanced both statically and dynamically. Finally the assembled impeller along with shaft shall be dynamically balanced. All axial flow fan impeller shall consist of high efficiency aerofoil section blades. The centrifugal fan impellers shall be formed backwardly with non-overloading characteristics and welded to the back plate and shroud, if any. The fan wheel shall be statically and dynamically balanced. Centrifugal fan housing shall be of welded construction and provided with flanges at outlet for duct connection. The large size fans shall be split casing type. A common base frame shall be provided for fan and driving motor and whole assembly shall be mounted on vibration isolators. Casing for roof exhausters and their components shall be suitable for outdoor installation. The fan housing shall be constructed of heavy gauge galvanized MS sheets. The base shall be suitable for mounting on the roof opening. The base shall be designed to prevent ingress of water into the building and shall ensure that the assembly is totally weather proof. The hood shall be hinged type and arranged such that the fan and driving motor shall be readily accessible for maintenance and inspection. An enclosed type disconnecting (lock-out) switch shall be provided under the hood so that power supply to the fan motor is disconnected upon opening the hood. Suitable motor brackets as per manufacturer's standard for both roof and wall mounted axial flow fans shall be provided. The brackets shall be designed to provide rigid mounting for motors. A suitable access door shall be provided in casing for motor. Wherever required for, the fans shall be provided with a damper at		

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outlet. Dampers at the outlet of centrifugal fan shall be of approved multi-bladed type with neoprene edging on blades for tight shut off. Each blade shall be provided with bronze/gun metal bearing at each end of spindle. Operating lever along with the necessary linkages shall be provided at an accessible position for operating the dampers.

Suitable fixing device for locking the damper at desired position and an indicator to show the percentage of opening of damper shall also be provided.

All roof exhausters shall be provided with gravity operated type back draft damper. For wall mounted axial flow fans, gravity operated back draft dampers shall be provided. The back draft damper shall be such that it shall not allow infiltration of air from outside while forced infiltration by fan shall be achieved through the above damper. The blades of the damper shall be freely mounted to allow the damper to open with the pressure developed by the fan. The damper shall be provided with suitable flanges.

Centrifugal fans shall be provided with adjustable V-belts and sheaves. All belts shall be sized for 250% rated horsepower. All V-belts drives shall be equipped with removable guards that do not impede the air flow to the fan inlet and belt tensioning device. There should be minimum two belts per drive. Belts shall be designed for following performance.

(i)	Service Factor:	:	2.5
(ii)	<u>BHP</u>		<u>Minimum no of belts</u>
	Less than 5	:	Two
	5 - 10	:	Three
	Greater than 10	:	Four

Small Centrifugal fans of Fan-filter unit of BHP rating less than 1 HP may be of directly driven type.

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All axial flow fans shall be directly mounted on the extended motor shaft.

First critical speed of the rotating assembly shall be at least 25% above the operating speed.

Centrifugal fan shall be mounted on self-aligning heavy-duty ball bearing or roller bearing of adequate capacity and life. Bearing shall be grease/oil lubricated and is provided with fittings for lubrication from outside. The bearings shall be located in an easily accessible location to facilitate maintenance. The minimum adjusted rating life for Bearings at operating conditions shall be 40,000 hrs and the same shall be as per IS-3824.

Inlet screen shall be provided at centrifugal fan suction made out of 14 SWG galvanized wire knitted in 25 mm square mesh. Suitable flanges to protect the edges of the screen shall be provided.

Double deflection rubber in shear or rubber in compression type vibration isolator shall be provided for each fan. Rubber bushes, washers, wherever needed for the vibration isolators shall be included in the supply. Sufficient number of such isolators shall be provided to ensure isolation of foundation from vibration of the equipment.

6.1.6 Materials of construction

6.1.6.1 The following materials shall be used for the construction of various parts of centrifugal and axial flow fans and its auxiliaries:

(a)	Centrifugal fan impeller	:	M.S Sheet min. 16 SWG thick
(b)	Axial flow fan impeller	:	Cast Aluminium Alloy
(c)	Fan Shaft	:	EN-8
(d)	Fan Scrawl	:	Heavy gauge M.S. min14 SWG thick

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(e) Supported frame and structure : M.S. of adequate thickness (min. 14 g thick) (f) Cone inlet for wall exhauster : M.S (14 SWG thick). (g) Gravity loaded back-draft damper (i) Blades : Aluminium of min. 26 SWG thick (ii) Casing / frame : Galvanized iron. (h) Flexible connection of fan outlet for duct connection : Plastic impregnated canvas with M.S. flanges and cleats (i) 'V' pulleys : C.I. Multigrooved (j) 'V' Belt : Reinforced rubber of appropriate section. (k) Slide rails : Structural Steel. (l) Bolts and nuts : M.S. (IS: 1367 unless otherwise specified) (m) Connection pieces : Galvanized iron according to supplier's design (Minimum 18 g thick) (n) Rain protection cowl, hoods, and casing for Axial flow fans : M.S. to be hot dipped galvanized after fabrication. (o) Vibration isolating pad, washers, and bushes, if any : Hard synthetic rubber of hardness 40 deg shore. 6.1.6.2 Fans for special application: (a) Axial flow exhaust fans for Battery Room shall be of spark proof construction & bifurcated type or indirectly driven. All the parts coming in contact with acid fumes shall have epoxy coating.		

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(b) Type-B Filters: Dry panel type filters having filtration efficiency not less than 99% down to particle size of 5 microns. Total number of filter modules shall be decided based on approved filter schedule. Nuts, Bolts, rubber bushes, loose fittings, spring as necessary for mounting the filter modules in ladder type frames. One (1) complete set of special maintenance tools. Cleaning, protection, painting as specified. Any other equipment and/or material necessary to ensure safe and satisfactory operation. General arrangement and fabrication drawings for mounting frames of filters, drawings/data as required for filters. 6.2.2 Standard and Codes Unless otherwise specified, it is intended that tenders shall offer standard equipment for this specification. Materials of construction, construction of components, performance testing of equipments etc shall generally conform to the standards and codes as mentioned elsewhere in this specification. 6.2.3 General Description Type of air filters specified herein is required to filter the outside air for ventilated spaces, housing the sophisticated equipment. The maintenance of clean environment is utmost important for proper functioning of all these equipment and the whole power station. As such air filters shall be made of best quality material and shall be of high reliability proven design. 6.2.4 Performance Required (a) Type-A Filters: These filters shall be capable of filtering out the air borne particles		

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with a filtration efficiency of 90% down to particle size of 10 microns. Air quantity to be filtered is indicated in schedule. The pressure drop across the filter should be limited to 6 mm WC when clean and 12 mm WC when dirty. The face velocity shall not exceed 2.5 m/sec. The filter media shall be suitable for service at 100% relative humidity.

(b) Type-B Filters:

These filters shall be capable of filtering out the air borne particles with a filtration efficiency of 99% down to particle size of 5 microns. Air quantity to be filtered is indicated in schedule. The pressure drop across the filter should be limited to 6 mm WC when clean and 12 mm WC when dirty. The face velocity shall not exceed 1.5 m/sec. Filter media shall be suitable for service at 100% R.H.

6.2.5 General Design Requirements

Panel type dry air filters (Type-A):

All filters shall be designed for horizontal air flow and vertical mounting.

The filter shall be H.D.P. dry panel type. The filter media shall be designed to hold dust, sand, lint etc. and prevent it from being dislodged by vibration or other cause and passing through filter. The filter media shall be non-flammable type and shall be suitable for operation under extreme conditions of humidity upto and including 100% RH. The filter media shall have resistance to corrosion and contaminant producing action and perform through out its life without the possibility of deterioration.

The filter shall be of washable type and the filter media shall be constructed from several layers of H.D.P. Wire mesh shall be stitched together with G.I. on both side for support and crimped to form deep folds for maximum filtration area, low differential pressure, high dust retention capacity and high flow rate. The filter folds shall be separated by aluminium spacers to ensure uniform distribution of air flow through the filter media. Proper sealing between filter and filter casing shall be done to obviate the possibility of air leakage.

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Each filter panel shall consist of an aluminium frame.

Face velocity shall not exceed 2.5 m/sec. and pressure drop shall be limited to 6 mm W.C. and 12 mm W.C. in clean and dirty conditions respectively.

The filtration efficiency of dry filters shall be not less than 90% down to particle size of 10 microns.

The filters shall be in panels of size about 600 mm X 600 mm unless otherwise indicated specifically.

The filter-mounting frame shall be made of M.S. rolled section and hot dip galvanized to withstand corrosion. Necessary fabrication and G.A. drawings for mounting frame shall be furnished by Vendor. The mounting frame shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters.

Panel type dry filters (Type-B):

The filter media shall be preferably of H.D.P. and shall be washable type.

The filtration efficiency of dry filters shall be not less than 99% down to particle size of 5 microns.

The face velocity through filter shall not exceed 1.5 m/sec. The pressure drop shall be limited to 6 mm W.G. in clean and 12mm W.G. in dirty condition.

For further details, refer the relevant points of this specification.

(a) Material of Construction

 The following materials shall be used for the construction of various parts of filters.

 (i) Filter media : As given in general description

 (ii) Filter frame : Aluminium

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(iii) Nut – Bolts : Galvanized (iv) Gasket : Neoprene (v) Bush, Springs : Galvanized (vi) Filter mounting : M. S. Rolled section hot galvanized. frame		

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6.11 <u>SPLIT AIR CONDITIONER</u> 6.11.1 General The air conditioner units shall be split type, factory assembled, and environmental friendly refrigerant to be used as a coolant. Body shall be as per Bidder's standard. The units shall have compressor and cross flow type blowers. The indoor unit shall be mounted on wall inside the room. The indoor unit consists of the evaporator coil, capillary tube, inbuilt control		

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panel, air filter, supply and return air grills. Outdoor unit shall be mounted on outside wall or on terrace.		
6.11.2	Inlet louvers	
The louvers shall be oscillating type leading to even air distribution.		
6.11.3	Compressors	
The out door unit consist of Reciprocating type compressor which is suitable to 415 V/3 phase supply. Compressors shall be of reputed make and suitable for continuous operation. Compressors for higher capacity (more than 3TR) SAC units shall be scroll type.		
6.11.4	Cooling Coil	
Cooling coils of air-cooled condensers shall be of the fin and tube type having copper fins firmly bonded to copper tubes. Capacity of the coils shall be as required. Tubes shall be 10.0 mm O.D. and 0.4 mm thickness with 8 fins/inch. The face velocity of air shall not exceed 152 m/min. Cooling coil shall be inner grooved copper, hydrophilic blue fins.		
6.11.5	Evaporator Coil	
Evaporator coils shall be of the fin and tube type having copper fins firmly bonded to copper tubes. Capacity of the coils shall be as required. Suction tubes shall be 15.8 mm and liquid connection shall be 10 mm approx. The face velocity of air s not exceed 150 m/min.		
6.11.6	Supply Air Fans	
Fans shall be of suitable type, cross flow and non-overloading type with forward curved blades.		
Fans shall be driven by electric motors.		
6.11.7	Filters	
The filter media of SAC units for Dining room of Canteen Building shall be		

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made of Activated carbon electrostatic fibre filter to eliminate the odour of all indoor smells and traps fine dust and smoke particles. Filter media of SAC units for other areas shall be HDPE. 6.11.8 Temperature and control The dry bulb temperature of control room shall be maintained within the specified tolerance limit by step capacity control of individual AC unit. A thermostat placed in the unit results in substantial power saving and precision cooling. The thermostat set point shall be staggered so that units operate in lead-lag operation. The temperature control shall be part of the unit. In auto mode, the spilt air conditioner shall adjust its performance automatically depending on the room temperature and heat generated. 6.11.9 Codes and Standards Design, manufacture, inspection and testing of the equipment covered by the Specification shall, unless otherwise specified, conform to the latest edition of the Codes and Standards as mentioned elsewhere in this specification. 6.11.10 Installation Spilt air conditioner shall be installed as per Equipment Supplier's recommendations for better performance of the system. Air conditioner indoor unit shall be mounted on wall with suitable mounting arrangement. The Bidder shall provide R.C.C. foundation or suitable foundation frame as per relevant IS standards for outdoor unit and the bidder shall supply the isolation pad.		

4.31/2020/PS-PEM-MSX P



DOCUMENT TITLE:

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

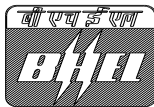
Volume: II

Section: IIA

REV. NO. 00

DATE:

GENERAL TECHNICAL REQUIREMENT OF MATERIAL HANDLING

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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1.0 **ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)**

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

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.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

- 1.0.0** Hoists shall be provided in all areas where any equipment/ component weighing above half ton is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than half meter. The location and number of hoists is to be finalized during detailed engineering. Final arrangement is subject to approval of Customer. The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled. The hoist parameters (i.e. lift & travel) are subject to change/s, to suit the final layout of the area in which it is intended to be installed.

Electric hoist shall be provided for capacity >1T.

Chain pulley block (Manual hoist) - 500kg to <=1T, wherever feasible, considering layout constraints.

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 electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos)	CAPACITY(T)	TYPE
1				
2				
3				

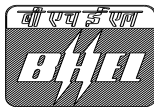
Note:

- Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
- Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
- Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

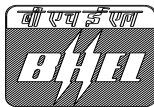
2.0 **SCOPE OF SUPPLIES**

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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- 2.1.0 Electric hoist shall include but not be limited to the following: -
- Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
 - Equipment shall be designed to operate in non- hazardous area.
 - Electric hoists shall be pendent operated.
 - Both hoisting and trolley movement shall be motor driven.
 - Wheels shall be single flanged type.
 - Hook shall be swivelling type and fitted with a safety latch.
 - Control panel shall be hoist mounted.
 - Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
 - Brakes shall be fail to safety.
 - Load/overload testing of the hoists shall be carried out as per IS: 3938.
 - All material, castings and forgings will be of tested quality & certificates shall be made available for review as per approved QAP
 - Lifting lug, eye bolts etc., for handling hoist parts.
 - Erection hardware.
- 2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.
- 2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.
- 2.4.0 Erection and Commissioning
- 2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)
- 2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.
- 3.0 Inspection and Testing**
As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.
- 4.0 Works Excluded**
Supply of ISMB monorail.
- 5.0 PAINTING SPECIFICATION**
As per painting details specified elsewhere in specification.
- 6.0 PACKING**
In general packing shall be wooden box packing.
- 7.0 TESTING AT VENDOR'S WORKS**
Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.
- The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 **MAKE OF SUB - VENDOR ITEMS**

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-I)

9.0 **TESTING AT SITE**

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- The correctness of all circuits and interlocks and sequence of operation; and
- The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

10.0 **TECHNICAL DATA SHEET:**

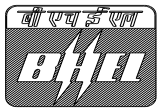
A) Technical data sheet-A for ELECTRIC HOIST:

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
		Electric hoist with electrically operated trolley
1	Design, duty, fabrication and testing of the crane confirm to standard / code number	As per IS: 3938 (latest edition), Class-II duty
2	Area of installation, quantity, rated capacity (Safe Working Load) of cranes	As per Annexure A
3	Margin	The crane/hoist capacity shall be selected considering 25% margin over the weight of heaviest component/ equipment to be handled.
4	Overload Test	125% of Rated capacity (Safe Working Load)

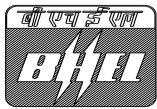


**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW BHUSAWAL TPS UNIT-6**

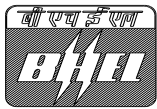
5	Deflection test of crane	NA
6	Operation from	Pendant station - It shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor
7	Design Ambient temperature	50° C
8	PERFORMANCE	
8.1	Crane speed with full load	
8.1.1	Main hoist	3
8.1.2	Trolley travel (CT)	15
8.1.3	Longitudinal bridge travel (LT)	NA
8.2.1	Acceleration values	NA
8.2.2		CT motion (trolley travel) as per IS: 3938
9	Lift in Metres	The lifting rope shall be of sufficient length to permit the main hook to reach the zero level.
9.1	Main Hoist	Shall be suitable as per approved layout
9.2	Hook Approaches	To suit the lifting requirement.
	COMPONENT DETAILS	
10	Trolley	
10.1	Type	Fabricated steel / Cast steel
10.2	Material	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels. Material of construction as per IS: 2062 (Grade A/B).
10.3	Whether jacking pads for lifting trolley provided or not	Yes
11	Rope drums	

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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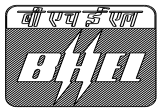
11.1	Material (Indicate IS)	Cast steel or mild steel.
11.2	Flange / flangeless	Flanged
11.3	Numbers provided	One
11.4	Type of grooves	Machined grooved identical Right hand and Left hand of proper shape for the rope used. Additional grooves shall be provided as per IS 3177/3938 in rope drum
12	Rope details	
12.1	Construction / Core	The wire ropes shall be of suitable diameter as per Suppliers design of crane. The rope shall confirm to I.S. 1835, 1804 and 2266. The rope shall be parallel right hand lay having 6 x 37 constructions with hemp core. However, this should be in relation with Drum diameter as per IS: 3177. The rope selection procedure shall be as per IS 3177 cl. no. 8.3.2.
12.2	Tensile designation (Rope Grade)	1770 or 1960 (in N/sq. mm)
12.3	Factor of safety	Not less than 5
13	Sheaves details	
13.1	Material	The sheaves (Pulleys) shall be of carbon steel casting having chemical and mechanical properties as per IS: 1030 (Class 11).
13.2	Type of guards provided	Fabricated from Sheet steel
14	Gear box details	
14.1		Forged steel as per IS 3938
14.2	Hoist Motion / Cross Travel	
14.2.1	Type of mounting of gear box	Horizontal / Vertical
14.2.2	Classification	Suitable for M5 duty
14.2.3	Type of gears	Spur / Helical, hardened and tempered with machine cut teeth
14.2.4	Type of lubrication	Oil splash/ grease lubricated

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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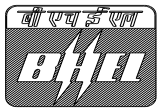
14.2.5	Hardness (BHN) – gear	568+/-20BHN for alloy steel.
14.2.6	Hardness (BHN) – pinion	568+/-20BHN for alloy steel.
14.2.7	Difference in Gear and pinion hardness	Min 20 BHN
14.2.8	Materials (gear/pinions)	Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.
14.2.9	Casings	Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers.
14.2.10	Noise level	85 db
14.2.11	Standard conforming to	IS: 4460
15	Wheels details	Cross Tavel
15.1	Material	EN-8/9
15.2	Hardness	IS: 3938. Max hardness 200 BHN
15.3	Type	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
15.4	Numbers provided	As per manufacturer's standard.
15.5	Specification conforming to	IS: 3938
15.6	Arrangement of lubrication	Grease
16	Lifting hooks	
16.1	Type	Plain shank trapezoidal section
16.2	Safe lifting capacity	As per Safe Working Load
16.3	Material	Solid, forged, heat treated alloy steel/ carbon steel of rugged construction as per IS:15560

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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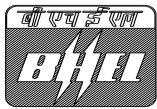
16.4	Standard conforming to	IS: 15560
16.5	Hook can swivel	Yes
16.6	Safety latch on hook provided	Yes
16.7	Locking device on swivelling hook	Provided
16.8	Hook suspension	Ball or roller thrust bearing
17	Buffers	Cross Travel
17.1	Type	Spring or rubber buffers shall be provided on the trolley
17.2	Numbers provided	4
17.3	Details of end stop	NA
18	Brakes	
18.1		Hoist Motion / Cross Travel
18.2	Type of brake (ac / dc)	DCEM/ ACEM disc type (fail to safety)
18.3	Number provided per motor	1
18.4	Braking capacity (% of full load torque)	150% / 125%
19	Drive system for hoisting	
19.1	Arrangement of drive from motor to rope drum (main)	Through geared steel coupling and gear box
20	Bearings	Hook / Trolley wheels / Rope drum / Gear box / Sheave / Any other assembly
20.1	Type	Antifriction ball / roller bearings
20.2	Lubrication	Grease lubrication

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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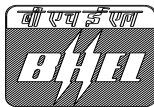
20.3	Bearing life	10,000 working hours.
21	Bridge girder	
21.1	Type & Quantity	NA
21.2	Vertical Deflection and Camber	NA
21.3	Type of connection to end carriage	NA
21.4	End carriage span material	NA
22	Motors	
22.1	Hoist Motions	MH / CT
22.2	Type	Motor shall be rated for duty S4, CDF 40% and 150 starts per hour. Service class of motor shall be "M8" as per IS: 3177. Conditions given in IS:3938 for hoist motor shall be followed.
22.3	Enclosure	TEFC
22.4	Numbers furnished	One
22.5	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +/-5% occurring separately or combined voltage and frequency variation of 10%.
22.6	Class of protection	IP-55
22.7	Margin	Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed.
22.8	Class of insulation	All motors shall be totally enclosed, fan cooled type, having class-B stator insulation and class-F rotor insulation for slip ring motors & class-B insulation for squirrel cage motor with temperature rise limited to class-B operation in all cases.
22.9	Overload protection for motors provided	One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel. The operation of overload relay shall interrupt the main magnetic contactor. Adequate short circuit protection shall be provided for main and individual circuits.
23.10	Space heater requirements	Not required

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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24	Limit switches	Main Hoist / Cross Travel
24.1	In hoisting motion	Each hoist shall be provided with 2 limit switches. 1. A screw type limit switch with self resetting features which will act in case of over hoisting. 2. A gravity operated hand reset type limit switch as a back-up protection against over-hoist
24.2	In CT/LT motion	Track type limit switches shall be provided on the trolley to prevent over travelling in either direction
24.3	Material of contacts	Double break Silver Cadmium
24.4	Control voltage	110V
24.5	Construction	The limit switches shall be housed in robust metallic oil and dust tight enclosure conforming to IP:65. At least 2 NO and 2 NC contacts shall be provided for each limit switch.
25	Power conductors (DSL)	Shrouded GI type runway conductor.
25.1	Type	CT travel : PVC shrouded GI conductor bus bar
25.2	Size	Shall be sized with a margin of 10% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL shall be provided.
25.3	Length	Suitable for entire bay length.
26	Isolation switch & Control Panel	Isolation switch shall be provided at operating floor. Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity. The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon. All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals. Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V I-ph 50Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.
26.1	Material & size	Rolled sheet steel 2mm size
26.2	DOP	IP 55

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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26.3	Qty	1 no. per hoist
27	Control for Hoisting operations	
27.1	Creep speed	NA
27.2	Starting torque of VVVF	NA
27.3	Starting current	NA
27.4	Temperature	NA
28	Cable	Power / Control / Trailing
28.1	Type	The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 mm ² nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 mm ² stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.
28.2	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage with cranes at extreme position.
29	Earthing	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed. Electrical system shall be designed for a fault level of 50 kA. Earthing system adopted shall be type TN-CS.
29.1	Material of earthing	G.I / Copper
30	Contactors	AC 4 duty for reversing application. AC 3 duty for non -reversing application.
31	Switches	AC 23 for motor application, AC 22 for other application.
32	Fuses	HRC
33	Power supply	
34	Transformer	Dry type, with insulation class B or better.
34.1	Quantity	3 X 100 % for control

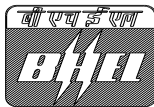
	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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34.2	Voltage Rating	Control 415/110V
34.3	KVA rating	Min. 20% over loading to be considered while sizing the rating

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
1	Type	Hand operated chain pulley blocks. Chain pulley blocks shall be with or without the travelling trolley depending upon the layout requirement and intended use.
2	Area of installation	As per Annexure A
3	Design	IS: 3832
4	Duty Class as per IS:3832	Class -II
5	Hoisting Mechanism	Through endless chains
5.1	Type	Hand operated gear transmission
5.2	Type of gear	Spur
5.3	Load Chain	
5.3.1	Type	Link type
5.3.2	Material	Alloy steel (grade 40) as per IS 3109 (part-II)
5.4	Hand Chain	
5.4.1	Type	Link type
5.4.2	Material	Mild steel (grade 30) as per IS 2429 (Part I)
5.5	Load Hook & Hook Block	
5.5.1	Type of load hook	Plain shank- Trapezoidal section
5.5.2	Load hooks conforms to (Std./Code)/ Material	IS: 15560/ Forged steel
5.5.3	Type of hook suspension	Swivelling type fitted with a locking device.
5.5.4	Type of make of bearing of hook suspension	Thrust ball bearing
5.6	Gears	
5.6.1	Type	Spur
5.6.2	Material	Alloy steel / carbon steel
5.6.3	Type of bearing used	Antifriction ball bearing / Roller
5.7	Pinions	
5.7.1	Type of bearing used	Antifriction ball bearing / Roller
5.8	Sprockets	
5.8.1	Type of bearings used	Antifriction ball bearing / Roller
5.8.2	Method of lubrications Used	
5.8.2.1	Bearings	Grease
5.8.2.2	Gearing & Pinions	Grease
5.8.2.3	Sprockets	Grease
5.8.3	Brakes	
5.8.3.1	Type	Screw and friction disc type
5.8.3.2		Chain pulley block shall be fitted with an automatic mechanical ratchet and pawl arrangement to prevent self- lowering of load.
6	Trolley & Bridge Drive	Through endless chains
6.1	Trolley	
6.1.1	Type	Geared (Manually operated)
6.1.2	Material of frame	Rolled structural steel (IS:2062 Grade A or B)

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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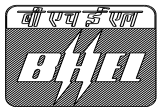
6.2	Drive Chain	
6.2.1	Type	Link type
6.2.2	Material	Steel Gr.30
6.2.3	Wheel	
6.2.3.1	Number of pairs of wheel in each trolley/bridge	Two/four
6.2.3.2	Flange	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
6.2.3.3	Wheel material	Wheels should be preferably of forged steel construction
6.2.3.4	Type of bearings need	Antifriction
6.3	Gears	
6.3.1	Type	Spur / helical
6.3.2	Material	Alloy/ Carbon steel
6.3.3	Type of bearings used	Antifriction
6.4	Method of lubrication for	
6.4.1	Bearings	Grease
6.4.2	Sprockets	Grease
6.5	Load chain wheel	
6.5.1	Material	SG iron / Steel casting / Pressed sheet steel.
6.6	Hand chain wheel	
6.6.1	Material	SG iron / Steel casting / Pressed sheet steel / Gray iron casting
7	Hoisting and trolley travel effort	As per IS 3832

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) ELECTRIC HOIST

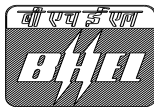
SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-415-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-415-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-415-553-A102	Schematic Circuit Diagram
4	PE-V0-415-553-A103	Mechanism Sizing Calculation
5	PE-V0-415-553-A105	O & M Manual

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-415-553-A200	Manufacturing Quality Plan
2	PE-V0-415-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-415-553-A202	O & M Manual

Notes:

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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13.0 MANDATORY SPARES:

MANDATORY SPARES FOR ELECTRIC HOIST AND MANUAL HOIST (AS APPLICABLE)

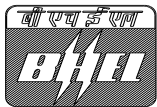
A. Mechanical spares for Electric Hoist

Mandatory Spares for Electric Hoists (for each type and rating)		
1	Brake linings	Two (2) sets of each type
2	Rope guide and rope tighter	One (1) of each type
3	Limit switch	Two (2) of each type and size
4	Bearings for long travel wheels	Two (2) sets
5	Bearings for gear boxes for each type of hoist	Two (2) sets
6	Break liners for all the brakes	100% of total population of each type & size
7	Oil seals	100% of total population of each type, size rating
8	Brake springs for all brakes	100% of total population of each type, size rating
9	Wire ropes for hooks	100% installed on each crane and hoist
10	Solenoid coils for brakes	Two (2) sets
11	Overload relay for motors	Two (2)
12	Limit switches for hoists and travel mechanisms	Two (2) sets
13	Spare motors for hoists	Two (2)
14	Long travel machinery	
14.1	Gear wheel	One (1) set
14.2	Internal clip	Two (2)
14.3	Pinion	One (1)

B. Mechanical spares for Manual hoist

Mandatory Spares for Chain Pulley Blocks (for each type and rating)		
1	Load chain wheel	One (1)
2	Load chain stripping fork	Five (5)
3	Hand chain wheel	Two (2)
4	Ratchet pawl	One (1)
5	Locking ratchet wheel	Two (2)
6	Guide roller	Two (2)

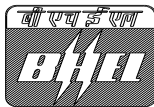
4431/2020/PS-PEM-MSX P

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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7	Brake disc	Two (2)
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Note:-

1. "One (1) Set" is defined as 100% requirement for one hoist for the entire hoists of similar size & capacity.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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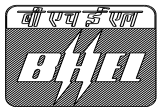
ANNEXURE I: MAKES AND SUB VENDOR LIST

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	TECHNO INDUSTRIES
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	TRACTEL TIRFOR INDIA PVT. LTD.
	Mangla Hoists Pvt Ltd
	BRADY & MORRIS ENGINEERING CO. LTD.
	REVA INDUSTRIES LTD.
	UNIVERSAL HOIST-O-FABRIK
CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists/CPB.

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	MOOZUMDAR / SIMRITI FORGING / HARMAN MOHTA / STEEL FORGING & ENGG. CO., KOLKATA /
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / BOMBAY WIRE ROPES / FORT WILLIAMS / UNITED WIRE ROPE/BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR /GECA / BHARAT BIJLI / MARATHON / LHP.
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI/HAVELL
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT POLYCAB / KEI/ HAVELL.
c)	TRAILING CABLE	UNIVERSAL/ FGL/CCL/HVP/KEI/RADIANT.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X660 MW BHUSAWAL TPS UNIT-6	
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18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /TEKNIC/VAISHNO
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALAJI / KAYCEE / BCH
21	SELECTOR SWITCHES	KAYCEE/ SULZER
22	PENDENT PUSH BUTTON STATION	OEM
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDRY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY BHEL.
4.0	BRAKES	OEM

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR AC VENTILATION

PROJECT 1X660 MW BHUSAWAL TPS UNIT-6

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 3W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 1 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.

1	RAW MATERIAL & B/OUT ITEMS:												
1.1	HOOKS	CHEMICAL & MECH MARK & IDENTIFICATION INTERNAL DEFECTS PROOF LOAD TEST NDT AFTER PROOF LOAD TEST	MA MA MA MA MA	LAB ANALYSIS VISUAL UT REVIEW DPT	ONE SAMPLE PER HEAT 100% 100% 100% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE I) IS 15560 ASTM E-165		MTC. TC IR TC TC	✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	ON SHANK PORTION
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STR & % ELONGATION - PROOF LOAD -HEAT TREATMENT -GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100% 1/LOT 100% 100% 1/BATCH	APPD. DRGS -DO- -DO- -DO- -DO-	APPD. DRGS. -DO- -DO- -DO- -DO-	IR MTC MTC HT CHRT MTC	✓ ✓ ✓ ✓ ✓ ✓	P P P P P P	V V V V V V	V V V V V V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 2 OF 4		PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR'S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR'S CATALOGUE	APP DRG / MFR'S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 3 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.

1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%		APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	IN PROCESS													
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %		IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%		IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	FINAL INSPECTION													
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %		IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	V V V V	

MANUFACTURER / CONTRACTOR	LEGEND:	FOR CUSTOMER USE
SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	
SIGNATURE		REVIEWED BY
		NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS:	<u>MANUFACTURING QUALITY PLAN</u> ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 4 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.

		SWIVELING OF HOOK	MA	VISUAL	100%	APPROVED DRG -DO-	APPROVED DRG -DO-	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%			IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ SPECIFICATI ON	APPROVED DRAWING/ SPECIFICATI ON	IR IR		P p	--- W	--- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	
CR – CRITICAL, MA – MAJOR , MI – MINOR													

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN

(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &

(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

MANUFACTURER / CONTRACTOR	LEGEND:	FOR CUSTOMER USE	
SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE “P” PERFORM “W” WITNESS AND “V” VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
1.0	RAW-MATERIALS												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V	
		SURFACE DEFECTS	MA	Visual	100%								
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm
		Hardness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, construction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST						
						REV	0	CONTRACT No							
						DATE		CONTRACTOR	BHEL-PEM						
						PAGE	1 of 4								
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		D*	M	C	N	REMARKS	
1	2	3	4	5	6	7	8	9			**	10		11	
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V			
2.0	IN-PROCESS														
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V		In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency prior to carrying out welding at the	
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V			
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V		100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum	
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V			
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/ W		FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .	
2.4	GEAR BOXES														
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN,	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V				
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V			
3.0	ELECTRICALS														
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V		For motor refer Note: 2	
		ROUTINE TESTS													
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V			
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V			
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V			
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V			
	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V			
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V			
4.0	FINAL INSPECTION														

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
SI.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:39	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT, LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.												
		LEGND											
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.											
		** M: MANUFACTURER/SUBCONTRACTOR											
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY											
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY											
		"P"- PERFORM", "W"- WITNESS AND "V"- VERIFICATION											
SIGNATURE		" CHP" CUSTOMER HOLD POINT											
						REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL						